

# Atherosclerotic cardiovascular disease screening and management protocols among adult HIV clinics in Asia

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## Abstract

**Objectives:** Integration of HIV and non-communicable disease services improves the quality and efficiency of care in low- and middle-income countries (LMICs). We aimed to describe current practices for the screening and management of atherosclerotic cardiovascular disease (ASCVD) among adult HIV clinics in Asia.

**Methods:** Sixteen LMIC sites included in the International Epidemiology Databases to Evaluate AIDS – Asia-Pacific network were surveyed.

**Results:** Sites were mostly (81%) based in urban public referral hospitals. Half had protocols to assess tobacco and alcohol use. Protocols for assessing physical inactivity and obesity were in place at 31% and 38% of sites, respectively. Most sites provided educational material on ASCVD risk factors (between 56% and 75% depending on risk factors). A total of 94% reported performing routine screening for hypertension, 100% for hyperlipidaemia and 88% for diabetes. Routine ASCVD risk assessment was reported by 94% of sites. Protocols for the management of hypertension, hyperlipidaemia, diabetes, high ASCVD risk and chronic ischaemic stroke were in place at 50%, 69%, 56%, 19% and 38% of sites, respectively. Blood pressure monitoring was free for patients at 69% of sites; however, most required patients to pay some or all the costs for other ASCVD-related procedures. Medications available in the clinic or within the same facility included angiotensin-converting enzyme inhibitors (81%), statins (94%) and sulphonylureas (94%).

**Conclusion:** The consistent availability of clinical screening, diagnostic testing and procedures and the availability of ASCVD medications in the Asian LMIC clinics surveyed are strengths that should be leveraged to improve the implementation of cardiovascular care protocols.

Keywords: HIV, cardiovascular disease, atherosclerosis, hypertension, Asia

## Introduction

While AIDS-related infections, malignancies and deaths have declined among people living with HIV (PLHIV) in the antiretroviral therapy (ART) era, there has been a concomitant increase in non-AIDS-related causes of death [1–3]. This trend is consistent with the dramatic global increase in population rates of

non-communicable disease over the past three decades [4]; however, many studies now show that PLHIV experience a disproportionate amount of this burden [5–7]. Although partly due to the high prevalence of traditional risk factors among PLHIV, the increase in non-AIDS-related causes of death may also be associated with the persistent low-level inflammation induced by long-term ART and HIV infection itself [8].

Atherosclerotic cardiovascular disease (ASCVD) is now a leading cause of non-AIDS-related death among people on ART [9–11]. However, in many low- and middle-income countries (LMICs), ASCVD is managed episodically, thereby placing patients at risk of long-term complications [12]. In contrast, HIV programmes

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in LMICs have proven very successful in establishing long-term care models that focus on continuity of care and retention, routine monitoring, and reduction in HIV transmission risk. Integration of HIV and non-communicable disease services has been shown to improve the quality and efficiency of care among PLHIV in LMICs [13,14], and was recommended by the World Health Organization in their action plan for the prevention and control of non-communicable diseases in Southeast Asia from 2013 to 2020 [15]. UNAIDS estimates that 5.9 million people are currently living with HIV in Asia [16]. Nevertheless, data remain limited with regard to the infrastructure and human resources available for non-communicable disease care among HIV clinics in the region.

Here we describe current practices for ASCVD screening and management among HIV clinics in LMICs in Asia. Our data will inform current and future research in the region and help policymakers develop more effective strategies to prevent and manage ASCVD among PLHIV.

## Methods

The International Epidemiology Databases to Evaluate AIDS (IeDEA; [www.iedea.org](http://www.iedea.org)) is a global consortium that includes cohorts located in Asia-Pacific, Caribbean, South and North America, and Central, East, Southern and West Africa [17–20]. IeDEA provides a unique platform for evaluating standard practices and resource allocation in HIV cohorts in these regions. In 2016, a survey of LMIC (as defined by World Bank [21]) sites in IeDEA was conducted to assess site capacity for non-communicable disease screening and management [22–24]. A follow-up survey was conducted in 2018 across sites in the IeDEA Asia-Pacific network to further evaluate screening and management practices for ASCVD. We have assessed the results from both surveys.

