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Integrated Hypertension and HIV Care Cascades in an HIV Treatment Program in Eastern Uganda: a retrospective cohort study

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Abstract

Background: Persons living with HIV (PLHIV) are at increased risk of cardiovascular disease (CVD). Integration of services for hypertension (HTN), the primary CVD risk factor, into HIV care programs is recommended in Uganda, though, uptake has been limited. We sought to compare the care cascades for HTN and HIV within an HIV program in Eastern Uganda.

Methods: We conducted a retrospective cohort study of all PLHIV enrolled in three HIV clinics between 2014 and 2017. We determined the proportion of patients in the following cascade steps over 12 months: Screened, Diagnosed, Initiated on treatment, Retained, Monitored, and Controlled. Cascades were analyzed using descriptive statistics and compared using chi-square and t-tests.

Results: Of 1649 enrolled patients, 98.5% were initiated on HIV treatment, of whom 70.7% were retained in care, 100% had viral load monitoring, and 90.3% achieved control (viral suppression). 456 (27.7%) participants were screened for HTN, of whom 46.9% were diagnosed, 88.1% were initiated on treatment, 57.3% were retained in care, 82.7% were monitored, and 24.3% achieved blood pressure control. There were no differences in any HIV cascade step between participants with HIV alone and those with both conditions.

Conclusion: The HIV care cascade approached global targets, while the parallel HTN care cascade demonstrated notable quality gaps. Management of HTN within this cohort did not negatively impact HIV care. Our findings suggest that models of integration should focus on screening PLHIV for HTN and retention and control of those diagnosed in order to fully leverage the successes of HIV programs.

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Conflicts of Interest and Source of Funding

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Keywords

Integrated; Care cascades; Hypertension; HIV treatment and Uganda

INTRODUCTION

HIV has become a chronic condition in low- and middle-income countries (LMIC), due to the success of vertically oriented HIV treatment programs[1]. Leveraging the infrastructure and lessons learned from these HIV programs to support the care of persons with chronic non-communicable diseases (NCDs) is a widely recognized global priority and has received recent attention in the literature[1,2].

Persons living with HIV (PLHIV) and receiving antiretroviral therapy (ART) are at increased risk of cardiovascular disease (CVD), the leading cause of premature morbidity and mortality globally[3]. This is due to direct effects of ART and HIV itself, compounded by traditional CVD risk factors such as increased life expectancy and Western diet[4,5]. Hypertension (HTN) is the most important preventable risk factor for CVD[6]. The prevalence of HTN in the setting of HIV may be higher than in the HIV-negative population[7]. High blood pressure is associated with mortality among PLHIV whose HIV disease is not advanced[8]. Concordant with World Health Organization (WHO) guidelines, the Uganda National HIV guidelines have recommended the integration of HTN care into HIV programs since 2014[9,10]. There has been limited uptake of this recommendation in practice in Uganda, despite successful efforts to integrate other programs such as tuberculosis, malaria, nutrition, maternal-child health, and family planning into that of HIV[11,12]. Within HIV programs that have attempted HTN integration in Uganda, there has been limited documented experience in evaluating the quality of care delivery in these settings.

Care cascades are useful frameworks for assessing the quality of health service delivery for specific diseases by documenting the proportion of individuals who proceed through the multiple steps along a defined sequence of care. Cascades allow policymakers, researchers, or clinical supervisors to visualize gaps in healthcare delivery in order to efficiently direct resources and develop strategies for bridging these gaps[13]. Cascades have been extensively utilized to evaluate quality of care for HIV, rheumatic heart disease, type 2 diabetes mellitus, Hepatitis C, tuberculosis and prevention of mother to child transmission (PMTCT)[6,13–16]. However, to our knowledge, cascades have not previously been used to evaluate two conditions simultaneously. Doing so could serve to illustrate gaps and strengths of each program and their impact on each other. With the goal of identifying opportunities for developing contextually appropriate integrated care models, we conducted a retrospective cohort study within an HIV program in Uganda and mapped the care cascades for both HTN and HIV.

METHODS

Study design, setting and participants

We conducted a retrospective cohort study using data abstracted from medical records of PLHIV who were enrolled in one of three high volume HIV clinics in Tororo District in Eastern Uganda.

Uganda is a low-income country in East Africa with a population of 34.6 million, of whom 18 million (52.1%) are 15 years and older. The prevalence of HIV among adults 15–49 years is 6.5% and the prevalence of HTN is 26.4% among adults 18–69 years[17,18]. Tororo is one of 116 districts and had a population of 517,080 as of the 2014 census[19].

In Uganda, ART clinics are the designated treatment centers for HIV and HIV-associated opportunistic infections and co-morbidities. They are physically situated as outpatient departments within health centers and hospitals. The three ART clinics included in this study were located in The AIDS Support Organization (TASO) Tororo, Nagongera Health Centre IV, and Mulanda Health Centre IV. We selected these three clinics because they are the largest in Tororo district, providing care to 4000, 1400, and 1000 PLHIV, respectively. They are housed within public sector facilities with support from both the Government of Uganda and HIV implementing partners (USAID and the PEPFAR Program). The clinics are staffed by multiple cadres of health workers including clinicians, nurses, midwives, and peer counselors. Each clinic offers a full spectrum of HIV services including screening, ART, viral load testing, and opportunistic infection testing and treatment. In accordance with 2014 WHO and Uganda national guidelines, each also is supposed to provide HTN services[10,20].

According to guidelines, within a given clinical encounter, blood pressure (BP) was measured by the clinician at his/her discretion. A person was considered to be hypertensive if they had a documented BP ≥ 140/90 mmHg or documented use of anti-hypertensive medications or documented history of hypertension[10,21,22] If a patient is diagnosed with HTN (by measurement or previous history), the clinician typically prescribes both ART and antihypertensives simultaneously and the client is given one follow-up appointment for both conditions. As these are public sector facilities, all medicines at facility pharmacies are obtained from the centralized National Medical Stores (NMS). The PEPFAR program provides funds to NMS to procure medicines specifically for HIV and opportunistic infections. Medicines for HTN and other NCDs are procured via general funds allocated to each health facility by MoH. If medicines are out of stock at the facility pharmacy, the patient is typically advised to purchase them from a private sector pharmacy.

