Reaching for 90:90:90 in correctional facilities in South Africa and Zambia: Virtual cross-section of coverage of HIV testing and antiretroviral therapy during universal test and treat implementation

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Abstract

Background People in correctional settings are a key population for HIV epidemic control. We sought to demonstrate scale-up of universal test and treat (UTT) in correctional facilities in South Africa and Zambia through a virtual cross-sectional analysis.

Methods We used routine data on two dates: at the start of UTT implementation (time 1, T1) and one year later (time 2, T2). We obtained correctional facility census lists for the selected dates and matched HIV testing and treatment data to generate virtual cross-sections of HIV care continuum indicators.

Results In the South African site, there were 4,193 and 3,868 people in the facility at times T1 and T2; 43% and 36% were matched with HIV testing or treatment data, respectively. At T1 and T2, respectively, 1803 (43%) and 1,386 (36%) had known HIV status, 804 (19%) and 845 (21%) were known to be living with HIV, and 60% and 56% of those with known HIV were receiving antiretroviral therapy (ART). In the Zambian site, there were 1,467 and 1,366 people in the facility at times T1 and T2; 58% and 92% were matched with HIV testing or treatment data, respectively. At T1 and T2, respectively, 857 (59%) and 1263 (92%) had known HIV status, 277 (19%) and 647 (47%) were known to be living with HIV, and 68% and 68% of those with known HIV were receiving ART.

Conclusions

This virtual cross-sectional analysis identified gaps in HIV testing coverage and ART initiation not clearly demonstrated by prior cohort-based studies.

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Introduction

HIV epidemic control requires achieving high levels of HIV diagnosis, uptake of antiretroviral therapy (ART), and virologic suppression.[1-3] In 2014, UNAIDS set specific goals to reach by 2020 for each element in the Fast Track strategy to end AIDS:[4] that 90% of people living with HIV (PLWH) know their status, that 90% of PLWH diagnosed with HIV receive ART, and that 90% of those receiving ART are retained in care with virologic suppression (i.e., the "90-90-90" goals). These targets were expanded to 95-95-95 by 2030.[5] In addition to generating public health benefits, success with the second and third 95s is associated with reduced HIV incidence and mortality.[2,6]

Despite notable achievements in expanding ART access, delivery is uneven.[7,8] These gaps in HIV care delivery threaten overall epidemic control. Some marginalized populations have high HIV prevalence along with barriers to accessing care and resultant lower HIV diagnosis and ART uptake. People in correctional facilities are one such marginalized population.[9] In South Africa, a middle-income country, the HIV prevalence among men in correctional facilities is between 20 and 25%, double the national prevalence among men (12%).[9-11] In Zambia, a low middle-income country, HIV prevalence among people in correctional facilities is 14.3% compared to a national adult prevalence of 11.0%.[12-14] Despite the high prevalence of HIV among criminal justice-involved people and their frequent return to the community, they are frequently overlooked by HIV care and prevention services.[15]

Universal test and treat (UTT) optimizes the HIV care continuum for PLWH through universal access to HIV testing and universal access to ART.[4] UTT has the potential to increase ART coverage with the expected impact of decreased HIV transmission and reduced HIV-related morbidity and mortality. Overlooking marginalized populations such as people in correctional facilities may attenuate the real-world effectiveness of UTT.[2,9,16-19]

Due to the specific characteristics and challenges of the correctional environment, we sought to introduce a UTT program in a correctional facility in South Africa and in Zambia, and evaluate UTT implementation effectiveness according to 90-90-90 targets by applying a novel virtual cross-sectional analysis approach. We have previously reported on the cost,[20] acceptability, and

potential for maintenance.[21] Here, we conducted a virtual cross-sectional analysis, using routinely collected data, to compare HIV testing and ART delivery before and after UTT implementation to describe effectiveness and identify gaps with reaching a high proportion of people in correctional facilities with these services in South Africa and Zambia.