Investigators from IeDEA developed and standardised a 302-question survey on site resources, lifestyle assessment and education practices, screening and management of non-communicable diseases (hypertension, diabetes, kidney and pulmonary disease, mental health disorders and cancer), care for paediatric and adolescent patients, availability of vaccinations, imaging, surgery and medicines and routine data collection procedures. The IeDEA Site Capacity Survey is available from the authors on request. Multilingual versions of the survey were implemented using Research Electronic Data Capture (REDCap), a secure, web-based application designed to support data capture for research studies ([www.project-redcap.org](http://www.project-redcap.org)). REDCap was developed at the Vanderbilt Institute for Clinical and Translational Research. It provides an interface for validated data entry, audit trails for tracking data manipulation, and automated import and export procedures to common statistical packages [25]. Separate REDCap databases were created for each of the participating regions and could be completed directly online or transferred from paper copies. Regional data centres coordinated distribution to and completion of the survey by the sites. Clinical site investigators affiliated with the IeDEA regional networks were primarily responsible for completing the surveys. Data collection for IeDEA Asia-Pacific sites was completed by October 2016.

Investigators from IeDEA Asia-Pacific developed an additional 66-question survey to supplement the above mentioned site capacity survey. The survey containing the additional questions is available from the authors on request. Questions related to hyperlipidaemia screening and management, ASCVD risk assessment and management, chronic ischaemic stroke management, and access to lipid lowering and anti-diabetic medicines. Although ASCVD risk assessment tools are limited in their capacity to predict

stroke risk accurately [26], we did not enquire about whether sites used additional means to assess stroke risk to prevent the survey becoming overly burdensome. An English version of the survey was implemented using REDCap, which allowed data to be entered directly online. Sites could also complete the survey on paper and send scanned files to the IeDEA Asia-Pacific coordinating centre (TREAT Asia/amfAR, Bangkok, Thailand) for data entry. Clinical site investigators and data managers affiliated with IeDEA Asia-Pacific were primarily responsible for completing the surveys. Data collection was completed by June 2018. An additional question on beta-blocker availability was put to the sites via email in October 2019.

## Analysis

All 16 LMIC sites in IeDEA Asia-Pacific participated in the global site capacity and regional ASCVD surveys. Countries included were Thailand (four sites), China (two sites), India (two sites), Indonesia (two sites), Malaysia (two sites), Vietnam (two sites), Cambodia (one site) and the Philippines (one site). Data from both surveys were combined and responses evaluated for inconsistencies, which were resolved through direct communication with site data managers. The results were split into eight categories: (1) general site characteristics; (2) risk factor assessment and patient education practices; (3) hypertension screening and management; (4) hyperlipidaemia screening and management; (5) diabetes screening and management; (6) ASCVD risk assessment and management, and chronic ischaemic stroke management; (7) availability of clinical testing and procedure; and (8) availability of medicines.

## Results

### General site characteristics

Sites were mostly (81%) based in urban public referral hospitals. Seventy-five percent were linked to an academic medical centre. The median number of active outpatients was 2649 (interquartile range 1500–7500) and total number of active outpatients across all sites was 81,426. Cardiology services were within the HIV clinic itself or available in the same facility for 75% of sites.

### Risk factor assessment and patient education practices

Approximately half of sites had protocols to assess tobacco (50%), alcohol (50%) and other substance use (56%), as well as family history of chronic illnesses (50%). Protocols for assessing physical inactivity and obesity were in place at 31% and 38% of sites, respectively. Most sites provided educational material to patients on tobacco (75%), alcohol (69%) and other substance use (56%), physical inactivity (63%), and obesity and nutrition (69%). The most common means of education was patient counselling (Table 1).

### Hypertension screening and management

Ninety-four percent of sites reported performing routine screening for hypertension, with 64% indicating that they had a protocol in place (Table 2). Most sites (88%) did not have any selection criteria for performing hypertension screening and most (81%) conducted screening at every visit. Fifty percent of sites had a protocol in place for hypertension management.

### Hyperlipidaemia screening and management

All sites reported performing routine screening for hyperlipidaemia, with 44% having a protocol in place. Available screening tests included total cholesterol (75% of sites), high-density lipoprotein cholesterol (63% of sites), low-density lipoprotein cholesterol