Prior to this study, as part of their routine work, health workers at the clinic sites were oriented to national and WHO HIV treatment guidelines which recommend screening for HTN and its risk factors. Clinical support discussions about challenging HIV/NCD cases were also used, as a matter of routine work, to build capacity among clinicians for NCD integration.

We empaneled all patients 18 years of age and above who enrolled into HIV care at any of the three study sites between January 2014 and January 2017. All were previously screened

and diagnosed with HIV. We followed each participant for 12 months from the time of enrollment. Data collection was carried out between January and May 2018. This study was approved by institutional review boards at The AIDS Support Organization (TASO) Uganda and The Uganda National Council for Science and Technology (UNCST).

Study procedure

Ten research assistants (RA), comprised of three clinicians and seven data clerks, were trained to abstract data from paper patient charts into a tablet-based data collection instrument (KoBo Collect). RAs were distributed in proportion to clinic volume but each data collection team contained one clinician at all times to assist with chart interpretation and data abstraction. The instrument was designed to include demographic information and relevant clinical data for both HIV and HTN. Internal quality assurance was conducted by double-entering data for the first 100 participants per study site, reviewing, and providing feedback to the RA's.

Study variables, cascade indicators and measurement

We defined each step in the HIV cascade based on widely accepted definitions[23]. We then defined corresponding, clinically relevant cascade steps for HTN based on the WHO Technical Package for Cardiovascular Disease Management in Primary Health Care and the American Society of Hypertension and International Society of Hypertension clinical practice guidelines[10,21,24]. Our definition for retention in HTN care was adopted from the Uganda consolidated HIV guidelines since PLHIV are retained for both HIV and HTN care at clinic level[10]. (Table 1).

Statistical analysis

We first conducted univariate analyses to describe demographic and baseline characteristics of the cohort. Means and standard deviations were obtained for continuous variables while percentages and frequencies described categorical variables. We then stratified the data into two sub-populations: HIV and HIV/HTN and compared baseline characteristics of these two subgroups using chi-square or Fisher's exact tests for categorical characteristics and t-tests for continuous characteristics.

To estimate proportions along each cascade, we conducted descriptive analyses and obtained frequencies and percentages of patients at each previously defined step compared with the preceding step. We then stratified the cascades by HIV (participants with HIV alone) and HIV/HTN (participants diagnosed with both HIV and HTN). Each percentage in the cascades was accompanied by corresponding 95% confidence intervals. We analyzed the data using Stata (version 13). The study was registered in clinicatrials.gov (NCT03605043) and we followed STROBE guidelines (see Appendix for STROBE checklist).

Role of funding source

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

RESULTS

A total 1649 PLHIV were enrolled in the cohort, of whom 387 (23.5%) participants were enrolled at Mulanda HC IV, 448 (27.2%) at Nagongera HC IV and 814 (49.4%) at TASO Tororo. The mean age of the cohort was 37.6 years (SD = 11.2) and 975 (59.1%) were female. The mean baseline CD4 count of the cohort was 365.4 (SD = 239.8) cells per mm^3. Mean systolic and diastolic BP were 134.6 (SD = 29.2) mmHg and 82.4 (SD = 186) mmHg, respectively. Most participants, 1384 (85.2%), were prescribed tenofovir/lamivudine/efavirenz (TDF/3TC/EFV) as the initial HIV treatment regimen (Table 2). Of patients diagnosed with HTN, 181 (94.3%) were prescribed anti-hypertensive medicines and 11 (5.7%) were prescribed lifestyle modification. Among patients who received an initial prescription for anti-hypertensive medicines, the commonest choice was the combination of calcium channel blocker and ACE inhibitor (69; 35.9%) (Table 7).

For the HIV cascade, 1625 (98.5%) were initiated on HIV treatment, of whom 1148 (70.7%) were retained in care, 1148 (100%) had viral load monitoring, and 1037 (90.3%) were controlled (viral suppression) (Table 3). With regards to the HTN cascade, 465 (27.7%) were screened for HTN, 218 (47.8%) were diagnosed with HTN, 192 (88.1%) were initiated on treatment, 110 (57.3%) were retained in care, 91 (82.7 %) were monitored for HTN, and 53 (58.2%) of these were controlled. This control rate represents 24.3% of those diagnosed with HTN (Table 4). The care cascades for both HIV and HTN among the 218 participants with HIV/HTN are juxtaposed in Figure 1. TASO Tororo achieved better HTN cascade outcomes compared to Mulanda and Nagongera in all the cascade steps apart from BP control. There was no statistically significant difference in BP control across the three HIV clinics (Table 9).

Of the 1431 patients with HIV alone, 1408 (98.4%) were initiated on ART, 1005 (71.4%) were retained in care, 100% of these were monitored, and 906 (90.2%) were controlled. Those controlled represented 63.3% of the entire sample. Of the 218 patients diagnosed with HTN, 217 (99.5%) were initiated on ART, 143 (65.9%) were retained in care, 100% of these retained were monitored, and 131 (91.6%) were controlled. There were no statistically significant differences in any HIV cascade step between patients with HIV/HTN and those with HIV only (Table 5).

At baseline, mean age and BMI were significantly higher among patients in the subgroup with HTN/HIV than those without HTN. There were no differences with regard to sex (p=0.6460) or baseline CD4 count (p=0.4270) between HIV and HIV/HTN (Table 2). Patients aged 31 to 50 and those above 50 years were more likely than younger patients to be screened for HTN [OR=1.56; 95% CI 1.18–2.08], [OR= 2.37; 95% CI 1.71–3.29]. There was also a trend toward overweight and obese patients being more likely to be screened for HTN (Table 6).

