

ORIGINAL RESEARCH

Access to Cardiovascular Disease and Hypertension Medicines in Developing Countries: An Analysis of Essential Medicine Lists, Price, Availability, and Affordability

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BACKGROUND: Access to medicines is important for long-term care of cardiovascular diseases and hypertension. This study provides a cross-country assessment of availability, prices, and affordability of cardiovascular disease and hypertension medicines to identify areas for improvement in access to medication treatment.

METHODS AND RESULTS: We used the World Health Organization online repository of national essential medicines lists (EMLs) for 53 countries to transcribe the information on the inclusion of 12 cardiovascular disease/hypertension medications within each country's essential medicines list. Data on availability, price, and affordability were obtained from 84 surveys in 59 countries that used the World Health Organization's Health Action International survey methodology. We summarized and compared the indicators across lowest-price generic and originator brand medicines in the public and private sectors and by country income groups. The average availability of the select medications was 54% in low- and lower-middle-income countries and 60% in high- and upper-middle-income countries, and was higher for generic (61%) than brand medicines (41%). The average patient median price ratio was 80.3 for brand and 16.7 for generic medicines and was higher for patients in low- and lower-middle-income countries compared with high- and upper-middle-income countries across all medicine categories. The costs of 1 month's antihypertensive medications were, on average, 6.0 days' wage for brand medicine and 1.8 days' wage for generics. Affordability was lower in low- and lower-middle-income countries than high- and upper-middle-income countries for both brand and generic medications.

CONCLUSIONS: The availability and accessibility of pharmaceuticals is an ongoing challenge for health systems. Low availability and high costs are major barriers to the use of and adherence to essential cardiovascular disease and antihypertensive medications worldwide, particularly in low- and lower-middle-income countries.

Key Words: cardiovascular disease ■ essential medicine lists ■ healthcare access ■ healthcare costs ■ hypertension ■ medication ■ price, availability, and affordability

Cardiovascular diseases (CVDs) are the world's leading cause of death.¹ In 2016, 31% of all global deaths were due to CVD such as heart attacks and strokes.¹ Low- and middle-income countries (LMICs) bear a growing burden of mortality attributable to CVD; of the 17.9 million global deaths resulting

from CVD in 2016, over three-quarters occurred in LMICs.² Hypertension, also known as high or raised blood pressure is a major, but preventable, risk factor for CVD events and is responsible for 55% of deaths caused by ischemic heart disease and 45% of deaths caused by cerebrovascular disease.³ Complications

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CLINICAL PERSPECTIVE

What Is New?

- Only 66% of the country essential medicines lists examined included at least 1 of the 4 statins surveyed (atorvastatin, lovastatin, pravastatin, and simvastatin), and only 70% included enalapril, an angiotensin-converting enzyme inhibitor; about half of national essential medicines lists from the African region did not include any of the above medicines.
- The availability of cardiovascular disease and hypertension medicines may be insufficient in some low-resource countries with a rising prevalence of hypertension; where medicines are available, their prices may be unaffordable.
- Patient prices for generic medicines are much lower compared with prices of brand medicines, but still many times higher than the international reference prices.

What Are the Clinical Implications?

- Updating country essential medicines lists to include at least 1 medication from each of the 5 major drug treatment classes (angiotensin-converting enzyme inhibitors, β -blockers, calcium channel blockers, thiazide/thiazide-like diuretics, and statins) can help to support hypertension control efforts.

Nonstandard Abbreviations and Acronyms

ACE	angiotensin-converting enzyme
BP	blood pressure
CVD	cardiovascular diseases
EML	essential medicines list
EURO	WHO Regional Office for Europe
HAI	Health Action International
HUMICs	high- and upper-middle-income countries
LLMICs	low- and lower-middle-income countries
LMICs	low- and middle-income countries
MPR	median price ratio
PPP	purchasing power parity
WB	World Bank
WHO	World Health Organization

from hypertension account for about 10 million deaths worldwide annually.^{3,4} An estimated 1.39 billion adults (aged ≥ 20 years) globally had raised blood pressure in 2010, with 1.04 billion of them residing in the LMICs.⁵

In the LMICs, among all the adults with hypertension, 39% were aware of their condition (ie, diagnosed with hypertension), 30% received treatment, and only 10% achieved control of their hypertension.^{6,7}

Prevention, control, and management of CVD and hypertension generally require long-term treatment, where sustained availability and accessibility of medicines are critical. Despite the proven efficacy of blood pressure-lowering medicines in controlling hypertension as well as preventing CVD events, their use is markedly insufficient—leading to suboptimal blood pressure control at the population level.^{6,7} Low availability and high costs are major barriers to the use of and adherence to essential CVD and antihypertensive medications worldwide and particularly in LMICs.^{8,9} Given the role that pharmaceuticals can play in the prevention and treatment of CVD and hypertension, it is likely that their relative availability, accessibility, and affordability play a significant role in improving CVD-related health outcomes within specific country contexts.^{10,11} Unfortunately, in many countries and areas, the needed essential medicines are often unavailable, inaccessible, and unaffordable.^{10,12}

One of the key requirements for ensuring the availability of any medication within a public health system is its presence on a country's essential medicines list (EML).¹³ The World Health Organization (WHO) created the first model EML in 1977 to help developing countries prioritize which medications to purchase given their limited resources.¹⁴ The model list is meant to be updated every few years to reflect new clinical evidence and health priorities, and countries are encouraged to adapt the EML to their particular context, budget, and disease burden profile.¹⁴ An in-depth look at the current inclusion of CVD/hypertension medications on country EMLs brings to light the current country-level barriers to access. This evidence can also be used to guide decision making on setting realistic targets and drug- and dose-specific protocols to improve the availability and affordability of medications for the prevention and treatment of CVD/hypertension.

Earlier studies demonstrated the link between the inclusion of a particular medicine in the EMLs and the availability and affordability in both the public and private sectors. Twagirumukiza et al¹⁵ demonstrated that the prices of antihypertensive medicines in sub-Saharan Africa were lower when they were included in the national EMLs compared with when the medicines were not included in the EMLs. In a similar vein, Bazargani et al¹³ found that the median availability of essential medicines was suboptimal at 61.5% but nonetheless significantly higher than nonessential medicines at 27.3%; and the average availability of essential medicines was 40.0% and 78.1% in the public and private sectors, respectively, compared with 6.6% and 57.1% for nonessential medicines, respectively.

Persaud et al¹⁶ compared the medicines included in 137 national EMLs with the 2017 WHO's model list of essential medicines and reported substantial differences between national lists of medicines.

A number of previous cross-country studies reported the extents and the variabilities in the availability, price, and affordability of selected CVD and/or hypertension medications at the within-country regional⁸ and multicountry contexts.^{9,10,17–21} This study presents an updated analysis of the country EMLs in relation to CVD and hypertension medicines; examines the availability, price, and affordability of select CVD and hypertension medicines by World Bank (WB) country income groups and WHO regions; and discusses the challenges, issues, and potential solutions for improved access to these essential medicines.

METHODS

The study used publicly available secondary data aggregated at the national level and did not include human subjects. Therefore, the study did not require institutional review board review. The medicine availability, price, and affordability data were from <https://haiweb.org/what-we-do/price-availability-affordability/price-availability-data/> (Medicine Prices, Availability, Affordability & Price Components Database). The country EMLs were from https://www.who.int/selection_medicines/country_lists/en/ (Essential Medicines Selection, National Medicines List/Formulary/Standard Treatment Guidelines).

Essential Medicines List

The WHO online repository of national EMLs/formulary/standard treatment guidelines provides access to country EMLs.²² Of the 117 EMLs available, we limited our study to 53 countries that have their national EMLs published in English, and were composed of 16 low-income countries, 21 low- and lower-middle-income countries (LLMICs), 15 upper-middle-income countries, and 1 high-income country. Therefore, the majority of the EMLs were from low-resource settings. For each country surveyed, the most recent available EML was used, ranging from 2004 to 2016. Five regions were represented: 25 countries from the WHO Regional Office for Africa, 12 countries from the WHO Regional Office for the Eastern Mediterranean, 6 countries from the WHO Regional Office for the Americas, 8 countries from the WHO Regional Office for the South-East Asia, and 2 countries from the WHO Regional Office for the Western Pacific. We transcribed the information on the inclusion of 12 CVD/hypertension medications within each country EML into 1 spreadsheet

for data analysis. The selected medicines conformed with the suggested drug list by WHO and included 1 angiotensin-converting enzyme (ACE) inhibitor (enalapril), 3 β -blockers (atenolol, carvedilol, metoprolol), 2 calcium channel blockers (nifedipine, amlodipine), 2 thiazide or thiazide-like diuretics (chlorthalidone, hydrochlorothiazide), and 4 statins (atorvastatin, lovastatin, pravastatin, and simvastatin). This analysis did not consider variations in included dosage, strengths, or formulations of the medications, with the only inclusion criteria being listed on the EML. After transcription, the EML data were analyzed for variations in frequencies between medications and therapeutic classes.