**Table 1.** Assessment and patient education for individual risk factors (N=16)

| Characteristic                            | Tobacco use<br>n (%) | Alcohol use<br>n (%) | Other<br>substance use<br>n (%) | Physical<br>inactivity<br>n (%) | Obesity and<br>nutrition<br>n (%) | Family history<br>of chronic<br>illness |
|---|----------------------|----------------------|---------------------------------|---------------------------------|-----------------------------------|---|
| Written protocol in place to assess       | 8 (50)               | 8 (50)               | 9 (56)                          | 5 (31)                          | 6 (38)                            | 8 (50%)                                 |
| Educational material provided to patients | 12 (75)              | 11 (69)              | 9 (56)                          | 10 (63)                         | 11 (69)                           | NA                                      |
| Primary patient education method used     |                      |                      |                                 |                                 |                                   |   |
| Counselling                               | 5 (31)               | 5 (31)               | 3 (19)                          | 5 (31)                          | 5 (31)                            | NA                                      |
| Group education                           | 1 (6)                | 1 (6)                | 1 (6)                           | 1 (6)                           | 2 (13)                            | NA                                      |
| Referral                                  | 1 (6)                | 1 (6)                | 1 (6)                           | 0 (0)                           | 2 (13)                            | NA                                      |
| Written information                       | 3 (19)               | 2 (13)               | 3 (19)                          | 1 (6)                           | 1 (6)                             | NA                                      |
| Unspecified                               | 2 (13)               | 2 (13)               | 1 (6)                           | 3 (19)                          | 1 (6)                             | NA                                      |

**Table 2.** Hypertension screening and management (N=16)

| Characteristic   | n (%)   | Characteristic  | n (%)   |
|--|---------|---|---------|
| Routine screening for hypertension                     | 15 (94) | 251–500   | 2 (13)  |
| Protocol for hypertension screening in place           | 9 (56)  | >500  | 8 (50)  |
| Screening tests used <sup>a</sup>                      |         | Uncertain   | 2 (13)  |
| Manual blood pressure measurement                      | 9 (56)  | Protocol for hypertension management                              | 8 (50)  |
| Automated blood pressure measurement                   | 8 (50)  | Location of hypertension management                               |         |
| Ambulatory 24-hour blood pressure monitoring           | 2 (13)  | Within HIV clinic   | 11 (69) |
| Patients assessed for hypertension                     |         | In same facility but not in HIV clinic                            | 3 (19)  |
| All  | 14 (88) | Off site  | 2 (13)  |
| High-risk groups                                       | 0 (0)   | Undefined   | 0 (0)   |
| Other selection  | 0 (0)   | Not available   | 0 (0)   |
| Undefined  | 2 (13)  | Staff primarily responsible for hypertension management           |         |
| Timing of hypertension screening <sup>a</sup>          |         | HIV physician   | 10 (63) |
| At enrolment into care                                 | 5 (31)  | Non-HIV physician   | 0 (0)   |
| At antiretroviral therapy initiation                   | 4 (25)  | Nurse   | 0 (0)   |
| Yearly   | 1 (6)   | Nurse assistant   | 1 (6)   |
| At every visit   | 13 (81) | Other clinical staff  | 0 (0)   |
| Number of patients screened for hypertension per month |         | Non-clinical staff  | 0 (0)   |
| 0–100  | 1 (6)   | Uncertain   | 5 (31)  |
| 101–250  | 3 (19)  | Training received in past 2 years for staff managing hypertension | 10 (63) |

<sup>a</sup> Respondents could select more than one option.

(69% of sites) and triglycerides (75% of sites). A protocol for hyperlipidaemia management was in place at 69% of sites. Further details on hyperlipidaemia screening and management procedures are shown in Table 3.

### Diabetes screening and management

Eighty-eight percent of sites reported performing routine screening for diabetes, with 56% indicating that they had a protocol in place (Table 4). The most frequent method used for diabetes screening was a fasting plasma glucose measurement (81% of sites). Fifty percent of sites had a protocol in place for diabetes management.

### Atherosclerotic cardiovascular disease risk assessment and management, and chronic ischaemic stroke management

Routine assessment of ASCVD risk was reported by 94% of sites, of which 25% reported having a protocol of any kind in place

and 6%, a protocol specifically for PLHIV (Table 5). The most commonly used risk equations were Framingham (56%) and the American College of Cardiology and American Heart Association pooled cohort (50%; respondents could select more than one option). Nineteen percent of sites reported assessing ASCVD risk among all patients and 63%, only among high-risk groups. A protocol for managing patients at high risk of ASCVD was in place at 19% of sites, and 6% of sites had an HIV-specific protocol. Thirty-eight percent of sites reported having a protocol for chronic ischaemic stroke management; however, no site had a protocol specifically for PLHIV.