DISCUSSION

In this study, we mapped the parallel care cascades for HIV and HTN within an HIV program in Uganda. This was meant to identify existing quality gaps that would help direct

the formulation of robust implementation efforts for integrated comprehensive CVD care within HIV care programs. Within this retrospective cohort, whereas the HIV cascade demonstrated solid performance with the exception of retention, the HTN cascade demonstrated multiple quality gaps. The UNAIDS 90-90-90 targets for ending the AIDS epidemic include 90% of PLHIV knowing their status, 90% of those diagnosed receiving sustained ART, and 90% of those on ART achieving viral suppression[25]. In our study of individuals already screened for HIV and informed of their status, ART initiation approached 100% and viral suppression among those retained in care surpassed 90%. The weakest HIV cascade element was retention in care (70% of those initiated). However, this approximates the retention estimate in SSA, which is 66.6%[26].

Within the context of this successful HIV program, among those diagnosed with HTN, there were no differences in the quality of HIV care delivery, as measured by the parallel care cascades, between the overall cohort and those with HTN. The similarity in the two cascades suggests that integrating HTN care into HIV programs might not negatively impact the quality of HIV care.

Though there are multiple potentially viable ways in which programs can be integrated, our study site utilized two of five HIV/NCD integration models distilled in a recent review: NCD screening among patients enrolled in HIV care and clinical integration of HIV and NCD service delivery. The other examples of models which have been have been studied or offer promise but were not utilized at our study sites are: integrated community-based screening for HIV and NCDs, customized care based on individual patient needs, and a population-health model of comprehensive care for all[2]. In Table 7, we present a summary of our recommendations for future research and policy related to integrated care delivery based upon our findings.

In our study, screening represented the greatest gap within the HTN cascade. Of the 1649 PLHIV in the cohort, only 465 (27.7%) were screened for HTN. These findings reveal a fundamental gap in the uptake and implementation of the 2014 WHO and Uganda Consolidated Guidelines for Prevention and Treatment of HIV, which recommended that all PLHIV should receive screening, diagnosis and management of HTN and its risk factors during each clinic visit to HIV clinics, in an integrated fashion[9,10]. HTN screening can happen concurrently with HIV screening, at clinic or in the community. A community-based HIV/NCD screening program in Uganda achieved a screening rate of 98% for HIV, HTN, and DM. The major challenge was that participants were linked to non-integrated, vertically oriented, care[27]. In Swaziland, integration of CVD risk factor screening into clinic-based HIV services was found to be feasible. Though the associated publication does not disclose screening rates, the authors note that changes in staffing, clinical space, and supply availability resulted in wide week-to-week variability in screening patterns[22]. Once participants in this cohort were screened for HTN, 46.9% were diagnosed. One prospective study in Uganda found a prevalence of HTN among PLHIV in a HIV clinic to be 27.9%[28]. Other studies in SSA have found a HTN prevalence of 11.0%−29.0% among PLHIV[22,29–31]. One prospective cohort study in the Netherlands identified a higher prevalence of HTN of 48.2% among PLHIV on ART, a figure similar to our findings[32]. Studies that report a low prevalence of HTN among PLHIV are dominated by ART-naïve populations[30]. Our

population of PLHIV included those on ART for variable durations prior to HTN screening and diagnosis. The low screening rate in this study suggests that 46.9% is an over-estimation of prevalence within the study population. Older patients were more likely than younger patients to be screened for HTN in our cohort and there was a trend toward more frequent screening of overweight and obese patients for HTN. Clinicians were likely to have been biased in their approach to HTN screening and to have prioritized screening among those patients who they deemed to be at high risk of HTN or CVD. Future work should explore clinicians' and patients' perspectives on screening, including preferred setting for screening, the tools and qualifications needed for screening, and the preferred modalities for promoting linkage to care.

Among those diagnosed with HTN, 88% were initiated on treatment with either lifestyle changes or medicines. This far exceeds global LMIC estimates of 29%[6]. One study in Uganda found treatment rates for HTN in the HIV clinic to be 83.0%, a figure similar to our findings[33]. These findings support the integration of HTN management within a high-functioning chronic care delivery system in which a treatment plan directly follows a diagnosis. Due to the retrospective nature of this study, initiation could only be ascertained by chart documentation of a prescription or discussion. Thus, the adherence to initiated treatment plans is likely to have been highly variable. This likely explains why retention, the next step, represented another large gap in the HTN cascade.

Retention in SSA HIV programs at 12 months following ART initiation approximates 70–80%[34]. In our study, HIV retention was greater than HTN retention (70.7% vs. 57.3%, respectively). According to our definition of HTN retention, a patient initiated on HTN therapy must have had their HTN addressed within 90 days. The difference between HIV and HTN retention within this HIV program is likely due to providers not addressing HTN during follow-up visits. A provider might have initiated HTN management and the patient might have returned for follow-up, but if HTN was not addressed during that follow-up visit, the patient was not considered to have been retained in HTN care. This represents another focused area of improvement for future implementation efforts of integrated care delivery.

Not surprisingly, there was little drop-off between the Retained and Monitored stages in our parallel cascades. This is because all patients who were retained in care had a viral load checked during follow-up and most (82.7%) had a BP check. The greater losses in monitoring of those with HTN, relative to HIV, might be attributable to unavailability of BP machines, providers not recognizing or prioritizing the previous diagnosis and treatment plan for HTN, or failure by clinicians to document subsequent BP readings.

BP control represented the second largest gap in our HTN cascade. While 90.3% of those monitored (and 63.8% of those initiated on treatment) for HIV achieved viral suppression during 12-month follow-up, only 58.2% of those monitored (and 27.6% of those initiated on treatment) for HTN achieved a measured BP of 140/90mmHg or lower. Blood pressure control in Uganda and other parts of SSA has remained very low, ranging from 7.0–28.0%[35,36]. This is much lower than in developed countries and illustrates the large disparities in global HTN control[6].