WHO/Health Action International Data Country Surveys

The WHO Essential Drugs and Medicine Policy Department and the Health Action International (HAI) project on Medicine Prices and Availability developed the WHO/HAI manual, which offers all countries a standardized method for collecting and analyzing medicine price, availability, and affordability across healthcare sectors and regions in a country.²³ The methodology tool includes detailed survey protocols and a preprogrammed Microsoft Excel computerized workbook to consolidate and summarize medicine prices (government procurement prices and patient prices), availability, affordability, and price components. Countries are required to follow the standard methodology to ensure consistency in data collection and the derivation of summary indicators, data reliability, and international comparisons. Since 2003, the WHO/HAI Project on Medicine Prices and Availability has been publishing the country survey data with summary indicators on a publicly accessible global website. The data for this study came from 84 surveys in 59 countries that used the WHO/HAI methodology, which allows standardized reporting and cross-country comparisons. The data, survey methodology, and indicator definitions are publicly available on the HAI website (<http://haiweb.org/what-we-do/price-availability-affordability/price-availability-data/>).

The WHO/HAI survey methodology requires countries to systematically collect the patient prices of a core list of medicines from a sample of outlets in the public, private, and other sectors (depending on country contexts).²³ The sample outlets are randomly chosen from 4 administrative areas consisting of 1 major urban center and 3 other randomly chosen administrative regions reachable within 1 day's travel from the central area. Data on public-sector patient prices are collected from at least 5 outlets, including the main public hospital. The selection of the private-sector

outlets is based on the proximity to the corresponding public health facilities chosen.^{19,23} Prices are also collected for government procurement—usually obtained centrally, for example, from the office of the procurement officer or central medical stores. Countries are required to collect information on 14 global and 16 regional core medicines, with the option of collecting data for up to 20 supplementary medicines depending on the local/regional importance and availability. For larger countries (eg, China, India) the surveys are usually conducted at the subnational levels.^{19,23} For each medicine, a fixed dosage form and strength is used, and data are collected on the originator brand and the lowest-priced generic equivalent found at each medicine outlet.²³

Hypertension and CVD Medicines

The global core list of 14 medicines includes 3 CVD/hypertension medicines: atenolol 50 mg cap/tab, captopril 25 mg cap/tab, simvastatin 20 mg cap/tab.²³ Country surveys may not include medicines from the global core if they are not marketed in the country. The regional lists are updated periodically to reflect new data on medicine availability. For instance, the WHO/HAI background report prepared for the WHO Planning Meeting on the Global Initiative for Treatment of Chronic Diseases included the following hypertensive medicines in the core list of 30 medicines: atenolol 50 mg tab/cap, captopril 25 mg tab/cap, hydrochlorothiazide 25 mg tab/cap, losartan 50 mg tab/cap, and nifedipine retard 20 mg tablet. In this study, we included the most-surveyed medicines that are representatives of the 5 major pharmaceutical classes: amlodipine 5 mg, atenolol 50 mg, captopril 25 mg, enalapril 10 mg, furosemide 40 mg, hydrochlorothiazide 25 mg, losartan 50 mg, lovastatin 20 mg, and nifedipine 20 mg. However, because of data scarcity, losartan is absent in the price analysis, and lovastatin and furosemide are absent in the affordability analysis.

Availability, Price, and Affordability Indicators

Availability in the WHO/HAI methodology is defined as the percentage of facilities in which a particular medicine was available at the time of the survey. The availability of medicines corresponding to the exact forms and strengths are reported. The availability data refer to the day of data collection at each particular facility and may not reflect average monthly or yearly availability of medicines at individual facilities.

The median price data collected in the surveys are expressed as a summary measure in relation to a standard set of reference prices, defined as the median price ratio (MPR), which facilitates national and

international comparisons. The medicine and dose-specific international reference prices are taken from the Management Sciences for Health International Drug Price Indicator Guide, which represents the median procurement prices offered by both not-for-profit and for-profit suppliers to developing countries for multisource products.²⁴ The MPR is calculated as the median local unit price divided by the international unit reference price in local currency using the exchange rate on the first day of data collection. We reported MPRs for (1) public-sector procurement, representing prices that the government and other purchasers pay to procure medicines, generally through a tendering process; (2) patient prices in the public sector that patients must pay in government, municipality, or other local authority health facilities, including clinics and hospitals, health centers, and pharmacies; and (3) patient prices in the private sector that patients pay in retail pharmacies and pharmacies in private clinics and hospitals. In countries where patients have a free provision of a medicine, the patient prices were assumed to be zero. Affordability was measured by the patient cost of medicines relative to an income measure, which the WHO/HAI methodology defines as the daily wage of the lowest-paid unskilled government worker in each country. Affordability is expressed as the number of days the lowest-paid unskilled government worker would have to work to afford the cost of 30 days of treatment.²³ More specifically for this analysis, the cost refers to the cost of 1 month's single antihypertensive medication.

Price Comparisons

The country surveys were conducted in various years ranging from 2002 to 2015. Therefore, to enable cross-country comparison of MPRs from different years, all MPRs were converted into a base-year (ie, 2010) MPR, taking into account inflation/deflation captured by the trends for the respective country consumer price indices, exchange rates obtained from the International Monetary Fund, and purchasing power parity. The detailed methodology for converting WHO/HAI survey price data for international comparison is described in the WHO/HAI manual.²³ Procurement prices did not require adjustment for purchasing power parity because the international pharmaceutical procurement market does not require standardization based on people's purchasing power.^{19,23}

Subgroup Analysis and Limitations

Results were classified according to 2 criteria: by country income group on the basis of 2015 WB income groups and by WHO regions. Table S1 provides the full list of country surveys used in this analysis,

mapped into a matrix of WB country groups and WHO regions. There are significant data gaps; that is, different surveys cover different sublists of medicines and indicator information, and average values should not be viewed as globally or regionally representative. Tables S2 through S9 include the number of countries (n) from which averages were derived. For instance, WHO/HAI survey data on Afghanistan represent the only low-income country in the WHO Regional Office for the Eastern Mediterranean region, and therefore the results presented are based on this single country observation (ie, n=1). We reported average values for the indicators, including the range (ie, minimum and maximum values). For countries with multiple-year data, we used the most recent survey year data for analyzing the availability, patient price, procurement price, and affordability of respective medicines. In presenting the graphs in the Results section, we further categorized the 4 WB groups into 2 country groups: high- and upper-middle-income countries (HUMICs) and LLMICs. Tables S3 through S9 report the results of 4 WB country groups and 6 WHO regions.

RESULTS

CVD Medication Presence on Country National EMLs

Figure 1 (left panel) displays the percentage of country EMLs that included each of the 12 select medicines; Figure 1 (right panel) displays the corresponding percentages by drug class, and Table S2 provides detailed country-level data for each medicine. None of the 53 countries had all 12 selected medicines on their

most recent available EML. The products with the lowest inclusion rates include all statins (ie, atorvastatin, lovastatin, pravastatin, and simvastatin), enalapril, amlodipine, and chlorthalidone. Statins and ACE inhibitors are commonly regarded as 2 of the 4 necessary medications for secondary prevention of CVD. Yet, despite many statins going off patent in the early- to mid-2000s and the inclusion of simvastatin on the WHO model essential medicines list in 2007, statins remain omitted from many country EMLs.

Although the standard of care for the secondary prevention of CVD often dictates the use of the 5 classes of medications, their inclusion on EMLs is not equal. Of the 4 statins surveyed (atorvastatin, lovastatin, pravastatin, and simvastatin), only 66% of country EMLs examined included at least 1, and only 70% of countries placed enalapril, an ACE inhibitor, on their lists. In comparison, nearly all countries (96%) included at least 1 β -blocker. Countries were considerably more likely to list atenolol as the chosen β -blocker: 92% of countries included atenolol on their EML, compared with 42% including carvedilol and 32% including metoprolol. Previous studies have found ACE inhibitors and statins to be more expensive than aspirin and β -blockers across all economic settings.²⁵

Availability of Medicines

Figure 2 depicts the availability of brand and generic versions in the public and private sectors for each medicine. Tables S3 and S4 present the availability data by WHO regions and WB country groups for the public and private sectors, respectively. In Figure 2, the dark-shaded bars in both graphs represent availability