Methods

We conducted an implementation research study—the treatment as prevention study—evaluating UTT implementation in correctional facilities in South Africa and Zambia.[22] We selected correctional facilities in these two countries to improve generalizability through diversity of study settings (i.e., a middle income and low-income country) and to harness the presence of donor funding supporting HIV programs in correctional facilities in countries where we already had established relationships with correctional service departments. For the analysis presented here, we included one large facility (5000 people) in South Africa and one medium-sized facility (1400 people) in Zambia. A third facility that was included in the overall study was excluded from these analyses due to incomplete census data at the needed timepoints. The two included correctional facilities collectively encompassed ten correctional units including six male units, three female units, and one youth unit (ages 18-22 years). All facilities housed a mix of persons awaiting trial and sentenced persons. Prior to study initiation, each site provided HIV services based on guidelines in place at the time including CD4 count-based criteria for ART initiation and prioritization of ART "readiness" over rapid ART initiation. The study was initiated prior to adoption of UTT policies in South Africa and Zambia.

The study protocol was approved by ethics committees of the University of Zambia, University of the Witwatersrand, Johns Hopkins University, University of North Carolina, London School of Hygiene & Tropical Medicine, and James Cook University. Additionally, the South African DCS and Department of Health, and the Zambian Correctional Service and National Health Research Authority approved the protocol.

Procedures

The study incorporated the following core components:[22]

Augmented HIV testing: We assisted the correctional services with human resources and supplies to increase capacity to deliver HIV testing services. During UTT implementation, HIV testing was offered routinely on facility entry and approximately twice annually through mass screening events. Implementation support for UTT sought to leverage other funding, including from the Global Fund and PEPFAR to assure availability of HIV testing, ART medications, and ART care. As part of the UTT program, two HIV testing counsellors each were provided to the Lusaka facility and the South African facility. Overall external funding for HIV testing declined from 2016 to 2017 in the South African facility, leading to a decline in testing capacity.

Supported referral to UTT and peer adherence support: The study team trained nurses, HIV testing counsellors, facility clinicians, and peer educators on UTT to increase awareness among health providers and people held in correctional facilities on this approach to HIV care.

Changing ART care to a UTT approach: At a national level, this involved working with government on policy changes and, in study correctional facilities, training and mentoring facility clinicians (nurse clinicians and medical officers) and nursing staff in the UTT approach. Facility clinicians were instructed on rapid ART including offering ART to all persons testing HIV positive who were expected to be incarcerated ≥30 days, regardless of CD4 count. ART was generally not offered to people with imminent anticipated release because of concerns for follow-up. The project also provided one clinician each to the South African and Zambian facilities.

ART supply: The study supplied ART in South Africa for the first three months of the study while the DCS revised their ART policies and procurement plan. In Zambia, ART was available from the government throughout UTT implementation.

Viral load testing support: In South Africa, due to operational challenges with viral load testing and challenges matching viral load results to identifiers, few viral load results were available. In Zambia, where viral load testing was not routine at the start of the program, study staff

coordinated HIV viral load testing and the study provided testing at 6 and 12 months (Amplicor HIV-1, Roche, Branchburg, USA).

Evaluation time points

Cross-sectional outcomes were estimated at two time points for each facility. The first time point (T1) corresponded to a date shortly prior to initiation of UTT in the facility. The second time point (T2) corresponded to a date between 12 and 18 months after T1 (Figure 1). Due to regulatory and administrative reasons, UTT implementation began earlier in Zambia than in South Africa. The pre-UTT and post-UTT implementation are 1 January 2017 and 31 December 2017 for South Africa and 1 June 2016 and 1 December 2017 for Zambia.