The low rate of HTN control is likely largely attributable to the silent nature of HTN and to limited access to medicines. Despite its contribution to the global burden of disease, its impact on CVD, renal disease, stroke, and premature disability and mortality, HTN is largely asymptomatic[37]. Patients who have been screened, diagnosed, monitored, and retained in care still must be educated about the condition and the importance of adherence to lifestyle and medical management in order to achieve BP control. Importantly, even amongst those who have been informed and aim to adhere to medical therapies, there are numerous barriers to access for medicines used to treat HTN and other NCDs. Availability and affordability of these medicines in LMIC remains poor[38]. Within Uganda, we have previously demonstrated disparities in availability by sector, geography, and level of health facility as well as substantial variability in availability and price over time[39]. Access barriers also contribute to poor performance of the more proximal cascade steps. For example, it is common for clinicians to not screen patients for HTN since they know that the medicines are not available and/or not affordable[40]. Vertical HIV programs have achieved consistently high stock of ART due to highly functional supply chains and consistent funding. However, NCD medicine supply chains have not achieved these levels of success. As is standard with HIV, HTN management often necessitates the use of multiple medicines. Finally, fixed dose combination (FDC) therapy offers the potential to simplify medication regimens for HTN treatment and improve adherence, as it has done for HIV treatment[41,42]. An application for anti-hypertensive FDC is currently under review for addition to the WHO Essential Medicines List and Model Formulary[43].

To achieve BP control in the HIV setting and elsewhere, innovative, multi-level approaches are necessary. Population-level health promotion and prevention efforts, such as the WHO Best Buys, are critical for decreasing the impact of HTN on society. Community engagement, which involves participation, mobilization and empowerment, has positively impacted HIV care through engaging providers, clients, and local policy makers[42]. Community support systems and mobile health platforms show promise in promoting follow-up, medication adherence, health education, and fostering linkages between clinicians and patients[42]. Non-physician health worker (NPHW) programs should be implemented and bolstered. Evidence from Uganda has shown that community health workers desire a role in the NCD care spectrum but are demotivated by their clients' experiences of low quality of care at health facilities and poor community outreach by facility-based clinicians[44]. Task redistribution, driven by clear guidelines, protocols, and close oversight, should be an area of investment[21,42,45,46]. Evidence suggests that some defined clinical tasks such as BP measurement can even be shared by lay persons such as HIV expert clients[21]. Finally, at the health system level, improvements are needed in the health information infrastructure such that the performance quality of HTN and other NCD service delivery is driven by specified indicators and targets for all cascade steps, routine performance reviews, and standardized reporting mechanisms, as is done with HIV. Additionally, integrating HTN cascade indicators into routinely used electronic health records with decision support tools is likely to help clinicians optimize chronic care for both HTN and HIV.

This study was limited by the retrospective data collection as the quality and comprehensiveness of written clinical records are often sub-optimal in this and similar

settings. For example, we know that lifestyle modifications are often not recorded in the clinical chart as part of the care plan. This may have led to an underestimation of the frequency of recommended lifestyle change in managing HTN. However, our team of trained data collectors abstracted data from all available sources including clinic notes, prescription forms, and laboratory results, thereby strengthening the findings of our retrospective analysis. Additionally, the study was conducted in a limited geographic area within a single HIV program which could limit the generalizability of our findings. However, our findings are representative of those from the national data which demonstrate that 99.5% of all individuals diagnosed with HIV are stared on ART, 76% are retained after one year of ART initiation, and 88.4 % are virally suppressed[47–49].

In conclusion, in this first published study of parallel HIV and HTN care cascades, we demonstrate that, in the context of a high-functioning HIV program in Eastern Uganda, there remain many areas for improvement in the quality of HTN service delivery. Given the burden of HTN globally, it is imperative that we understand such gaps and work to address them. More vertical programs are not needed nor would they be cost effective, at least in the case of HTN[37]. HTN can serve as a model NCD in this context, however, comprehensive chronic care delivery models are needed. As many have suggested, and as this study demonstrates, great potential lies in leveraging the successes of HIV programs to provide NCD care as an integrated comprehensive package of services without compromising the quality of HIV care. Future work should utilize innovative quality improvement and implementation science approaches to rigorously study such integrated models of care delivery.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. El-Sadr WM, Goosby E. Building on the HIV platform: tackling the challenge of noncommunicable diseases among persons living with HIV. AIDS. 2018;32:S1–S3. [PubMed: 29952785]
2. Njuguna B, Vorkoper S, Patel P et al. Models of integration of HIV and noncommunicable disease care in sub-Saharan Africa: lessons learned and evidence gaps. AIDS. 2018;32:S33–S42. [PubMed: 29952788]
3. Forouzanfar MH, Afshin A, Alexander LT et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388: 1659–1724. [PubMed: 27733284]
4. Haldane V, Legido-Quigley H, Chuah FLH et al. Integrating cardiovascular diseases, hypertension, and diabetes with HIV services: a systematic review. AIDS Care. 2018;103–115. [PubMed: 28679283]
5. Magafu MG, Moji K, Igumbor EU et al. Non-communicable diseases in antiretroviral therapy recipients in Kagera Tanzania: a cross-sectional study. Pan Afr Med J. 2013; 16:84. [PubMed: 24711874]
6. Mills KT, Bundy JD, Kelly TN et al. Global Disparities of Hypertension Prevalence and Control. Circulation. 2016;134:141–50. [PubMed: 27354285]
7. van Zoest RA, van den Born BH, Reiss P. Hypertension in people living with HIV. Curr Opin HIV AIDS. 2017;12:513–22. [PubMed: 28787286]
8. Bloomfield GS, Hogan JW, Keter A et al. Blood pressure level impacts risk of death among HIV seropositive adults in Kenya: a retrospective analysis of electronic health records. BMC Infect Dis. 2014;14(1):284. [PubMed: 24886474]
9. World Health Organization (WHO). March 2014 supplement to the 2013 consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection: recommendations for a public health approach. Available at: http://www.who.int/hiv/pub/guidelines/arv2013/arvs2013upplement_march2014/en/ (accessed October 06, 2018)
10. Uganda Ministry of Health. Consolidated Guidelines for Prevention and Treatment of HIV in Uganda. 2016 Available at: http://library.health.go.ug/publications/service-delivery-diseases-control-prevention-communicable-diseases/hivaids/consolidated (accessed September 30, 2018)
11. Uganda Ministry of Health. National HIV and AIDS Priority Action Plan 2015/2016–2017/2018. Available at: http://library.health.go.ug/publications/service-delivery-diseases-control-prevention-communicable-diseases/hivaids/national-h-4 (accessed Septemeber 20, 2018)
12. Marais BJ, Lönnroth K, Lawn SD et al. Tuberculosis comorbidity with communicable and non-communicable diseases: integrating health services and control efforts. Lancet Infect Dis. 2013;13:436–48. [PubMed: 23531392]
13. Subbaraman R, Nathavitharana RR, Satyanarayana S et al. The tuberculosis cascade of care in India's public sector: a systematic review and meta-analysis. PLoS Med. 2016;13:e1002149. [PubMed: 27780217]
14. Gimbel S, Voss J, Mercer MA et al. The prevention of mother-to-child transmission of HIV cascade analysis tool: supporting health managers to improve facility-level service delivery. BMC Res Notes. 2014;7:743. [PubMed: 25335783]
15. Nosyk B, Montaner JSG, Colley G et al. The cascade of HIV care in British Columbia, Canada, 1996–2011: a population-based retrospective cohort study. Lancet Infect Dis. 2014;14:40–49. [PubMed: 24076277]
16. Longenecker CT, Morris SR, Aliku TO et al. Rheumatic heart disease treatment cascade in Uganda. Circ Cardiovasc Qual Outcomes. 2017;10:e004037. [PubMed: 29133472]
17. Joint United Nations Programme on HIV/AIDS (UNAIDS)/UGANDA. 2017: Available at: http://www.unaids.org/en/regionscountries/countries/uganda (accessed September 30, 2018)
18. Guwatudde D, Mutungi G, Wesonga R et al. The epidemiology of hypertension in Uganda: findings from the national non-communicable diseases risk factor survey. PLoS One. 2015;10:e0138991. [PubMed: 26406462]