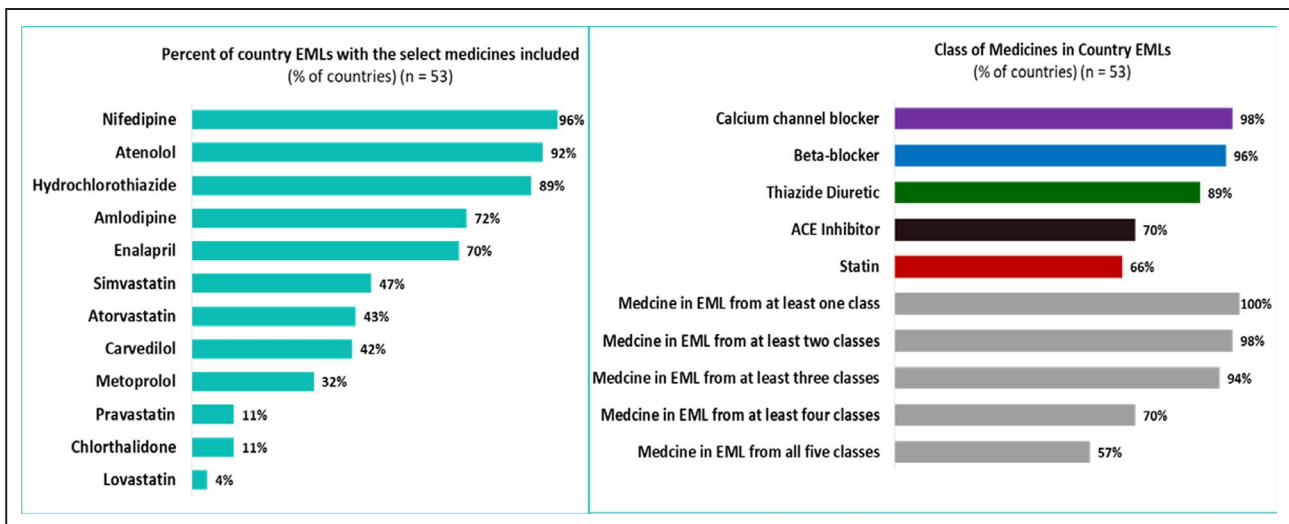


Figure 1. Percentage of country EMLs with select CVD/hypertension medicines and class of medicines included.

Twelve medicines were categorized into 5 drug classes: ACE inhibitor (enalapril), β -blockers (atenolol, carvedilol, metoprolol), calcium channel blockers (nifedipine, amlodipine), thiazide/thiazide-like diuretics (chlorthalidone, hydrochlorothiazide), and statins (atorvastatin, lovastatin, pravastatin, and simvastatin). See Table S2 for country-level data. ACE indicates angiotensin-converting enzyme; CVD, cardiovascular disease; and EML, essential medicines list.

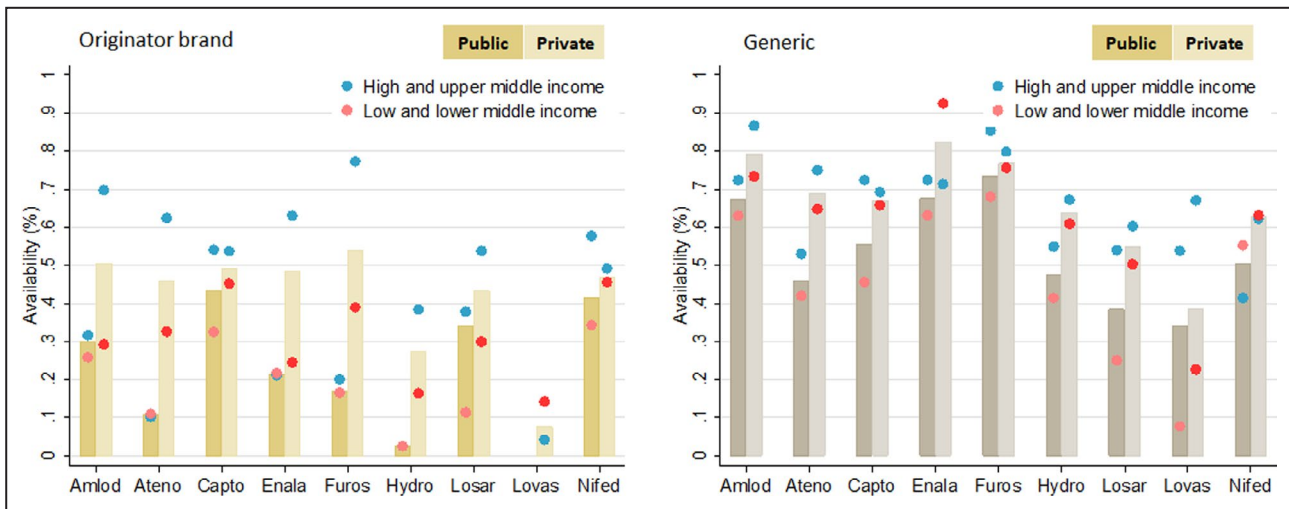


Figure 2. Availability of medicines in the public and private sectors.

Authors' calculation using World Health Organization/Health Action International data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Average availability (%) is the average (arithmetic mean) of availability of all antihypertensive medicines in the country. For countries with multiple years' availability data, only the latest year's data are used. Amlod indicates amlodipine 5 mg; Ateno, atenolol 50 mg; Capto, captopril 25 mg; Enala, enalapril 10 mg; Furos, furosemide 40 mg; Hydro, hydrochlorothiazide 25 mg; Losar, losartan 50 mg; Lovas, lovastatin 20 mg; Nifed, nifedipine 20 mg. Data on public-sector availability for the originator brand lovastatin are absent. See Tables S3 and S4 for availability data by World Health Organization regions and World Bank country groups.

in the public sector and the light-shaded bars represent availability in the private sector. The availability data were also presented for 2 groups of countries: blue dots represent HUMICs, and red dots represent LLMICs. Each of the bars and dots shows the percentage of facilities in which each medicine was available at the time of the survey.

Marked variations in the availability of different medicines are evident. In general, the 2 graphs reveal that (1) availability was higher for generic than brand medicines; (2) availability in the private sector was higher than availability in the public sector; and (3) availability was higher in HUMICs than LLMICs. For brand medicines, the average availability in the public sector was 29% compared with 46% in the private sector (left panel); the average availability of the selected generic medicines in the public sector was 55% compared with 67% in the private sector (right panel).

In HUMICs, the average availability of brand medicines in the public sector was 33% compared with 20% for the LLMICs. The average availability of brand medicines in the private sector was 54% and 34% for the HUMICs and LLMICs, respectively. For generic medicines, the average public-sector availability was 62% and 47% for HUMICs and LLMICs, respectively. The availability in the private sector was 62% and 47% for HUMICs and LLMICs, respectively.

Figure 3 shows cross-country scatterplots of hypertension prevalence plotted against average country availability of generic medicines and brand medicines in the public and private sectors. The dotted lines in the x and y axes represent the

average prevalence and availability across all countries. In these scatterplots, countries in the bottom-right quadrants would have high prevalence and low availability. The scatterplots identify a number of countries, with a high prevalence of hypertension but low availability of generic medicines (eg, Democratic Republic of Congo, Republic of Congo, among others). Increasing availability in these countries would be important for reducing the prevalence and moving them to the upper-left quadrant.

Public-Sector Procurement Price

Figure 4 shows government procurement prices, expressed as the MPR to international reference prices, adjusted for inflation and purchasing power. The darker- and lighter-shaded bars represent government procurement prices for brand and generic medicines, respectively. Compared with the international reference price, the government procurement prices, on average, were 17 times higher for brand medicines, 4.5 times higher for the lowest-priced generic, 21.7 times higher for the brand medicines in the LLMICs, and 13.2 times higher for the brand medicines in the HUMICs. The procurement MPRs for generics were just above 4 for both HUMICs and LLMICs.

The medicine-specific MRPs for the brand medicines ranged from 6.5 to 25.2. Prices for the enalapril and captopril brands were 21.8 and 25.2 times higher than the international reference price, respectively. Among the generics, the MPRs ranged from 1.9 to