### Clinical testing and procedure availability

Blood pressure monitoring was available in all but one (94%) of the sites surveyed. Other tests and procedures were usually available either within the HIV clinic itself or in the same facility as the HIV clinic: glycosylated haemoglobin (HbA1c, 81%), fasting

**Table 3.** Hyperlipidaemia screening and management (N=16)

| Characteristic  | n (%)    | Characteristic   | n (%)   |
|---|----------|--|---------|
| Routine screening for hyperlipidaemia                     | 16 (100) | Nurse  | 0 (0)   |
| Protocol for hyperlipidaemia screening                    | 7 (44)   | Nurse assistant  | 0 (0)   |
| Screening tests used <sup>a</sup>                         |          | Other clinical staff   | 1 (6)   |
| Fasting blood lipids                                      | 15 (94)  | Non-clinical staff   | 0 (0)   |
| Non-fasting blood lipids                                  | 1 (6)    | Uncertain  | 0 (0)   |
| Total cholesterol   | 12 (75)  | Payment of hyperlipidaemia screening costs                           |         |
| High-density lipoprotein (HDL) cholesterol                | 10 (63)  | Patient only   | 5 (31)  |
| Low-density lipoprotein (LDL) cholesterol                 | 11 (69)  | Full public funding  | 6 (38)  |
| Triglycerides   | 12 (75)  | Co-payment (patient and public)                                      | 4 (25)  |
| Patients assessed for hyperlipidaemia                     |          | Mixture of all   | 1 (6)   |
| All   | 11 (69)  | Protocol for hyperlipidaemia management                              | 11 (69) |
| High-risk groups  | 2 (13)   | Location of hyperlipidaemia management                               |         |
| Other selection   | 3 (19)   | Within HIV clinic  | 14 (88) |
| Undefined   | 0 (0)    | In same facility but not in HIV clinic                               | 1 (6)   |
| Timing of hyperlipidaemia screening <sup>a</sup>          |          | Off site   | 0 (0)   |
| At enrolment into care                                    | 3 (19)   | Undefined  | 0 (0)   |
| At antiretroviral therapy initiation                      | 3 (19)   | Not available  | 1 (6)   |
| Yearly  | 13 (81)  | Staff primarily responsible for hyperlipidaemia management           |         |
| At every visit  | 1 (6)    | HIV physician  | 13 (81) |
| Number of patients screened for hyperlipidaemia per month |          | Non-HIV physician  | 0 (0)   |
| 0–100   | 3 (19)   | Nurse  | 0 (0)   |
| 101–250   | 4 (25)   | Nurse assistant  | 0 (0)   |
| 251–500   | 4 (25)   | Other clinical staff   | 1 (6)   |
| >500  | 3 (19)   | Non-clinical staff   | 2 (13)  |
| Uncertain   | 2 (13)   | Uncertain  | 0 (0)   |
| Location of hyperlipidaemia screening                     |          | Training received in past 2 years for staff managing hyperlipidaemia | 10 (63) |
| Within HIV clinic   | 13 (81)  | Payment of hyperlipidaemia management costs                          | 5 (31)  |
| In same facility but not in HIV clinic                    | 2 (13)   | Patient only   | 4 (25)  |
| Off site  | 0 (0)    | Full public funding  | 6 (38)  |
| Undefined   | 1 (6)    | Co-payment (patient and public)                                      | 1 (6)   |
| Not available   | 0 (0)    | Mixture of all   |         |
| Staff primarily responsible for hyperlipidaemia screening |          |  |         |
| HIV physician   | 15 (94)  |  |         |
| Non-HIV physician   | 0 (0)    |  |         |

<sup>a</sup> Respondents could select more than one option.

**Table 4.** Diabetes screening and management (N=16)

| Characteristic                           | n (%)    | Characteristic                                     | n (%)   |
|--|----------|--|---------|
| Routine screening for diabetes           | 14 (88%) | Timing of diabetes screening <sup>a</sup>          |         |
| Protocol for diabetes screening in place | 9 (56%)  | At enrolment into care                             | 5 (31%) |
| Screening tests used <sup>a</sup>        |          | At antiretroviral therapy initiation               | 5 (31%) |
| Random plasma glucose measurement        | 7 (44%)  | Yearly   | 4 (25%) |
| Fasting plasma glucose measurement       | 13 (81%) | At every visit                                     | 3 (19%) |
| 2-hour plasma glucose tolerance test     | 4 (25%)  | Number of patients screened for diabetes per month |         |
| HbA1c                                    | 6 (38%)  | 0–100  | 6 (38%) |
| Patients assessed for diabetes           |          | 101–250  | 5 (31%) |
| All                                      | 9 (56%)  | 251–500  | 1 (6%)  |
| High-risk groups                         | 2 (13%)  | >500   | 3 (19%) |
| Other selection                          | 0 (0%)   | Uncertain  | 1 (6%)  |
| Undefined                                | 3 (19%)  |  |         |