19. Uganda Bureau of Statistics (UBoS). National Population and Housing Census 2014: Area Specific Profiles – Tororo District. Available at: http://www.ubos.org/onlinefiles/uploads/ubos/2014CensusProfiles/TORORO.pdf (accessed July 29,2018)
20. World Health Organisation (WHO). Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Available at https://www.who.int/hiv/pub/guidelines/arv2013/en/ (Accessed March 23, 2019).
21. World Health Organization (WHO). Technical package for cardiovascular disease management in primary health care: evidence-based treatment protocols. Available at: https://creativecommons.org/licenses/by-nc-sa/3.0/igo) (accessed July 26,2018)
22. Rabkin M, Palma A, McNairy ML et al. Integrating cardiovascular disease risk factor screening into HIV services in Swaziland: lessons from an implementation science study. AIDS. 2018;32:S43–S46. [PubMed: 29952789]
23. Billioux VG, Chang LW, Reynolds SJ et al. Human immunodeficiency virus care cascade among sub-populations in Rakai, Uganda: an observational study. Journal of the International AIDS Society 2017; 20(1):21590. [PubMed: 28605171]
24. Weber MA, Schiffrin EL, White WB et al. Clinical practice guidelines for the management of hypertension in the community: a statement by the American Society of Hypertension and the International Society of Hypertension. J Clin Hypertens (Greenwich) 2014;16(1):14–26. [PubMed: 24341872]
25. Joint United Nations Programme on HIV/AIDS (UNAIDS). 90–90–90 - An ambitious treatment target to help end the AIDS epidemic. January 2017: Available at: http://www.unaids.org/en/resources/documents/2017/90-90-90 (accessed July 29, 2018)
26. Haas AD, Zaniewski E, Anderegg N et al. Retention and mortality on antiretroviral therapy in sub-Saharan Africa: collaborative analyses of HIV treatment programmes. J Int AIDS Soc. 2018;21:e25084.
27. Chamie G, Kwarisiima D, Clark TD et al. Leveraging rapid community-based HIV testing campaigns for non-communicable diseases in rural Uganda. PLoS One. 2012;7:e43400. [PubMed: 22916256]
28. Mateen FJ, Kanters S, Kalyesubula R et al. Hypertension prevalence and Framingham risk score stratification in a large HIV-positive cohort in Uganda. J Hypertens. 2013;31:1372–8. [PubMed: 23615323]
29. Patel P, Rose CE, Collins PY et al. Noncommunicable diseases among HIV-infected persons in low-income and middle-income countries: a systematic review and meta-analysis. AIDS. 2018;32:S5–S20. [PubMed: 29952786]
30. Kwarisiima D, Balzer L, Heller D et al. Population-based assessment of hypertension epidemiology and risk factors among HIV-positive and general populations in rural Uganda. PLoS One. 2016;11:e0156309. [PubMed: 27232186]
31. Kazooba P, Kasamba I, Mayanja BN et al. Cardiometabolic risk among HIV-POSITIVE Ugandan adults: prevalence, predictors and effect of long-term antiretroviral therapy. Pan Afr Med J. 2017;27:40 [PubMed: 28761616]
32. van Zoest RA, Wit FW, Kooij KW et al. Higher prevalence of hypertension in HIV-1-infected patients on combination antiretroviral therapy is associated with changes in body composition and prior stavudine exposure. Clin Infect Dis. 2016;63:205–13. [PubMed: 27143668]
33. Sander LD, Newell K, Ssebbowa P et al. Hypertension, cardiovascular risk factors and antihypertensive medication utilisation among HIV-infected individuals in Rakai, Uganda. Trop Med Int Health. 2015;20:391–6. [PubMed: 25430847]
34. Rosen S, Fox MP, Gill CJ. Patient retention in antiretroviral therapy programs in sub-Saharan Africa: a systematic review. PLoS Med. 2007;4:e298. [PubMed: 17941716]
35. Ssinabulya I, Nabunnya Y, Kiggundu B et al. Hypertension control and care at Mulago Hospital ambulatory clinic, Kampala-Uganda. BMC Res Notes. 2016;9:487. [PubMed: 27855717]
36. Antignac M, Diop IB, Macquart de Terline D et al. Socioeconomic Status and Hypertension Control in Sub-Saharan Africa: The Multination EIGHT Study (Evaluation of Hypertension in Sub-Saharan Africa). Hypertension. 2018; 71:577–584. [PubMed: 29378852]