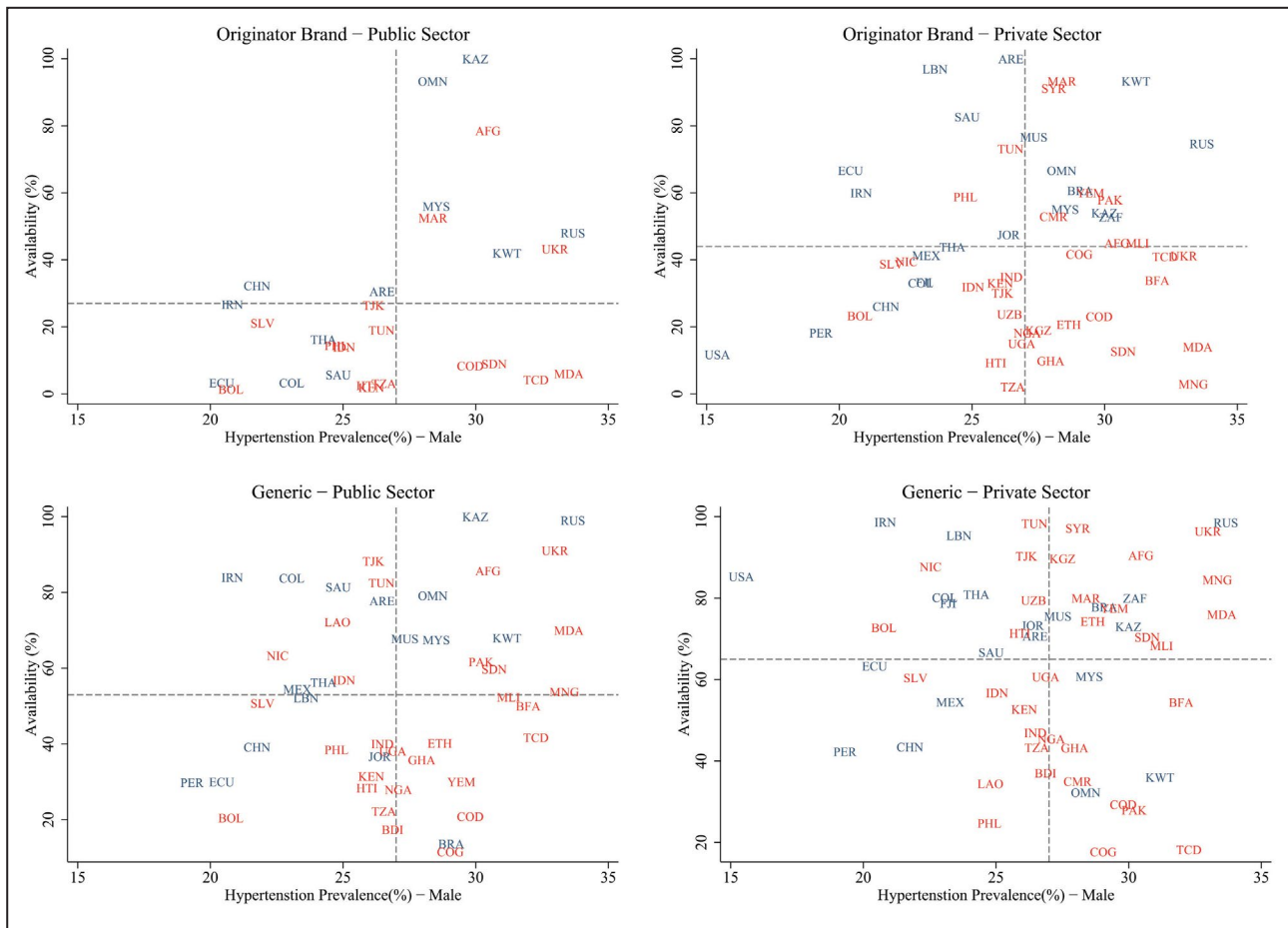


Figure 3. Average availability of select CVD/hypertension medicines vs hypertension prevalence.

Age-standardized cross-country hypertension prevalence data for males and females are available from the 2017 NCD Risk Factor Collaboration (<http://www.ncdrisc.org/data-downloads-blood-pressure.html>). For a particular country, the latest available data for select medicines could be from surveys of different years (eg, 2010 for amlodipine, 2014 for atenolol). In those cases, the latest year’s hypertension prevalence is used to produce availability vs hypertension prevalence scatterplots. The dotted lines in the x and y axes represent the corresponding cross-country averages. Since cross-country male-female prevalence rates correlate well, Figure 3 is produced using the male prevalence data only. Three-digit country codes are used for the data points; blue color fonts are for the HUMICs, and red color fonts are for the LLMICs. The dotted lines in the scatterplots represent the corresponding average availabilities (y axes) and hypertension prevalence (x axes). Country codes—AFG, Afghanistan; ARE, United Arab Emirates, BDI, Burundi; BFA, Burkina Faso; BOL, Bolivia; BRA, Brazil; CHN, China; CMR, Cameroon; COD, Democratic Republic of Congo; COG, Republic of Congo; COL, Colombia; ECU, Ecuador; ETH, Ethiopia; FJI, Fiji; GHA, Ghana; HTI, Haiti; IDN, Indonesia; IND, India; IRN, Iran; JOR, Jordan; KAZ, Kazakhstan; KEN, Kenya; KGZ, Kyrgyzstan; KWT, Kuwait; LAO, Lao PDR; LBN, Lebanon; MAR, Morocco; MDA, Moldova; MEX, Mexico; MLI, Mali; MNG, Mongolia; MUS, Mauritius; MYS, Malaysia; NGA, Nigeria; NIC, Nicaragua; OMN, Oman; PAK, Pakistan; PER, Peru; PHL, Philippines; RUS, Russia; SAU, Saudi Arabia; SDN, Sudan; SLV, El Salvador; SYR, Syria; TCD, Chad; THA, Thailand; TJK, Tajikistan; TUN, Tunisia; TZA, Tanzania; UGA, Uganda; UKR, Ukraine; USA, USA; UZB, Uzbekistan; YEM, Yemen; ZAF, South Africa. CVD indicates cardiovascular disease; HUMICs, high- and upper-middle-income countries; and LLMICs, low- and lower-middle-income countries.

15.6; the procurement prices for hydrochlorothiazide and lovastatin were 10.6 and 15.6 times higher than the international reference price, respectively. Table S5 shows the public-sector procurement prices of the select medicines by WHO regions and WB country groups.

Patient Price

Figure 5 presents prices patients pay in the public and private sectors for the select brand medicines

(left panel) and generic medicines (right panel). Again, the prices are expressed as MPRs relative to the international reference prices for the respective medicines. Overall, average patient MPR for the selected brand medicines was 80.3; the MPRs for brand medicines are much lower in the public sector (23.0) compared with the private sector (98.9). There were marked differences in the public-sector patient prices between HUMICs and LLMICs (ie, MPRs of 9.4 and 46.4, respectively). By contrast, on average,

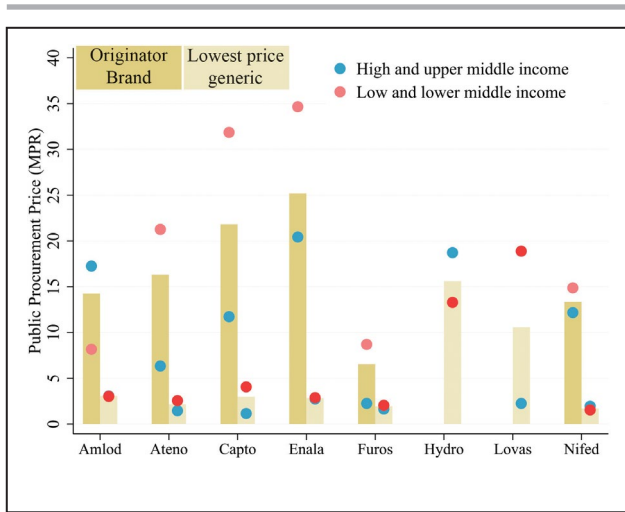


Figure 4. Procurement price in the public sector. Authors’ calculation using World Health Organization/Health Action International data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Countries with multiple years’ data, the latest available year’s data are used, and are converted into 2010 base year price. Amlod, Amlodipine 5 mg; Ateno, atenolol 50 mg; Capto, captopril 25 mg; Enala, enalapril 10 mg; Furos, furosemide 40 mg; Hydro, hydrochlorothiazide 25 mg; Losar, losartan 50 mg; Lovas, lovastatin 20 mg; Nifed, nifedipine 20 mg. Data on procurement prices for the branded hydrochlorothiazide and branded lovastatin were absent. See Table S5 for data by World Health Organization regions and World Bank income groups.

between HUMICs and LLMICs, we observed a modest difference in the private-sector MPRs for brand medicines (ie, 98.0 versus 95.2, respectively). There

were wide variations in the MPRs of individual brand medicines. The public-sector patient prices for captopril and enalapril brand medicines were over 40 times higher than the corresponding international reference prices. The patient prices for brand medicine in the private sector for atenolol, enalapril, furosemide, and lovastatin were 184.4, 179.3, 139.8, and 116.6 times higher than the corresponding international reference prices.

The patient prices for generic medicine were much lower compared with the brand medicines, but still many times higher than the international reference price. The averages of the MPRs for select generic medicines overall, public, and private sectors were 16.7, 8.1, and 26.1, respectively. While between the HUMICs and LLMICs there was a big difference in the public-sector MPRs for the generics (ie, 2.8 versus 11.2), the average MPRs for the selected medicines are similar in the private sector (ie, 25.3). The average patient MPR was higher for patients in LLMICs compared with HUMICs across all medicine categories. Compared with HUMICs, patient prices in public sectors in LLMICs were triple for brand medicines compared with HUMICs (ie, 36.5 times versus 12.1 times) and double for the generics (9.7 times versus 4.5 times). The patient prices in the public and private sectors by WHO regions and WB income groups are reported in Tables S6 and S7, respectively.