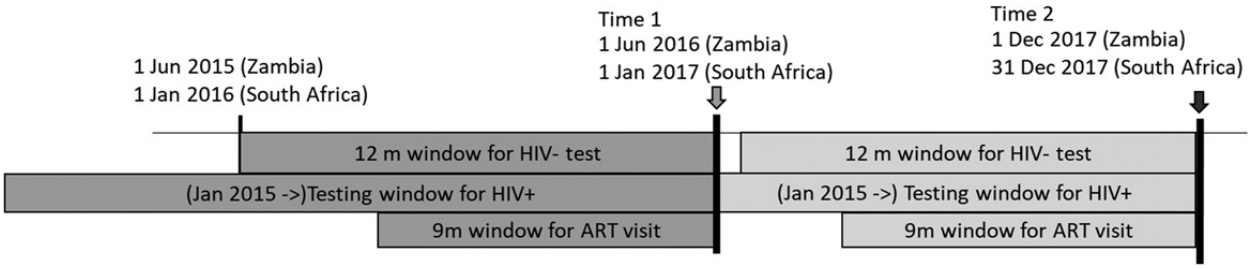

FIGURE 1. Virtual cross-section time points and included data.
Dates differed by country because of timing of the start of universal testing and treatment implementation.

Outcomes

Routine data on HIV testing, ART initiation and continuation, and viral loads (when available) were used to determine the proportion of persons achieving indicators in the 90-90-90 cascade. We created virtual cross-sectional estimates based on the census of people incarcerated in the facility on the selected evaluation day to determine the proportion with known HIV status and the proportion with known HIV receiving ART. We described these proportions prior to UTT implementation and after 12 months of implementation (Figure 1).

For the "first 90", rather than the proportion of PLWH detained in the facility who knew their HIV status, we used a surrogate marker: the proportion of *all* persons detained in the facility with a known HIV status. Individuals were classified as HIV-positive if they had a positive HIV test result

from the correctional facility at any time before the evaluation date or were receiving HIV care. We defined HIV-negative status as evidence of a negative HIV test result within 12 months of the evaluation date. Persons who either had no documentation of an HIV test or a negative HIV test >12 months prior to the evaluation date, and no evidence of being in HIV care, were classified as "unknown" status. The sum of known HIV-negative and known HIV-positive formed the numerator of those with a known HIV status. The denominator was the total correctional facility census on the date of the analysis. Routine data has been similarly applied to estimating cross-sectional indicators in other settings.[23,24]

For the "second 90", we used a numerator of all those receiving ART as indicated by a correctional facility ART care visit documented in the past 9 months. The visit was identified through a recorded visit at the HIV clinic, ART dispensing pharmacy, or an ART-related laboratory test result (CD4 count or HIV viral load). The denominator was those persons in the correctional facility on the evaluation date known to be living with HIV as identified in the "first 90" assessment.

For the "third 90", we searched clinic databases and laboratory systems for viral load results. We used a threshold of <1,000 copies(c)/mL for viral load suppression for consistency with WHO guidelines in place at the time.[25]

Analysis

For the two study facilities we obtained a "census" list, including correctional facility identification numbers, for all persons in the facility on T1 and T2. We linked identifiers to the following data sources: electronic testing records in South Africa (TIER.Net and an electronic database that preceded the use of the TIER.Net in these facilities)[26] and paper-based HIV testing registers in both South Africa and Zambia; electronic HIV care databases (TIER.Net in South Africa and SmartCare in Zambia) and paper-based clinic records in Zambia; and laboratory data from electronic HIV care databases and electronic laboratory databases (TIER.Net in South Africa and CIDRZ Laboratory Information Management System and SmartCare electronic databases in Zambia).

In South Africa, electronic matching was completed using correctional facility identification numbers. In Zambia, manual matching, based on name (exact or nearly exact match), sex, and

year of birth (allowing for variance of a year if all other data matched) was used to merge the census list with testing data and clinical records. After initial matching, discrepancies and unmatched records were manually reviewed. If a match could not be confidently made, no data were assigned to that individual. In Zambia, we removed duplicate records based on name, sex, and date of birth or SmartCare number in testing or HIV care databases that were not able to be linked to the census list.