37. World Health Organization (WHO). A global brief on hypertension: silent killer, global public health crisis: World Health Day 2013http://www.who.int/iris/handle/10665/79059 (accessed Septemebr 28,2018)
38. Cameron A, Roubos I, Ewen M et al. Differences in the availability of medicines for chronic and acute conditions in the public and private sectors of developing countries. Bull World Health Organ. 2011;89:412–21 [PubMed: 21673857]
39. Armstrong-Hough M, Kishore SP, Byakika S et al. Disparities in availability of essential medicines to treat non-communicable diseases in Uganda: A Poisson analysis using the Service Availability and Readiness Assessment. PLoS One. 2018;13:e0192332. [PubMed: 29420640]
40. Leung C, Aris E, Mhalu A et al. Preparedness of HIV care and treatment clinics for the management of concomitant non–communicable diseases: a cross–sectional survey. BMC Public Health. 2016;16(1):1002. [PubMed: 27655406]
41. Bangalore S, Kamalakkannan G, Parkar S et al. Fixed-dose combinations improve medication compliance: a meta-analysis. Am J Med. 2007;120:713–9. [PubMed: 17679131]
42. Vedanthan R, Bernabe-Ortiz A, Herasme OI et al. Innovative approaches to hypertension control in low-and middle-income countries. Cardiol Clin. 2017;35:99–115. [PubMed: 27886793]
43. Kishore SP SA, Rodgers A, Jaffe MG et al. Fixed-dose combinations for hypertension. Lancet. 2018;392:819–20. [PubMed: 30215377]
44. Ojo TT, Hawley NL, Desai MM et al. Exploring knowledge and attitudes toward non-communicable diseases among village health teams in Eastern Uganda: a cross-sectional study. BMC Public Health. 2017;17:947. [PubMed: 29233114]
45. Rabkin M, de Pinho H, Michaels-Strasser S, Naitore D, Rawat A, Topp SM. Strengthening the health workforce to support integration of HIV and noncommunicable disease services in sub-Saharan Africa. AIDS. 2018;32:S47–S54. [PubMed: 29952790]
46. World health Organization (WHO). Technical package for cardiovascular disease management in primary health care: team-based care. Available at: https://creativecommons.org/licenses/by-nc-sa/3.0/igo) (accessed July 26,2018)
47. Uganda Ministry of Health. Uganda viral load dashboard: supression rate, March 2019 Available at https://vldash.cphluganda.org/ (accessed March 30, 2019)
48. Uganda AIDS Commision. Mid-Term Review of the National HIV and AIDS Strategic Plan (NSP) 2015/2016–2019/2020. 2018 Availbl at http://library.health.go.ug/publications/service-delivery-diseases-control-prevention-communicablediseases/hivaids/national-h-1 (accessed March 23, 2019)
49. Uganda Ministry of Health; AIDS Control Program. HIV implemnting partners coordination meeting, January 2019.

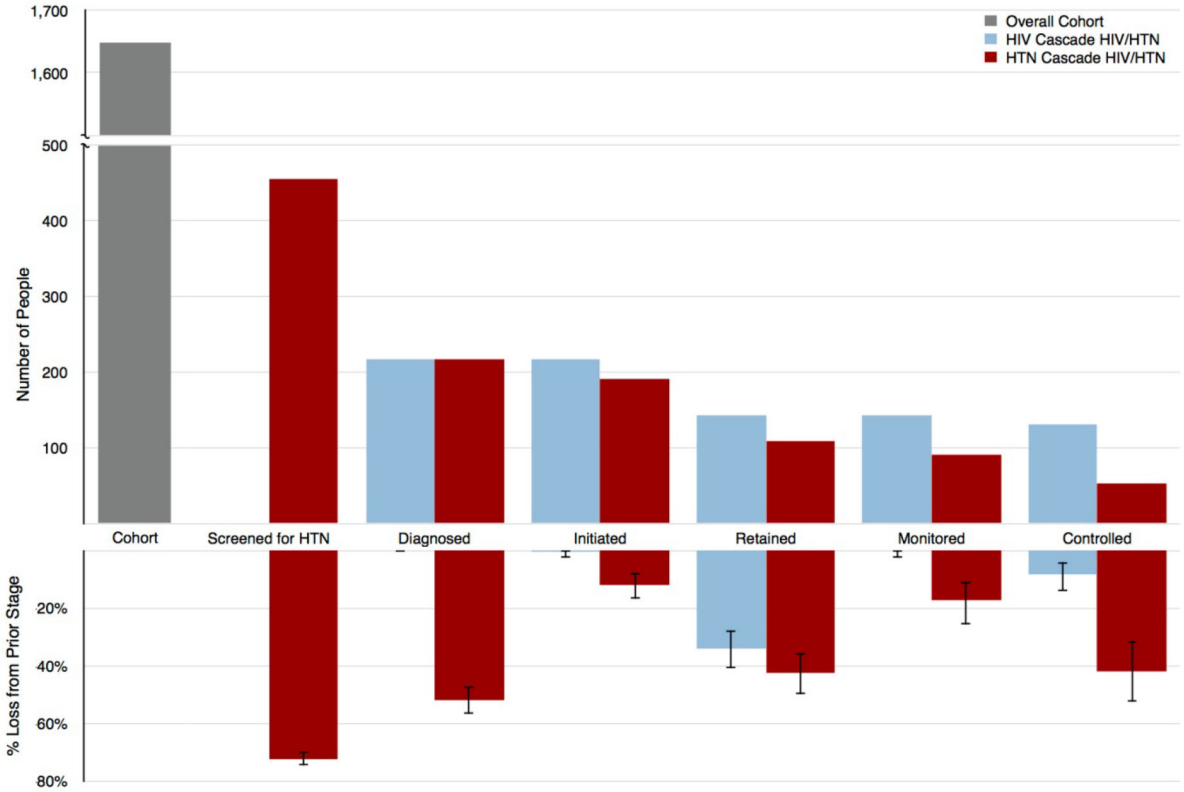

Figure 1.

Integrated care cascades for HIV and HTN. The bars above each cascade step represent the number of participants included in each step, while the bars below each cascade step represent the percentage of participants lost from the previous step. The grey bar represents the entire cohort of 1,649 participants with HIV, the blue bar represents the HIV cascade for those with HIV and HTN, and the red bar represents the HTN cascade for those with HIV and HTN. Error bars reflect the 95% confidence interval.