**Table 4.** Diabetes screening and management (N=16) (continued)

| Characteristic                                      | n (%)   | Characteristic  | n (%)   |
|---|---------|---|---------|
| Protocol for diabetes management                    | 8 (50%) | Non-HIV physician   | 0 (0%)  |
| Location of diabetes management                     |         | Nurse   | 0 (0%)  |
| Within HIV clinic                                   | 9 (56%) | Nurse assistant   | 0 (0%)  |
| In same facility but not in HIV clinic              | 4 (25%) | Other clinical staff  | 0 (0%)  |
| Off site  | 1 (6%)  | Non-clinical staff  | 0 (0%)  |
| Undefined   | 1 (6%)  | Uncertain   | 7 (44%) |
| Not available                                       | 1 (6%)  | Training received in past 2 years for staff managing diabetes | 10 (63) |
| Staff primarily responsible for diabetes management |         |   |         |
| HIV physician                                       | 9 (56%) |   |         |

<sup>a</sup> Respondents could select more than one option. HbA1c: glycosylated haemoglobin.

**Table 5.** ASCVD risk assessment and management, and chronic ischaemic stroke management (N=16)

| Characteristic  | n (%)   | Characteristic  | n (%)   |
|---|---------|---|---------|
| Routine assessment of ASCVD risk                            | 15 (94) | Nurse   | 1 (6)   |
| Protocol for ASCVD risk assessment                          | 4 (25)  | Nurse assistant   | 0 (0)   |
| HIV-specific protocol                                       | 1 (6)   | Other clinical staff  | 0 (0)   |
| Cardiovascular disease risk calculators used <sup>a</sup>   |         | Non-clinical staff  | 1 (6)   |
| Data collection on adverse events of anti-HIV drugs (D:A:D) | 2 (13)  | Uncertain   | 1 (6)   |
| Framingham  | 9 (56)  | Protocol for managing those with high risk of ASCVD                           | 3 (19)  |
| American College of Cardiology                              | 8 (50)  | HIV-specific protocol   | 1 (6)   |
| Other   | 0 (0)   | Protocol for chronic ischaemic stroke management                              | 6 (38)  |
| Patients assessed for ASCVD risk                            |         | HIV-specific protocol   | 0 (0)   |
| All   | 3 (19)  | Location of chronic ischaemic stroke management                               |         |
| High-risk groups  | 10 (63) | Within HIV clinic   | 4 (25)  |
| Other selection   | 2 (13)  | In same facility but not in HIV clinic  | 9 (56)  |
| None  | 1 (6)   | Off site  | 2 (13)  |
| Timing of ASCVD assessment <sup>a</sup>                     |         | Undefined   | 0 (0)   |
| At enrolment into care                                      | 4 (25)  | Not available   | 1 (6)   |
| At antiretroviral therapy initiation                        | 2 (13)  | Staff primarily responsible for chronic ischaemic stroke management           |         |
| Yearly  | 9 (56)  | HIV physician   | 4 (25)  |
| At every visit  | 0 (0)   | Non-HIV physician   | 10 (63) |
| Number of patients assessed for ASCVD risk per month        |         | Nurse   | 0 (0)   |
| 0–100   | 8 (50)  | Nurse assistant   | 0 (0)   |
| 101–250   | 2 (13)  | Other clinical staff  | 1 (6)   |
| 251–500   | 2 (13)  | Non-clinical staff  | 1 (6)   |
| >500  | 1 (6)   | Uncertain   | 0 (0)   |
| Uncertain   | 3 (19)  | Training received in past 2 years for staff managing chronic ischaemic stroke | 6 (38)  |
| Location of ASCVD risk assessment                           |         | Payment of chronic ischaemic stroke management costs                          |         |
| Within HIV clinic   | 13 (81) | Patient only  | 7 (44)  |
| In same facility but not in HIV clinic                      | 1 (6)   | Full public funding   | 4 (25)  |
| Off site  | 0 (0)   | Co-payment (patient and public)   | 4 (25)  |
| Undefined   | 1 (6)   | Mixture of all  | 1 (6)   |
| Not available   | 1 (6)   |   |         |
| Staff primarily responsible for ASCVD risk assessment       |         |   |         |
| HIV physician   | 13 (81) |   |         |
| Non-HIV physician   | 0 (0)   |   |         |