In South Africa, HIV testing register data were abstracted for particular time ranges to correspond to 12 months prior to the cross-sectional evaluation point for testing HIV-negative and 24 months prior to the cross-sectional evaluation point for testing HIV-positive. Electronic HIV care record downloads only included the latest care visit or laboratory results. For this reason, six-monthly snapshots of care going back two years prior to the evaluation time point were selected to identify a visit within the past six months, assuming routine visits occurred with that frequency.

Virtual cross-sectional analysis estimates were compared at two time points for each facility. We used descriptive statistics to characterize the number of persons on the census lists, the change in the facility population based on those lists, and the proportion of persons on the lists that we were able to link to HIV data. We calculated the proportion of all persons on the census list who 1) had a known HIV status, 2) had a known diagnosis of HIV and were receiving ART, and 3) were receiving ART and had a viral load <1000 c/mL (for Zambia). We further described the proportions by sex, and age group divided into two groups of <34 and ≥35 years old.

Results

South Africa

At T1 at the South African facility, there were 4,193 persons detained in the facility, 84% were men and the median age was 33 years (interquartile range (IQR) 28, 40). A total of 2,390 (57%) persons were not linked with HIV-related data; 999 (24%) were matched with an HIV-negative test result from the prior 12 months and 804 (19%) were matched to a positive HIV test result from the prior 24 months or evidence of having received HIV care within the prior 24 months (Figure S1 A). At T2 at the South African facility, there were 3,868 listed persons, 82% were men

and the median age was 34 years (IQR 29, 41). A total of 2,583 (67%) persons were not linked; 540 (14%) were matched to an HIV-negative test result from the prior 12 months and 804 (21%) were matched to a positive HIV test result from the prior 24 months or evidence of having received HIV treatment within the prior 24 months (Figure S1 B). Of all 5,530 persons matched to any HIV-related records, 2,530 (46%) were on the census list at both time points, 1,662 (30%) were only present at T1 and 1,338 (24%) were only present at T2. A total of 117 people with a negative HIV test at T1 had repeat testing at T2 of whom 16 (14%) tested positive.

At the South African facility, more HIV tests were completed each month in 2016 (314 per month) than in 2017 (197 per month) due to a shift in external funding for HIV testing unrelated to the study. In the South African facility, the proportion of persons reaching HIV care continuum outcomes at the T1 and T2 evaluation time points, respectively, were as follows: 43% (1803/4193) and 36% (1385/3869) had a known HIV status. Of these, 45% (804/1803) and 61% (845/1385), respectively, were known to be living with HIV, and 60% (482/804) and 56% (476/845) with known HIV were on ART (Table 1; Figure 2). A larger proportion of women than men were receiving ART at T1 (78% and 56%, respectively), this reversed at T2 due to loss of an ART prescriber in the women's clinic (37% and 61%, respectively). A total of 2,530 (60%) persons resident at T1 were still in the facility at T2. Of those people, at T1 21% (523/2,530) were known to be living with HIV, and 74% (388/523) of those were receiving ART. At T2, of those 2,530 in the facility at both times, 23% (592/2,530) were known to be living with HIV, and 73% (430/592) of those known to be living with HIV were receiving ART.

Table 1. HIV diagnosis and ART treatment by individual characteristics, South Africa.