In Figure 6, we plotted the public procurement MPRs against the patient price (MPR) in the public sector for the corresponding country/year pairs of data points. In

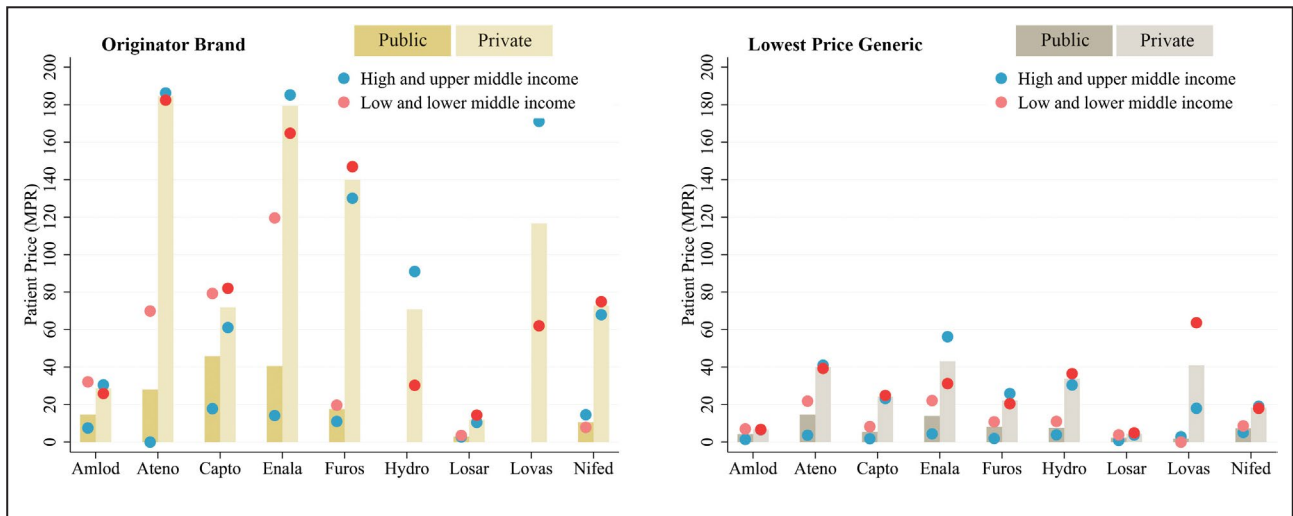


Figure 5. Patient prices in the public and private sector. Authors’ calculation using World Health Organization/Health Action International data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Prices for the latest available year for corresponding countries are used, and are converted into 2010 base year price. Amlod, amlodipine 5 mg; Ateno, atenolol 50 mg; Capto, captopril 25 mg; Enala, enalapril 10 mg; Furos, furosemide 40 mg; Hydro, hydrochlorothiazide 25 mg; Losar, losartan 50 mg; Lovas, lovastatin 20 mg; Nifed, nifedipine 20 mg. Data on procurement prices for the branded hydrochlorothiazide and branded lovastatin were absent. See Tables S6 and S7 for data by World Health Organization regions and World Bank income groups.

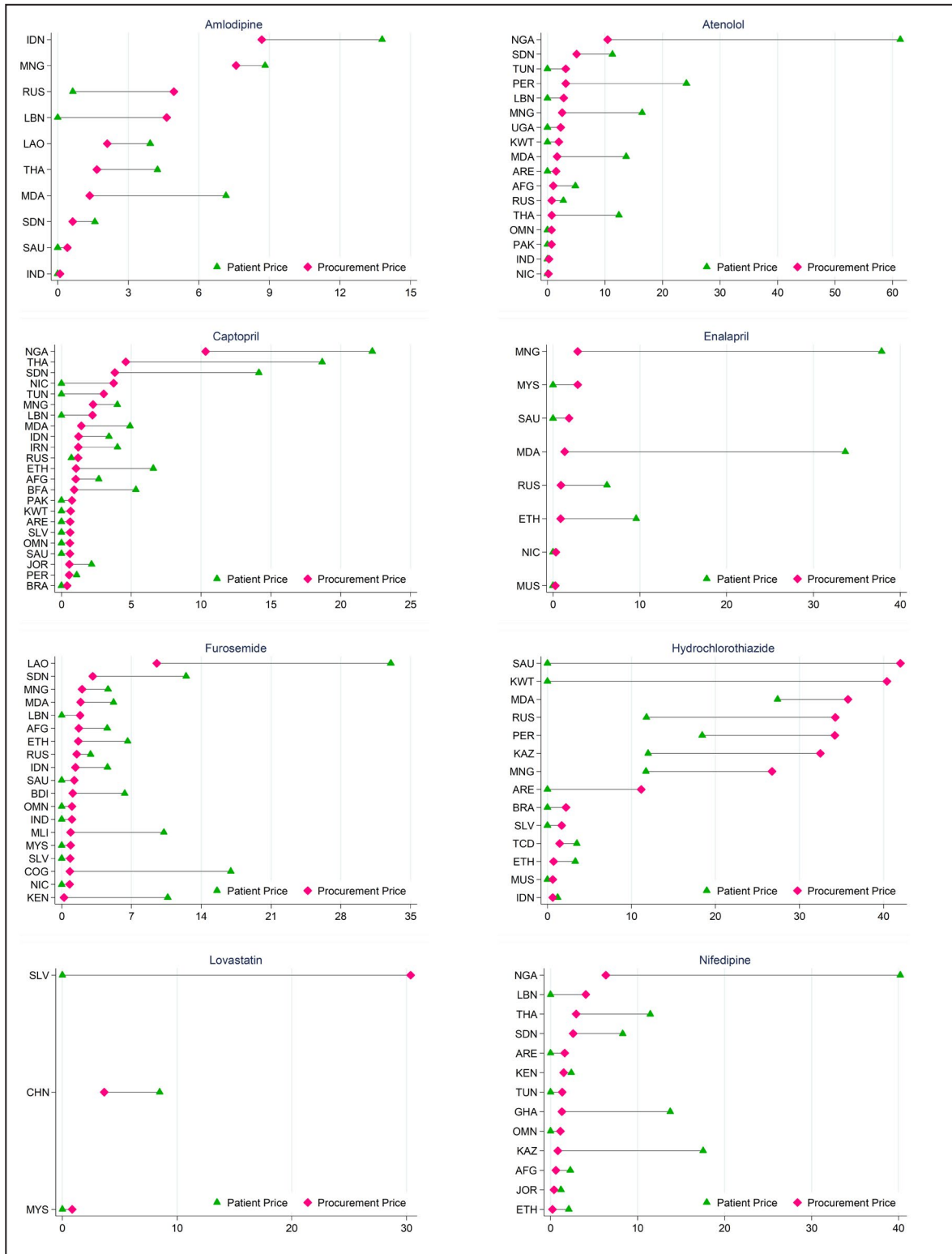


Figure 6. Public procurement price vs patient price in public sector.
The data points are presented with 3-digit country codes and represent the same country/year combination.

general, the public-sector patient prices were higher in the majority of the countries compared with the government procurement prices of the corresponding

medicines. However, while in certain settings, for specific drugs, the patient price is markedly higher than the procurement price, this need not always be the case.

Affordability

One of the compelling ways of illustrating the impact of medicine prices on the cost of health care for individual patients and society is to compare the cost of treatment with people’s actual incomes. Affordability is expressed as the number of days the lowest-paid unskilled government worker would have to work to afford the cost of 1 month’s single antihypertensive or CVD medication treatment.²³

In Figure 7, the y axes in the graphs represent the number of days’ wage needed to cover for 1 month’s cost of corresponding CVD/hypertension medicines. The costs of 1 month’s antihypertensive medications were, on average, 6.0 days’ wages for brand medicine and 1.8 days’ wages for generics. On average, affordability is lower (ie, higher number of days’ wage needed) in LLMICs compared with HUMICs for both brands and generics. For all the medicines analyzed, generics were much more affordable than brand medicines. The affordability data by WHO regions and WB income groups are presented in Table S8 for the public sector and Table S9 for the private sector.

DISCUSSION

The EML is a government-approved list of select medicines that guides the procurement, supply, and use of medicines in the public sector within countries.²⁶ Our study highlights the insufficient availability of CVD and

hypertension medicines in low-resource countries with a high prevalence of hypertension. Further, it shows that the patient prices for generic medicine are much lower compared with that of brand medicines, but still many times higher than the international reference prices. The findings are consistent with earlier literature (eg Wirtz et al and van Mourik et al) in establishing that the availability of medicines tends to be lower in the public sector compared with the private sector and that affordability of brand medicine tends to be lower in the private sector.^{19,21} However, this study shows that while public-sector procurement has high price variability, analysis of prices by income group presents a large discrepancy between LLMICs and HUMICs for the brand medicines (ie, MPRs of 21.7 and 13.2, respectively).