<sup>a</sup> Respondents could select more than one option. ASCVD: atherosclerotic cardiovascular disease.

plasma glucose (88%), oral glucose tolerance test (81%), random plasma glucose (88%), point-of-care diabetes testing (75%), computed tomography scan (81%), brain magnetic resonance imaging (81%), computed tomography angiogram (68%), echocardiogram (88%), electrocardiogram (81%), any form of cardiac stress test (75%), 24-hour Holter monitor (69%), carotid duplex or ultrasound (69%), cardiac catheterisation (63%), cardiac troponin (75%), creatine kinase myocardial band isoenzyme (75%), creatine phosphokinase (75%) and stroke rehabilitation (75%). Cerebral thrombectomy and coronary bypass or stenting were available within the same facility as the HIV clinic at 50% of sites. Digital photography for remote diagnosis of diabetic retinopathy was available either within the HIV clinic, within the same facility as the HIV clinic or off site at 50% of sites. Blood pressure monitoring was free to patients at 69% of sites; however, most sites required patients to pay some or all the associated costs for other procedures (Table 6).

## Medication availability

Medications available in the clinic or within the same facility to treat ASCVD-associated conditions included thiazides (88%), angiotensin-converting enzyme inhibitors (81%), calcium channel blockers (88%), beta-blockers (94%), statins (94%), fibrates (88%), ezetimibe (56%), aspirin (88%), P2Y12 inhibitors (81%), alteplase (56%) and sulphonylureas (94%). Further details on medication availability are provided in Table 7.

## Discussion

The surveys of 16 HIV clinics in LMICs in Asia revealed several gaps in ASCVD diagnosis and management practices, in particular, a lack of ASCVD screening and management protocols. To our knowledge, this is the first study to report the capacity of HIV clinics in Asia to manage and screen for ASCVD.

**Table 6.** Test and procedure availability (N=16)

| Availability and cost                  | Blood pressure monitor n (%) | HbA1c n (%)                   | Fasting plasma glucose n (%) | Oral glucose tolerance test n (%) | Random plasma glucose n (%)      | Digital photography <sup>a</sup> n (%) | Point of care diabetes testing n (%) | Computed tomography scan n (%) |
|--|------------------------------|-------------------------------|------------------------------|-----------------------------------|----------------------------------|--|--------------------------------------|--------------------------------|
| Availability                           |                              |                               |                              |                                   |                                  |  |                                      |                                |
| Within HIV clinic                      | 15 (94)                      | 9 (56)                        | 12 (75)                      | 6 (38)                            | 11 (69)                          | 1 (6)                                  | 10 (63)                              | 3 (19)                         |
| In same facility but not in HIV clinic | 0 (0)                        | 4 (25)                        | 2 (13)                       | 7 (44)                            | 3 (19)                           | 4 (25)                                 | 2 (13)                               | 10 (63)                        |
| Off site                               | 0 (0)                        | 2 (13)                        | 1 (6)                        | 1 (6)                             | 0 (0)                            | 3 (19)                                 | 2 (13)                               | 2 (13)                         |
| Not available                          | 1 (6)                        | 1 (6)                         | 1 (6)                        | 2 (13)                            | 2 (13)                           | 8 (50)                                 | 2 (13)                               | 1 (6)                          |
| Procedure or test free for patients    | 11 (69)                      | 5 (31)                        | 7 (44)                       | 3 (19)                            | 5 (31)                           | 3 (19)                                 | 5 (31)                               | 4 (25)                         |
|  | Brain MRI                    | Computed tomography angiogram | Echocardiogram               | ECG                               | Cardiac stress test <sup>b</sup> | 24-hour Holter monitor                 | Carotid duplex/ultrasound            | Cardiac catheterisation        |
| Availability                           |                              |                               |                              |                                   |                                  |  |                                      |                                |
| Within HIV clinic                      | 3 (19)                       | 3 (19)                        | 3 (19)                       | 7 (44)                            | 2 (13)                           | 2 (13)                                 | 2 (13)                               | 2 (13)                         |
| In same facility but not in HIV clinic | 10 (63)                      | 8 (50)                        | 11 (69)                      | 6 (38)                            | 10 (63)                          | 9 (56)                                 | 9 (56)                               | 8 (50)                         |
| Off site                               | 2 (13)                       | 4 (25)                        | 1 (6)                        | 1 (6)                             | 2 (13)                           | 3 (19)                                 | 3 (19)                               | 4 (25)                         |
| Not available                          | 1 (6)                        | 1 (6)                         | 1 (6)                        | 2 (13)                            | 2 (13)                           | 2 (13)                                 | 2 (13)                               | 2 (13)                         |
| Procedure or test free for patients    | 4 (25)                       | 4 (25)                        | 4 (25)                       | 5 (31)                            | 3 (19)                           | 3 (19)                                 | 3 (19)                               | 2 (13)                         |
|  | Cardiac troponin             | Creatine kinase MB isoenzyme  | Creatine phosphokinase       | Cerebral thrombectomy             | Stroke rehabilitation            | Coronary bypass or stenting            |                                      |                                |
| Availability                           |                              |                               |                              |                                   |                                  |  |                                      |                                |
| Within HIV clinic                      | 6 (38)                       | 6 (38)                        | 6 (38)                       | 0 (0)                             | 1 (6)                            | 0 (0)                                  |                                      |                                |
| In same facility but not in HIV clinic | 6 (38)                       | 6 (38)                        | 6 (38)                       | 8 (50)                            | 11 (69)                          | 8 (50)                                 |                                      |                                |
| Off site                               | 2 (13)                       | 2 (13)                        | 2 (13)                       | 4 (25)                            | 3 (19)                           | 6 (38)                                 |                                      |                                |
| Not available                          | 2 (13)                       | 2 (13)                        | 2 (13)                       | 4 (25)                            | 1 (6)                            | 2 (13)                                 |                                      |                                |
| Procedure or test free for patients    | 3 (19)                       | 3 (19)                        | 3 (19)                       | 3 (19)                            | 5 (31)                           | NA                                     |                                      |                                |