	Total		Female		Male		<34 years		≥35 years	
	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)
Total N	4193	3869	669	699	3524	3169	2330	1973	1863	1895
HIV status										
Known	1803 (43)	1386 (36)	223 (33)	252 (36)	1580 (45)	1133 (36)	1086 (47)	737(37)	717 (38)	648 (34)
Negative	999 (24)	540 (14)	81 (12)	75 (11)	918 (26)	465 (15)	712 (30)	342 (17)	287 (15)	198 (10)
Positive	804 (19)	845 (22)	142 (21)	177 (25)	662 (19)	668 (21)	374 (16)	395 (20)	430 (23)	450 (24)
ART										
On ART	482 (60)	476 (56)	110 (77)	66 (37)	372 (56)	410 (61)	223 (60)	189 (48)	259 (60)	287 (64)
No ART	322 (40)	369 (44)	32 (22)	111 (63)	290 (44)	258 (39)	151 (40)	206 (52)	171 (40)	163 (36)

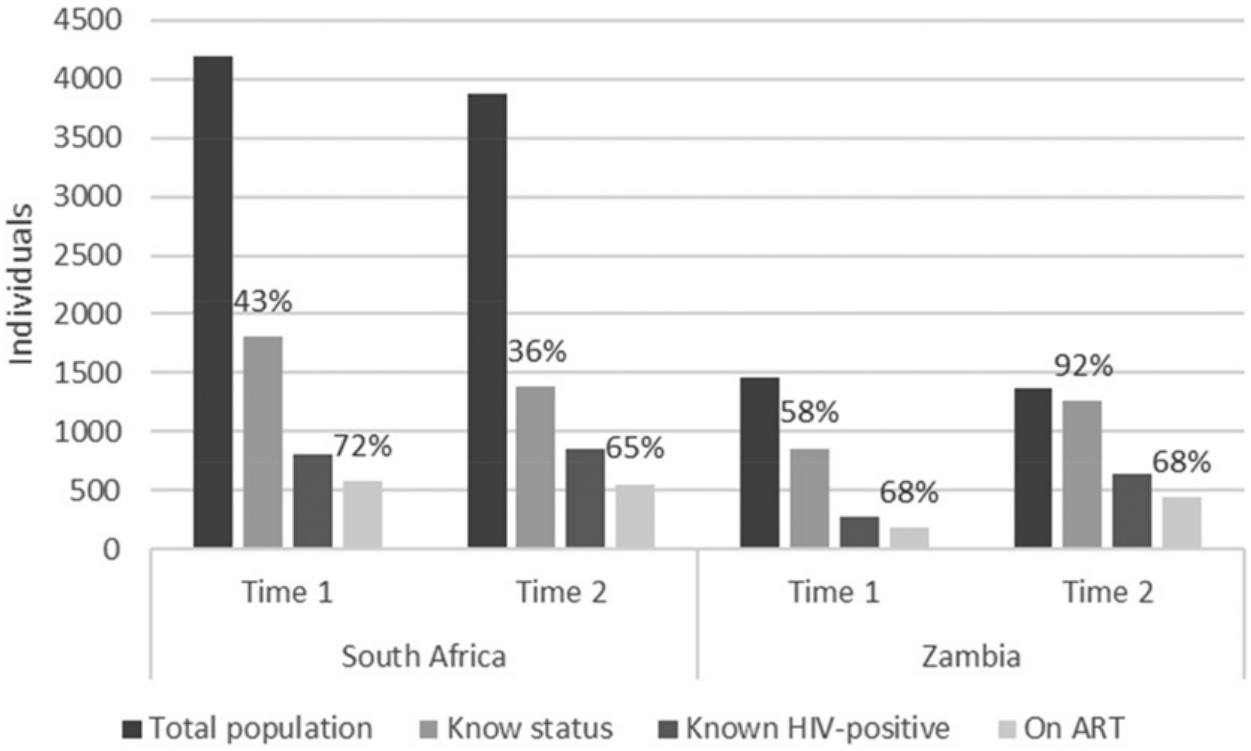

FIGURE 2. HIV continuum for a single correctional facility in South Africa and in Zambia.
Total population in correctional facility on cross-section date, number and percentage of who know status, number known HIV-positive, and total number and percent on ART.