Although ACE inhibitors and statins are priority treatments for CVD, only 70% and 66% of countries analyzed include the treatments on the national EML; about half of the national EMLs from the African region did not include any of the select medicines from these 2 classes. Even though modern β -blockers such as carvedilol and metoprolol (β - and α -blocker) are favored per a 2011 revision to the WHO EML, only 42% of countries included carvedilol and 32% included metoprolol on their EML. The majority of the available country EMLs retrieved from the WHO repository are quite outdated and therefore require updating. Updating country EMLs to include at least 1 representative medication from each of the 5 major

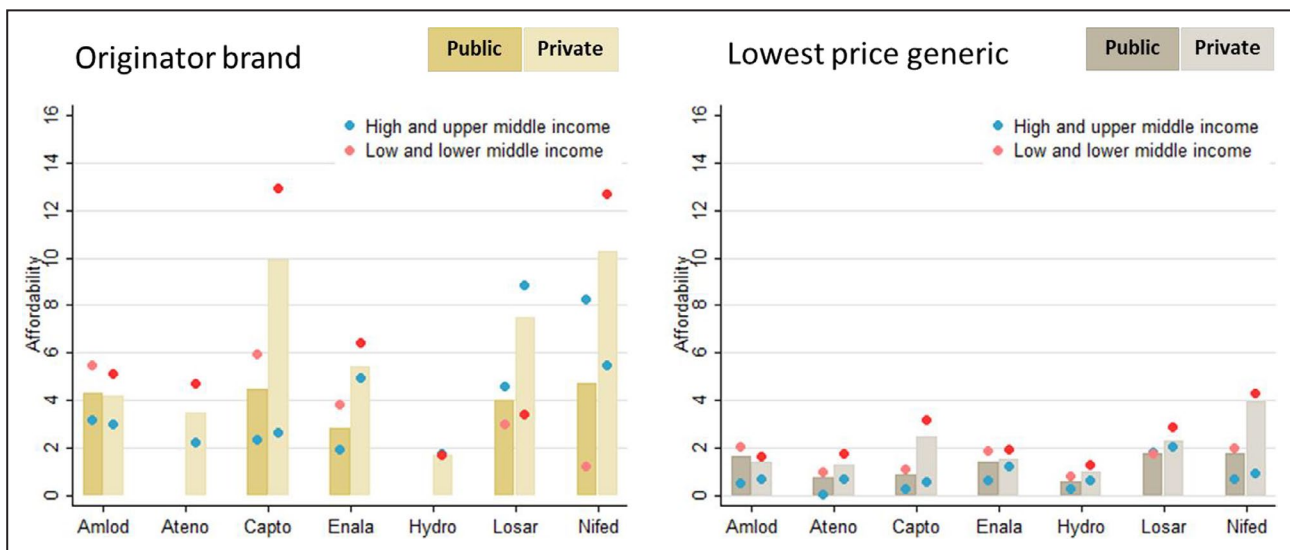


Figure 7. Affordability of select medicines in the public and private sector.

Authors’ calculation using World Health Organization/Health Action International data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Countries with affordability data for multiple years, only the latest year data are used. Amlod, amlodipine 5 mg; Ateno, atenolol 50 mg; Capto, captopril 25 mg; Enala, enalapril 10 mg; Furos, furosemide 40 mg; Hydro, hydrochlorothiazide 25 mg; Losar, losartan 50 mg; Lovas, lovastatin 20 mg; Nifed, nifedipine 20 mg. The country- and year-specific data on wages are provided in the World Health Organization/Health Action International website. See Tables S8 and S9 for data by World Health Organization regions and World Bank income groups.

CVD/hypertension drug treatment classes (ACE inhibitors, β -blockers, calcium channel blockers, thiazide/thiazide-like diuretic, and statin) can support hypertension management programs and efforts to increase hypertension control rates. Establishment of systematic and transparent procedures for defining the national list(s) of essential medicines, updated in regular intervals, is a critical first step in modernizing EMLs to add essential CVD drugs.²⁷ Inclusion of a CVD or hypertension treatment on a national EML focused attention on procuring the treatment and is associated with increased availability and affordability indices.^{13,15}

The procurement, availability, and accessibility of pharmaceuticals is an ongoing challenge for many health systems. However, CVD and hypertension for the majority of the population can be treated with a small number of carefully selected medicines on countries' EMLs. Recent advances in the pharmacologic treatment of CVD/hypertension entail fixed-dose combination drugs that include ≥ 2 active drug ingredients combined in a single-dosage form, which has the potential to transform the delivery of care by improving access, affordability, and patient adherence to essential treatment.^{28,29} Fixed-dose combinations for CVD, also known as the polypill, have been proposed for inclusion in the model list of essential medicines.²⁹ Use of these combinations for secondary prevention and primary prevention in high-risk individuals could close gaps in treatment of these conditions by reducing drug

costs, improving adherence and simplifying the drug regimen for patients who take them and healthcare workers who prescribe them.²⁸

Our findings on the presence of CVD/hypertension medicines on EMLs are based on 53 EMLs written in English; transcribing of the national EMLs written in other languages was beyond the scope of the study. It should also be noted that the inclusion of a medication on a country EML does not necessarily imply that the medicine is procured by the country, is procured in the proper dosage for treatment, or is of the right quality. Our analysis sought to examine only the minimum criteria of basic inclusion on EMLs. Narrowing the inclusion criteria to specific dosage strengths and product presentations would have reduced the number of countries with the medication present but may provide a more granular depiction of products included. This should be explored in future research, as a high variance in the reported dosage and product forms were seen across different country EMLs. Another limitation to the EML analysis is that it surveyed only CVD/hypertension medications, while treatment for CVD is often also reliant on specific medical technologies and devices. Almost no systematic data are currently available on the devices and medical technologies (eg externally validated blood pressure measurement devices) that governments require to be present in-country, with many not including this information within country EMLs. Additionally, the presence of a device

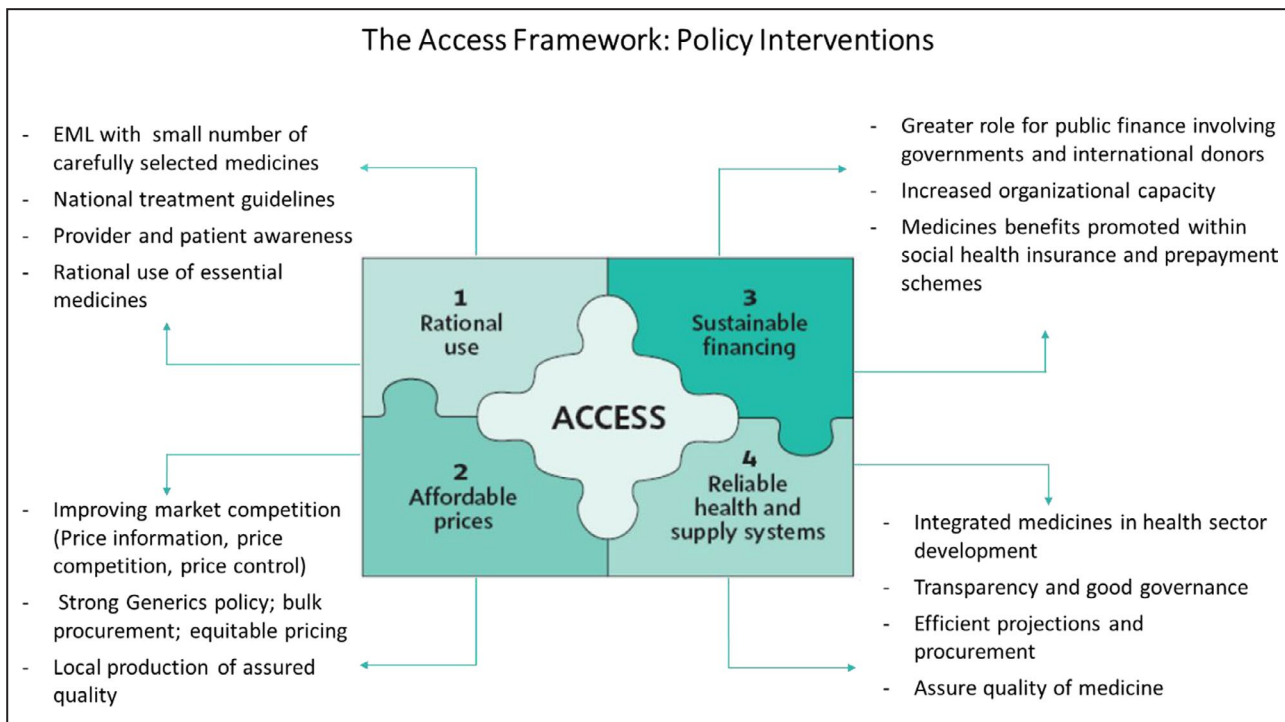


Figure 8. The World Health Organization access to drugs and medicine framework. The figure has been recreated using contents from the World Health Organization.³²

on the EML and even its procurement by a country at some point does not necessarily ensure that it is operable or in appropriate working condition.