<sup>a</sup> For remote diagnosis of diabetic retinopathy.

<sup>b</sup> Any form of cardiac stress test. ECG: electrocardiogram; HbA1c: glycosylated haemoglobin; MB: myocardial band; MRI: magnetic resonance imaging; NA: not assessed.

**Table 7.** Medication availability (N=16)

| Characteristic                         | Aspirin<br>n (%) | P2Y12<br>inhibitors<br>n (%) | Alteplase<br>n (%) | Atorvastatin<br>n (%) | Fluvostatin<br>n (%) | Lovastatin<br>n (%) | Pitavastatin<br>n (%) | Pravastatin<br>n (%) |
|--|------------------|------------------------------|--------------------|-----------------------|----------------------|---------------------|-----------------------|----------------------|
| Availability                           |                  |                              |                    |                       |                      |                     |                       |                      |
| Within HIV clinic                      | 3 (19)           | 6 (38)                       | 0 (0)              | 9 (56)                | 3 (19)               | 2 (13)              | 6 (38)                | 4 (25)               |
| In same facility but not in HIV clinic | 11 (69)          | 7 (44)                       | 9 (56)             | 5 (31)                | 3 (19)               | 5 (31)              | 5 (31)                | 6 (38)               |
| Off site                               | 1 (6)            | 2 (13)                       | 4 (25)             | 1 (6)                 | 3 (19)               | 3 (19)              | 1 (6)                 | 3 (19)               |
| Not available                          | 1 (6)            | 1 (6)                        | 3 (19)             | 1 (6)                 | 7 (44)               | 6 (38)              | 4 (25)                | 3 (19)               |
|  | Rosuvastatin     | Simvastatin                  | Gemfibrozil        | Fenofibrate           | Clofibrate           | Ezetimibe           | Thiazides             | ACE-inhibitors       |
| Availability                           |                  |                              |                    |                       |                      |                     |                       |                      |
| Within HIV clinic                      | 8 (50)           | 7 (44)                       | 7 (44)             | 9 (56)                | 2 (13)               | 5 (31)              | 10 (63)               | 9 (56)               |
| In same facility but not in HIV clinic | 5 (31)           | 6 (38)                       | 5 (31)             | 5 (31)                | 5 (31)               | 4 (25)              | 4 (25)                | 4 (25)               |
| Off site                               | 1 (6)            | 2 (13)                       | 2 (13)             | 1 (6)                 | 2 (13)               | 4 (25)              | 0 (0)                 | 1 (6)                |
| Not available                          | 2 (13)           | 1 (6)                        | 2 (13)             | 1 (6)                 | 7 (44)               | 3 (19)              | 2 (13)                | 2 (13)               |
|  | CCBs             | Beta-blockers                | Sulphonylureas     | Meglitinides          | AGIs                 | Glitazones          | DPP-4 inhibitors      | Incretin mimetics    |
| Availability                           |                  |                              |                    |                       |                      |                     |                       |                      |
| Within HIV clinic                      | 10 (63)          | 4 (25)                       | 8 (50)             | 3 (19)                | 4 (25)               | 6 (38)              | 5 (31)                | 2 (13)               |
| In same facility but not in HIV clinic | 4 (25)           | 11 (69)                      | 7 (44)             | 8 (50)                | 7 (44)               | 6 (38)              | 7 (44)                | 6 (38)               |
| Off site                               | 0 (0)            | 1 (6)                        | 1 (6)              | 2 (13)                | 3 (19)               | 3 (19)              | 2 (13)                | 3 (19)               |
| Not available                          | 2 (13)           | 0 (0)                        | 0 (0)              | 3 (19)                | 2 (13)               | 1 (6)               | 2 (13%)               | 5 (31%)              |