Zambia

At T1 at the Lusaka facility, there were 1,467 persons detained in the facility, 92% of whom were men and the median age was 30 (IQR, 25, 37). Of these persons, 857 (58%) were linked with HIV data; the other 610 (42%) had no HIV testing or care records during the observation window. At T2, there were 1,370 persons, 91% were men, and the median age was 30 (IQR 24, 36), 1,263 (92%) were successfully matched with HIV data; the other 107 had no HIV testing or care records during the observation window (Figure S2).

At the Zambian facility, at T1 and T2, the proportions with known HIV status were 58% (857/1,467) and 92% (1,263/1,370), respectively. At T1 and T2, 32% (277/857) and 51% (647/1,263) were known to be living with HIV, respectively. Those known to be living with HIV receiving ART increased in absolute numbers but not in proportion between T1 and T2 at 68% (188/277) and 68% (438/647), respectively (Table 2). At T2, 85 of the 428 (19%) persons on ART

Table 2. HIV diagnosis and ART treatment by individual characteristics, Zambia.

	Total		Female		Male		<34		≥35	
	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)	Time 1 n(%)	Time 2 n(%)
Total N	1467	1370	125	128	1342	1241	950	946	517	420
HIV status										
Known	857 (59)	1263 (92)	81 (65)	121 (95)	776 (58)	1141 (92)	558 (59)	859 (90)	299 (58)	405 (92)
Negative	580 (40)	616 (45)	51 (41)	43 (34)	529 (39)	573 (46)	416 (44)	505 (53)	164 (32)	100 (26)
Positive	277 (19)	647 (47)	30 (24)	78 (61)	247 (18)	568 (46)	142 (15)	354 (37)	135 (26)	290 (70)
ART										
On ART	188 (68)	438 (68)	16 (53)	29 (37)	172 (70)	408 (72)	86 (61)	230 (65)	102 (76)	206 (71)
No ART	89 (32)	209 (32)	14 (47)	49(63)	75 (30)	160 (28)	56 (39)	124 (35)	33 (24)	84 (29)
HIV RNA										
<1000 c/mL		78 (92)		-		77 (92)		45 (92)		33 (92)
≥1000 c/mL		7 (8)		-		7 (8)		4 (8)		3 (8)

N=4 with unknown age at time point 2

had a six-month HIV viral load test; 59 (69%) had a viral load <50 c/mL and 78 (91.8%) were suppressed at a threshold of <1,000 c/mL.

In Zambia, the proportion of persons with known HIV status increased across demographic groups from T1 to T2. While the total number of persons on ART increased, the proportion of women known to be living with HIV who were receiving ART declined: 53 to 37% (Table 2). Only 128 (8.7%) persons were identified as having been in the facility at both time-points; of those 100% had HIV status data and 98% of those living with HIV had been initiated on ART.

Discussion

We applied a novel virtual cross-sectional analysis method to describe the HIV care continuum for people incarcerated in two southern African correctional facilities on specific days according to 90-90-90 indicators for HIV epidemic control. According to these metrics, success achieving UTT in these correctional facilities was uneven during the first year of implementation. In Zambia, HIV testing markedly increased, reaching 92% of people compared to 58% prior to UTT. In Zambia, the number of persons receiving ART also increased during implementation, from 188 to 438. However, because of the increase in HIV diagnoses, the proportion of those with known HIV receiving ART did not increase, remaining at 68%. In South Africa, 90% HIV control targets were not met for HIV testing or ART initiation during the introduction of UTT. In addition, we observed potential ongoing transmission with 16 people in the South African facility initially HIV-negative followed by HIV-positive test results, highlighting the importance of HIV prevention in correctional facilities.

We observed specific challenges during UTT implementation. In South Africa, staffing limitations, due to a reduction in external donor funding for HIV testing services, led to a decline in HIV testing. ART initiation was also hampered by limited staffing as well as a reluctance among clinical staff to initiate ART when transfer or release was expected within one month in Zambia and within one to three months in South Africa. The high turnover of persons in detention within the study correctional facilities was a challenge for managing testing volumes and ART initiation, follow-up, and continuity of care.[21] This dynamic nature of the correctional facility population

was reflected by the fact that only 9% of persons were present at both time points in Zambia and 60% were present at both time points in South Africa.