Our availability, price, and affordability analyses revealed considerable variations by medicine, public versus private sector, and brand versus generics. Patients in LLMICs faced higher prices and lower affordability compared with HUMICs for both branded and generic medicines, though generic medicines were more affordable than branded drugs in all countries evaluated. This warrants actions to increase access to medicines that can include the use of effective generics and efficient procurement mechanisms. The WHO estimates show that public-sector availability of essential medicines caters to only one-third of population needs, while private-sector availability caters to the remaining two-thirds. India is an example where 70% of health care is through the private or informal sector. Given that some LLMICS reported higher availability and lower prices for some CVD/hypertension medicines, it is possible to improve access to quality-assured, affordable essential medicines. This requires stronger partnerships among governments, pharmaceutical companies, nongovernmental organizations, civil society, and donors, including consumers.²⁶ The WHO has formulated a 4-part framework to guide and coordinate collective action on access to essential medicines.^{30–32} Figure 8 summarizes the elements in the access to medicine framework.

The first critical element in the access framework entails ensuring the rational selection and use of essential medicines with proven efficacy, safety, quality, and cost-effectiveness.³² The next step entails the affordable provisioning of those medicines. This can be achieved with a variety of management, regulatory, and policy interventions, including use of available and impartial price information; allowing price competition in the local market; promoting bulk procurement; implementing strong generics policies; negotiating equitable pricing for newer essential medicines; undertaking price negotiation for newly registered essential medicines; eliminating trade barriers on essential medicines; reducing markups through more efficient distribution and dispensing systems; encouraging local production of essential medicines of assured quality; and including WTO Trade-Related Aspects of Intellectual Property Rights compatible safeguards into national legislation.³² In countries where the patient prices in the public sector are considerably higher compared with the public procurement prices, identification of factors contributing to the price differences is critical, which may include low availability (ie, small quantities being procured), lack of coordination and stock outages, lack of transparency and poor governance, and inefficiency in the procurement process and supply chain. The success of CVD and hypertension control initiatives will, therefore, depend on identifying and then

addressing barriers to accessing CVD-related medications at the primary healthcare level. Long-term use of medications for CVD and hypertension management and treatment is contingent on sustainable financing, which requires an expanded role of public finance involving governments, nongovernmental organizations, and donors. On the basis of the established medication guidelines, public funding for target medicines needs to be increased, including exploring opportunities for external funding (eg, grants, loans, and donations) and other financing mechanisms, such as debt relief, solidarity, and pooled funds. The fourth element in the access framework entails the presence of a reliable health and supply system. Reliable supply systems require integrating medicines in the health-sector development plan, creating efficient public–private–nongovernmental organization mix approaches in supply delivery, assuring the quality of medicines through regulatory control, and exploring various purchasing schemes such as procurement cooperatives. Critical elements of a reliable health system include transparency and good governance in the selection, procurement, and use of affordable and effective generic drugs.

ARTICLE INFORMATION

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Supplementary Materials

Tables S1–S9

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SUPPLEMENTAL MATERIAL

Table S1. WHO Health Action International (HAI) Database: Country Surveys.

WHO regions/ World Bank Income groups	High-Income countries	Low-income countries	Lower-middle-income Countries	Upper-middle-income countries
AFRO countries		Burundi (2013) ^{av, prp, ptp, af} Burkina Faso (2009) ^{av, prp, ptp, af} Dem. Rep. of Congo (2007) ^{av, ptp, af} Ethiopia (2004, 2013) ^{av, prp, ptp, af} Mali (2004) ^{av, prp, ptp, af} Chad (2004) ^{av, prp, ptp, af} Tanzania (2004) ^{av, prp, ptp} , (2012) ^{av, ptp, af} Uganda (2004) ^{av, prp, ptp, af} (2015) ^{av, ptp, af}	Cameroon (2002) ^{av} Cameroon (2005) ^{av, prp, ptp, af} Congo (2007) ^{av, prp, ptp, af} Ghana (2004) ^{av, prp, ptp, af} Ghana (2002) ^{af} Kenya (2001) ^{prp, af} (2004) ^{av, prp, ptp} Nigeria (2004) ^{av, prp, ptp, af} Sao Tom en Principe (2008) ^{af}	Mauritius (2008) ^{av, prp, ptp, af} South Africa (2004, 2011) ^{av, prp, ptp, af}
AMRO countries	USA (2015) ^{av, ptp}	Haiti (2011) ^{av, ptp, af}	Bolivia (2008) ^{av, ptp, af} Nicaragua (2008) ^{av, prp, ptp, af} El Salvador (2006) ^{av, prp, ptp, af}	Brazil (2008) ^{av, ptp, af} ; (2001) ^{prp, af} Colombia (2008) ^{av, ptp, af} Ecuador (2008) ^{av, ptp, af} Mexico (2009) ^{av, ptp, af} Peru (2005) ^{av, prp, ptp, af} , (2002) ^{af}
EMRO countries	United Arab Emirates (2006) ^{av, prp, ptp, af} Kuwait (2004) ^{av, prp, ptp, af} Oman (2007) ^{av, prp, ptp, af} Saudi Arabia (2015) ^{av, prp, ptp, af}	Afghanistan (2011) ^{av, prp, ptp, af}	Morocco (2004) ^{av, prp, ptp, af} Pakistan (2004) ^{av, prp, ptp} Sudan (2005) ^{av, af} , (2006, 2013) ^{av, prp, ptp, af} , Sudan (2012) ^{prp, af} Syria (2003) ^{av, prp, af} Tunisia (2004) ^{av, prp, ptp, af} Yemen (2006) ^{av, ptp, af} Egypt (2013) ^{prp, af}	Iran (2014) ^{av, prp, af} Iran (2007) ^{av, prp, ptp, af} Jordan (2004) ^{av, prp, ptp, af} Lebanon (2004) ^{av, prp, ptp, af} Lebanon (2013) ^{av, prp, ptp, af}
EURO countries			Armenia (2001) ^{af} Kyrgyzstan (2010, 2015) ^{av, prp, ptp, af} , (2005) ^{av, af} Moldova (2011) ^{av, prp, ptp, af} Tajikistan (2013) ^{av, ptp, af} Ukraine (2012) ^{av, ptp, af} Ukraine (2007) ^{av, prp, ptp, af} Uzbekistan (2004) ^{av, prp, af}	Kazakhstan (2004) ^{av, ptp, af} Kazakhstan (2010) ^{prp} Kazakhstan (2005) ^{prp} Kazakhstan (2015) ^{prp} Russia (2011) ^{av, prp, ptp, af}
SEARO countries			Indonesia (2010) ^{av, prp, ptp, af} Indonesia (2004) ^{av, ptp, af} India (2004, 2011) ^{av, prp, ptp, af} India (2005) ^{av, ptp} India (2003) ^{prp}	Thailand (2006) ^{av, prp, ptp, af}
WPRO countries			Lao PDR (2013) ^{av, prp, ptp, af} Mongolia (2012) ^{av, prp, ptp, af} Philippines (2005) ^{av, ptp, af} Philippines (2008) ^{prp} , (2002) ^{af}	China (2014) ^{av, prp, ptp, af} , (2012) ^{av, prp, ptp} , (2006) ^{av, prp, af} Fiji (2004) ^{av, prp, ptp} Malaysia (2004) ^{av, prp, ptp, af}

AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. Superscripts (*av*: availability, *prp*: procurement price, *ptp*: patient price, *af*: affordability) indicate the presence of any data for any selected medicine on the corresponding indicators. India surveys are regional surveys: 2004 in West Bengal; 2005 in 4 regions of Maharashtra; 2011 in NCT, Delhi. Similarly, China conducted regional surveys: 2006 in Shanghai; 2012 and 2014 in Shaanxi Province. For WB country classification, see WB Country and Lending Groups: Country Classification at <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>.

Table S2. Presence of Select CVD/Hypertension Medicines in Country EMLs.