ACE: angiotensin-converting enzyme; AGIs: alpha-glucosidase inhibitors; CCBs: calcium channel blockers; DPP: dipeptidyl peptidase.

For each of the major ASCVD risk factors assessed, approximately half of the surveyed sites indicated they had an assessment protocol in place. Between 56% and 75% of the sites provided some form of education to patients on these risk factors, indicating room for improvement. Education empowers patients and community members to seek care and to better manage their health [15]. In comparison with a similar survey among HIV treatment sites in Tanzania [27], education provision among our Asian sites was higher for tobacco use (75% vs 57%), lower for alcohol use (69% vs 86%), and slightly higher for obesity and nutrition (69% vs 64%).

Routine screening for hypertension, hyperlipidaemia, diabetes and ASCVD risk was common, and sites had excellent access to blood pressure monitors, lipid and fasting plasma glucose testing, and appropriate ASCVD risk equations. However, only 64% of sites had a protocol in place for hypertension screening and fewer had protocols to screen for hyperlipidaemia, diabetes or ASCVD risk. In Asia and elsewhere, primary care systems with well-established protocols have proven to be effective in non-communicable disease prevention and management [28–30]. Protocols help to standardise medical care and optimise the utility of equipment, laboratory testing and medications. For HIV or primary care clinics, protocols can also assist in deciding appropriate patient referral for a non-communicable disease-related complication.

Many sites also lacked a protocol for the management of hypertension, hyperlipidaemia, diabetes, high ASCVD risk and chronic stroke. This finding is consistent with other studies from resource-limited countries reporting findings from HIV [27] and primary care clinics [31,32]. Importantly, the availability of medications to treat these conditions was generally good. As an example,

while we found 94% of sites had statins available either within the HIV clinic or in the same facility as the HIV clinic, Leung *et al.* reported that less than 10% of the HIV clinics they had surveyed in Tanzania could provide simvastatin [27]. It was also encouraging to find that coronary bypass or stenting and stroke rehabilitation services were available at 88% and 94% of the surveyed sites, respectively.

Patient management of hypertension, hyperlipidaemia, diabetes and chronic stroke was usually carried out by an HIV physician. This is becoming more common in LMICs; however, in high-income countries, where integrated care has typically focused on better management of broad groups of people with multiple morbidities, HIV physicians may not have as much autonomy regarding their patient CVD care [33]. For 38% to 63% of sites, the staff member primarily responsible for patient management had received training in the last 2 years. Patients often had to pay some or all of the costs associated with diagnosis and management. Ensuring clinics are adequately staffed to address the growing ASCVD burden among PLHIV is critical. Moreover, healthcare workers must be adequately trained, encouraged to explore novel models of care and incentivised to continue developing their career track [15]. This study indicates that staff at the surveyed clinics have sufficient tools available to diagnose and manage patients appropriately.

There are several limitations to this study. First, the HIV clinics included may not be representative of HIV care across Asia, particularly in more rural areas. Second, our study is based on self-reported data collected cross-sectionally, which may be subject to recall and desirability biases. Finally, we have captured information only on the service availability and not their quality, uptake

or coverage. Further studies examining the quality of ASCVD care provided in Asian HIV clinics and impact of ASCVD prevention and care initiatives among PLHIV are warranted.

This study shows ASCVD care is generally well integrated among urban HIV centres in LMICs in Asia. The consistent availability of clinical screening, diagnostic testing and procedures, and ASCVD medication is a strength in the current system that should be leveraged to improve implementation of cardiovascular care protocols.

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## Conflicts of interest

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