HTN=Hypertension

Table 1:

Definitions, indicators, and measurements for the steps of the HIV and hypertension cascades of care

Cascade step	Definition (HIV care cascade)	Indicators	Numerator / Denominator	Definition (HTN care cascade)	Indicators	Numerator / Denominator
Screening	Number of individuals who received HIV Testing Services (HTS) and received their test results: Evidenced by documented HIV test results In the patient's file.	Number of individuals who received HIV Testing Services (HTS) and received their test results	N/A	Among PLHIV in the cohort 2014–2017: evidence of measurement of BP in one year as documented in the patient file or documented use of anti-hypertensive medications or documented history of hypertension[21,23]	Number of PLHIV screened for hypertension in one year	Total Number of PLHIV in the cohort
Diagnosis	Among individuals tested for HIV: documented HIV positive test results according to the standard national testing algorithm.	Number of confirmed HIV positive individuals	Total number of individuals tested for HIV	Among PLHIV screened for hypertension: a documented BP ≥ 140/90 mmHg or documented use of anti-hypertensive medications or documented history of hypertension[21–23]	Number of PLHIV diagnosed with hypertension	Total number of PLHIV screened for hypertension
Initiation of treatment	Among individuals with confirmed HIV positive status: started on ART	Number of HIV positive individuals started on ART	Total number of confirmed HIV positive individuals	Among PLHIV diagnosed with hypertension: documented prescription of anti-hypertensive medication(s), and/or lifestyle modification of weight reduction, exercise, smoking cessation and dietary modification[21,23]	Number of PLHIV and hypertensive initiated on treatment for hypertension	Total number of PLHIV diagnosed with hypertension
Retention	Among PLHIV started on ART: not missed his/her appointment or if missed appointment, has not been out of care for more than 90 days after their last missed appointment in the one-year period	Number of PLHIV retained I care	Total number of HIV positive individuals stated on ART	Among PLHIV and hypertension and started on treatment for hypertension: retained in HIV care and having hypertension management addressed within 90 days (i.e. prescription of anti-hypertensive)[1]	Number of PLHIV and hypertensive retained in care	Total number of PLHIV and hypertensive who are initiated on treatment for HTN
Monitored	Among PLHIV and retained: has had at least one viral load test done in 1 year	Number of PLHIV monitored	Number of PLHIV retained in care	Among PLHIV and hypertension and retained in HTN care: has had BP monitored at least once in 6 months[21,23]	Number of PLHIV and hypertensive monitored	Number of PLHIV and hypertensive retained in care
Control	Among PLHIV on ART: viral suppression was defined as having less than 1000 HIV copies/ml in	Number of PLHIV on ART with viral suppression	Total number of PLHIV in the cohort 2014–2017	Among PLHIV monitored for HTN: last documented BP of less than 140/90mmHg[21,23]	Number of PLHIV and hypertensive who are treated for hypertension and controlled	Total number of PLHIV and hypertensive who are initiated on treatment for HTN

Cascade step	Definition (HIV care cascade)	Indicators	Numerator / Denominator	Definition (HTN care cascade)	Indicators	Numerator / Denominator
	a patient with HIV.					

PLHIV=persons living with HIV; HTN=hypertension; HTS=HIV testing services; ART=anti-retroviral therapy; BP=blood pressure; N/A=Not applicable.

Table 2:

Baseline characteristics for study participants

Characteristic	Overall cohort (n=1649)	HIV (n=1431)	HIV/HTN (n=218)	p value[¥]
Age, years	37.6(SD=11.2)	36.7(SD=10.8)	43.6(SD=11.5)	< 0.0001
Age category, years				
18–30	500 (30.3%)	473 (33.1)	27 (12.4%)	< 0.0001
31–50	933 (56.6%)	801 (55.9)	132 (60.5%)	
>50	216 (13.1%)	157 (11.0)	59 (27.1%)	
Sex				
Male	647 (40.9%)	588 (41.1)	86 (39.4%)	0.6460
Female	975 (59.1%)	843 (58.9)	132 (60.6%)	
Health facility				
TASO Tororo	814 (49.3%)	623 (43.5)	191 (87.6%)	< 0.0001
Nagongera HC IV	448 (27.2%)	443 (31.0)	2 (2.3%)	
Mulanda HC IV	387 (23.5%)	365 (25.5)	22 (10.1%)	
Baseline BP, mmHg				
Systolic	134·6(SD=29.2)	116.8(SD=19.4)	158.4(SD=22.2)	< 0.0001
Diastolic	82.4(SD=18.6)	72.2(SD=14.0)	96.1(SD=14.8)	< 0.0001
Baseline CD4 count, cells/mm^3	347.6(SD=244.1)	345.4(SD=244.6)	365.4(SD=239.8)	0.4270
Baseline ART regimen				
TDF/3TC/EFV	1384 (85.1%)	1213 (86.2%)	171 (78.8%)	0.0001
AZT/3TC/NVP	93 (5.7%)	68 (4.8%)	25 (11.5%)	
AZT/3TC/EFV	44 (2.7%)	40 (2.8%)	4 (1.8%)	
TDF/3TC/NVP	43 (2.7%)	34 (2.4%)	9 (4.2%)	
Others	61 (3.8%)	53 (3.8%)	8 (3.7%)	
BMI, kg/m^2, (n=552)				
Underweight (<19.0)	186 (33.7%)	175 (33.7%)	11 (33.3%)	0.0140
Normal weight (19.0– <25.0)	331 (56.0%)	315 (60.7%)	16 (48.5%)	
Overweight (25.0–<30.0)	28 (5.0%)	24 (4.6%)	04 (12.1%)	
Obese (≥30.0)	7 (1.3%)	5 (1.0%)	2 (6.1%)	

Note:

[¥]Differences between groups are reported using Pearson's chi-squared test statistic (for categorical variables) and Student's independent t-test (for continuous variables).

Data are presented as means with standard deviations (SD), frequencies and percentages. HTN=Hypertension, TASO=The AIDS Support Organization, HC=Health center, BP=Blood pressure, ART=Anti-retroviral therapy, TDF=Tenofovir, 3TC=Lamivudine, EFV=Efavirenz, AZT=Zidovudine, NVP=Nevirapine.