Our study is the only population-based cross-sectional study from Africa, virtual or actual, of HIV epidemic control indicators in the correctional context, of which we are aware. Other studies have reported a numerator of the number of persons testing for HIV during a 6-to-12 month period and a denominator of the average daily census that does not account for the in and out flow of correctional facility populations; these studies have reported testing that reached between 39 and 84% of a population depending on the study design and available testing resources.[12,13,27-29] Several studies have also reported on ART initiation or retention on ART after initiation, reporting between 48 and 98% of persons diagnosed with HIV initiating ART.[22,27,28,30,31] Our estimate of the proportion of people known to be living with HIV on ART of 56-60% in South Africa and 68% in Zambia is at the lower end of range for ART initiation from these prior studies but may better reflect true ART coverage in correctional settings.

Population-based cross-sectional studies are crucial to understanding HIV epidemiology and service delivery needs. These studies have provided valuable information regarding success with epidemic control indicators, including incidence, HIV testing coverage, treatment uptake, and viral suppression.[14,32,33] Our approach of using a virtual cross-sectional analysis gives a more accurate description of overall testing coverage and ART engagement within a correctional facility population, and may do so with greater efficiency than a physical survey. For example, compared to prior cohort studies, including one conducted as part of this overall project,[22] a cross-sectional or virtual cross-sectional analysis approach may better approximate the population-level proportion of persons known to be living with HIV who are actually on HIV treatment.

This study has the value of describing the HIV testing and care continua within the entire correctional population at two correctional facilities. It also has several limitations. Firstly, there were likely missing data given our use of routinely collected programmatic data. Secondly, due to missing data and variation in recording of individual identifiers, there was a likelihood of

inaccurate linkage of records. We tried to minimize the impact of inaccurate linkage by matching records using the unique identification number provided by the facilities and age, sex, and correctional center. This excluded some potentially correct matches, but likely led to overall high accuracy of the matches we did make. Due to differences in data sources and timing of data collection, we also could not make more generalizable inferences about the population-level impact of UTT across both facilities during the study period. Virtual cross-sectional studies, such as ours, would be strengthened with robust identifiers for linking all testing and HIV care data.[23]

Through this study, we have demonstrated the feasibility of using routine programmatic data to obtain virtual cross-sectional estimates of care continuum indicators for a dynamic population. By assessing HIV testing and care for the entire population in the correctional facility, we have identified gaps in testing and ART initiation to inform ongoing programmatic work. Specifically, we have identified a large population without recent HIV testing in the South African facility and overall disappointing proportion of PLWH initiating ART. Limited resources and lack of consistent financing is an important impediment to successfully implementing UTT. We believe that adequately resourcing HIV testing, treatment, and linkage programs—both in correctional facilities and between correctional facilities and community ART clinics—is critical to improve HIV continuum outcomes and the health of criminal justice-involved persons in pursuit of achieving ending the epidemic goals.

Contributors

CJH, MEH, KF, SER, and SC had overall responsibility for implementing the study, conceived and designed the study, developed the study protocol, collected and analyzed the data, and wrote the manuscript. SMT, HH, LC, HJS, MT, AJO, and MM contributed to developing the concept, design, and protocol for the study. LC assisted with data analysis and data interpretation. All authors reviewed the manuscript critically for intellectual content, and approved the final draft of the submitted manuscript.

Declaration of interests

We declare no competing interests

Data sharing

All deidentified matched correctional facility and HIV-related continuum data along with a data dictionary will be made available on request from the corresponding author.

Role of the funding source

The funders had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all study data and had final responsibility for the decision to submit for publication.

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