Table 3.

HIV Care Cascade for all PLHIV enrolled into care from January 2014 to January 2017

Cascade step	Freq. (n)	Denominator	Percent	CI
Initiated	1625	1649	98.5	97.8 – 99.0
Retained	1148	1625	70.7	68.4 – 72.8
Monitored	1148	1148	100.0	99.7 – 100.0
Controlled	1037	1148	90.3	88.5 – 91.9

Freq=Frequency, PLHIV=Persons living with HIV, CI=Confidence interval.

Table 4.

Hypertension care cascade within overall cohort of 1649 PLHIV based on the definitions presented in Table 1

Cascade step	Freq. (n=1649)	Denominator	%	CI (estimated range)
Screened	456	1649	27.7	25.5 – 29.9
Diagnosed	218	456	47.8	43.1 – 52.5
Initiated	192	218	88.1	83.0 – 92.1
Retained	110	192	57.3	49.9 – 64.4
Monitored	91	110	82.7	74.3 – 89·.3
Controlled	53	91	58.2	47.4 – 68.5

PLHIV=People living with HIV, HTN=Hypertension, CI=Confidence interval, %=percentage, Freq. =Frequency

Table 5.

HIV care cascades for participants with HIV alone and combined HIV/HTN based on the definitions presented in Table 1

	HIV cascade for HIV alone (n=1431)				HIV cascade for HIV/HTN (n=218)				
Cascade step	**Freq. (n)**	**Denominator**	**%**	**CI**	**Freq. (n)**	**Denominator**	**%**	**CI**	**p value**
Initiated	1408	1431	98.4	97.6 – 99.0	217	218	99.5	97.5 – 99.9	0.2075
Retained	1005	1408	71.4	68.9 – 73.7	143	217	65.9	59.2 – 72.2	0.2205
Monitored	1005	1005	100.0	99.6 −100.0	143	143	100.0	97.5 – 100.0	0.1660
Controlled	906	1005	90.2	88.1 – 91.9	131	143	91.6	85.8 – 95.6	0.4707

PLHIV=persons living with HIV, ART=Antiretroviral therapy, %=percentage, CI=95% confidence interval

Table 6.

Logistic regression analysis for factors associated with screening for hypertension among PLHIV

Variable	Not Screened for HTN n (%)	Screened for HTN n (%)	Unadjusted Odds ratios (95% CI)	Adjusted Odds ratio (95% CI)
Age category, years				
18–30	382 (32.7)	103 (22.6)	1.0	1.0
31–50	656 (56.1)	271 (59.4)	1.53 (1.16, 2.03) *	1.56 (1.18, 2.08) *
>50	131 (11.2)	82 (18.0)	2.32 (1.69, 3.18) *	2.37 (1.71, 3.29) *
Sex				
Male	477 (40.8)	189 (41.4)	1.0	
Female	692 (59.2)	267 (58.6)	0.97 (0.86, 1.10)	1.09 (0.97, 1.22)
BMI, kg/m^2, (n=552)				
Underweight (<19.0)	136 (33.7)	49 (34.0)	1.0	
Normal weight (19.0– <25.0)	243 (60.2)	85 (59.0)	0.97 (0.71, 1.33)	
Overweight (25.0-<30.0)	20 (4.9)	8 (5.6)	1.11 (0.52, 2.36)	
Obese (≥30.0)	5 (1.2)	2 (1.4)	1.11 (0.27, 4.63)	

CI=Confidence interval.

* P-value < 0.05, HTN=hypertension, kg=kilograms, m=meters

Table 7:

Initial prescription for HTN management among PLHIV diagnosed with HTN (N=192)

Treatment modality	Initial HTN Prescription	Frequency (n =192)	Percentage
Medicines for HTN treatment (N=181, 94.3%)			
	CCB + ACEI	69	35.9
	CCB + Beta blocker	26	13.5
	CCB	22	11.5
	CCB + Thiazide diuretic	21	10.9
	CCB + ARB	18	9.4
	Thiazide diuretic + Beta blocker	16	8.3
	Thiazide diuretic + ARB	3	1.6
	CCB + Thiazide diuretic + Furosemide	2	1.0
	Other medicines combinations	4	2.1
Lifestyle modification (N=11, 5.7%)			
	Lifestyle modification	11	5.7

CCB= Calcium channel blocker, ACEI=Angiotensin converting enzyme inhibitors, ARB=angiotensin receptor blocker

Table 8.

Differences in cascade outcomes across the three HIV clinics included in this study

Cascade step	TASO; n(row %)	Nagongera; n(row %)	Mulanda; n(row %)	P –value
Screened (n=456)	258 (56.6)	38 (8.3)	160 (35.1)	<0.0001 ^{X}
Diagnosed (n=218)	191 (87.6)	5 (2.3)	22 (10.1)	<0.0001 *
Initiated (n=192)	172 (89.6)	5 (2.6)	15 (7.8)	0.022 *
Retained (n=110)	105 (95.5)	1 (0.9)	4 (3.6)	0.007 *
Monitored (n=91)	89 (97.8)	1 (1.1)	1 (1.1)	0.016 *
Controlled (n=53)	52 (98.1)	0 (0.0)	1 (1.9)	0.619 *

^{X}Chi Square P-Value,

*Fisher's Exact P-value

Table 9.

Recommended areas of focus for future research and policy in HIV/NCD integrated care delivery

Qualitative research on knowledge, motivations, skills of both providers and patients to inform interventions for integrated HIV/NCD care;
Task redistribution for NCD screening and treatment within HIV clinics and communities. Such redistribution might utilize HIV peer counselors, community healthcare workers, patient groups, and/or community-based organizations;
Training and skills development on clinical integration for health workers, community health workers, and patients within HIV clinics;
Mechanisms to promote patient retention;
Developing and supporting patient-driven groups (i.e. advocacy, improved retention and/or adherence, mitigating medicine stockouts);
Establishing robust monitoring and evaluation frameworks coupled with target setting and performance review for NCD cascades;
Provision of fixed-dose combinations of generic medicines for NCDs within HIV clinics;
Implementation science research to help design, implement and evaluate multi-level interventions