WHO Region	Country (EML year)	ACE Inhibitor	Beta-blocker			Calcium channel blocker		Thiazide Diuretic		Statin			
		Enalapril	Atenolol	Carvedilol	Metoprolol	Nifedipine	Amlodipine	Chlorthalidone	Hydrochlorothiazide	Atorvastatin	Lovastatin	Pravastatin	Simvastatin
AFRO	Algeria (2006)	√	√		√	√	√		√	√		√	√
AFRO	Angola (2008)					√							
AFRO	Botswana (2012)	√	√	√	√	√	√		√	√			
AFRO	Burundi (2012)	√	√	√		√			√				
AFRO	CAR (2009)	√	√			√	√		√				√
AFRO	Chad (2007)		√			√			√				
AFRO	Congo (2013)	√	√			√			√				
AFRO	Cote d'Ivoire (n.d)	√	√	√		√	√		√	√		√	
AFRO	Dem. Congo (2010)	√	√			√	√	√	√				√
AFRO	Eritrea (2010)	√	√			√	√		√	√			√
AFRO	Ethiopia (2015)	√	√		√	√	√		√	√			√
AFRO	Ghana (n.d.)		√			√	√			√			√
AFRO	Kenya (2016)	√	√			√	√		√				
AFRO	Lesotho (2005)		√			√			√				
AFRO	Mali (2008)		√			√			√				
AFRO	Mauritania (2007)		√			√			√				
AFRO	Namibia (2008)		√			√			√				
AFRO	Nigeria (2010)		√			√	√		√				
AFRO	Rwanda (2010)		√			√	√		√				
AFRO	Senegal (2008)		√			√	√		√				
AFRO	South Africa (2014)	√	√	√		√	√		√	√			√
AFRO	Tanzania (2013)	√	√	√	√	√	√		√				√
AFRO	Togo (2012)	√	√			√	√		√				√
AFRO	Uganda (2007)		√			√							
AFRO	Zambia (2013)	√	√	√	√	√	√		√				√
EMRO	Afghanistan (2007)	√	√			√	√		√				√
EMRO	Djibouti (2007)	√				√			√				
EMRO	Egypt (2006)		√			√			√	√			
EMRO	Iran (2009)	√	√	√	√	√	√	√	√	√	√		√
EMRO	Iraq (2010)	√	√	√	√	√	√	√	√	√			√
EMRO	Lebanon (2010)		√				√						√
EMRO	Morocco (2008)	√	√	√		√	√		√				√
EMRO	Oman (2009)	√	√	√		√	√		√	√		√	√
EMRO	Pakistan (2007)	√	√			√	√		√				√
EMRO	Somalia (2006)		√						√				
EMRO	Sudan (2007)	√	√	√	√	√	√		√	√		√	√
EMRO	Tunisia (2008)	√	√	√	√	√	√	√	√	√		√	√
AMRO	Guyana (2010)	√	√		√	√	√		√	√			
AMRO	Haiti (2012)	√		√		√	√		√				
AMRO	Honduras (2011)	√	√	√		√	√						
AMRO	Mexico (2009)	√		√	√	√	√			√		√	√
AMRO	Paraguay (2009)	√	√	√		√	√		√	√			
AMRO	Peru (2010)	√	√	√		√	√		√	√			√
SEARO	Bhutan (2012)	√	√	√	√	√	√		√	√			
SEARO	India (2011)	√	√		√	√	√	√	√	√			
SEARO	Indonesia (2008)		√			√			√				√
SEARO	Myanmar (n.d)	√	√	√	√	√	√	√	√	√			√
SEARO	Nepal (2009)	√	√			√	√		√	√			
SEARO	Sri Lanka (2009)	√	√	√		√			√	√			
SEARO	Thailand (2012)	√	√	√	√	√	√		√	√			√
SEARO	Timor-Leste (2004)		√			√	√		√				
WPRO	Malaysia (2008)	√	√		√	√			√		√		
WPRO	Philippines (2008)	√	√	√	√	√	√		√				√
Percent of countries (n=53 EMLs)		70%	92%	42%	32%	96%	72%	11%	89%	43%	4%	11%	47%

WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region.

Table S3. Public Sector Availability.

Country Group	Amlodipine	Atenolol	Captopril	Enalapril	Furosemide	Hydrochloro thiazide	Losartan	Lovastatin	Nifedipine
	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)
Generic									
All Country	67 (6, 100) (17)	46 (3, 100) (36)	56 (4, 100) (40)	68 (21, 100) (15)	73 (8, 100) (32)	47 (6, 100) (27)	38 (2, 93) (15)	34 (4, 100) (7)	50 (5, 100) (20)
WHO Regions									
AFRO		15 (3, 32) (9)	22 (4, 75) (10)	60 (21, 100) (2)	56 (8, 95) (8)	41 (6, 100) (6)	3 (3, 3) (2)		45 (8, 93) (8)
AMRO	32 (6, 93) (4)	14 (3, 22) (6)	49 (4, 97) (9)	47 (35, 70) (5)	70 (39, 100) (7)	43 (9, 100) (6)	42 (15, 93) (4)	37 (4, 100) (3)	
EMRO	89 (83, 94) (4)	77 (17, 100) (10)	78 (30, 100) (12)	91 (91, 91) (1)	82 (64, 100) (7)	32 (6, 78) (6)	37 (7, 80) (4)		55 (93, 5) (7)
EURO	94 (90, 100) (3)	88 (62, 100) (4)	84 (62, 100) (4)	92 (88, 100) (4)	98 (92, 100) (4)	79 (26, 100) (5)	92 (93, 91) (2)		90 (80, 100) (2)
SEARO	80 (70, 90) (3)	59 (10, 88) (3)	66 (35, 98) (2)		75 (67, 83) (2)	49 (8, 91) (2)	23 (5, 40) (2)	9 (7, 11) (2)	20 (11, 30) (2)
WPRO	47 (83, 15) (3)	33 (5, 61) (4)	55 (46, 60) (3)	67 (60, 74) (3)	74 (54, 100) (4)	47 (29, 65) (2)	25 (25, 25) (1)	56 (11, 100) (2)	38 (38, 38) (1)
WB Groups									
HIC	94 (94, 94) (1)	95 (92, 100) (3)	91 (67, 100) (4)	91 (91, 91) (1)	96 (91, 100) (2)	53 (16, 78) (3)	46 (46, 46) (1)		44 (17, 72) (2)
LIC	6 (6, 6) (1)	26 (3, 86) (7)	39 (6, 100) (8)	28 (21, 35) (2)	55 (8, 95) (8)	51 (39, 74) (3)	3 (3, 3) (1)		43 (8, 93) (5)
LMIC	70 (7, 91) (8)	49 (8, 100) (16)	49 (4, 100) (17)	75 (39, 90) (11)	75 (23, 100) (14)	39 (6, 91) (12)	28 (2, 91) (7)	8 (6, 11) (3)	63 (8, 03) (8)
UMIC	69 (15, 100) (7)	40 (3, 100) (10)	66 (18, 100) (11)	69 (37, 100) (6)	83 (57, 100) (8)	56 (6, 100) (9)	55 (7, 93) (6)	54 (4, 100) (4)	40 (5, 100) (5)
Originator Brand									
All Country	30 (3, 70) (10)	11 (1, 30) (10)	43 (2, 100) (12)	21 (3, 50) (5)	17 (3, 88) (9)	2 (1, 4) (3)	34 (3, 90) (7)		41 (3, 93) (13)
WHO Regions									
AFRO					3 (3, 3) (1)	3 (2, 4) (2)			9 (3, 14) (2)
AMRO	3 (3, 3) (1)	2 (1, 2) (3)	3 (2, 3) (2)	3 (3, 3) (1)	7 (4, 10) (2)		3 (3, 3) (1)		52 (52, 52) (1)
EMRO	16 (6, 27) (2)	12 (4, 17) (3)	21 (11, 30) (2)		46 (3, 88) (2)		72 (--) (1)		60 (19, 93) (6)
EURO	35 (6, 67) (3)		84 (62, 100) (4)	31 (3, 50) (3)	17 (14, 20) (2)		12 (11, 13) (2)		50 (50, 50) (1)
SEARO	28 (15, 40) (2)	20 (10, 30) (2)	11 (2, 20) (2)		4 (--) (1)	1 (1, 1) (1)	20 (20, 20) (1)		7 (7, 7) (1)
WPRO	52 (34, 70) (2)	13 (10, 15) (2)	58 (15, 100) (2)	10 (10, 10) (1)	8 (--) (1)		59 (28, 90) (2)		27 (19, 35) (2)
WB Groups									
HIC	6 (6, 6) (6)	10 (4, 17) (2)	11 (11, 11) (1)				72 (72, 72) (1)		65 (22, 93) (3)
LIC		2 (2, 2) (1)	2 (2, 2) (1)		32 (3, 88) (3)	4 (4, 4) (1)			29 (3, 69) (3)
LMIC	26 (6, 40) (3)	13 (1, 30) (5)	39 (2, 83) (5)	22 (3, 40) (2)	8 (3, 14) (5)	2 (1, 2) (2)	11 (11, 11) (1)		37 (7, 75) (6)
UMIC	36 (3, 70) (6)	10 (10, 10) (2)	63 (3, 100) (5)	21 (3, 50) (3)	20 (20, 20) (1)		31 (3, 90) (5)		35 (35, 35) (1)

Authors' calculation using WHO/HAI data obtained from <http://www.haiweb.org/MedPriceDatabase/>. For countries with multiple years' availability data, only the latest year's data are used. WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. WB country groups: HIC: High-income countries; LIC: Low-income countries; LMIC: Lower-middle-income countries; UMIC: Upper-middle-income countries.

Table S4. Private Sector Availability.

Country Group	Amlodipine	Atenolol	Captopril	Enalapril	Furosemide	Hydrochloro thiazide	Losartan	Lovastatin	Nifedipine
	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)
Generic									
All Country	79 (19, 100) (21)	69 (2, 100) (49)	67 (3, 100) (51)	83 (34, 100) (17)	77 (6, 100) (35)	64 (3, 100) (33)	55 (7, 100) (24)	39 (2, 97) (14)	63 (3, 100) (32)
WHO Regions									
AFRO	19 (19, 19) (1)	51 (4, 87) (11)	47 (5, 88) (14)	87 (73, 100) (2)	67 (13, 100) (8)	56 (16, 100) (6)	32 (7, 50) (4)	9 (4, 12) (3)	61 (19, 100) (10)
AMRO	76 (40, 93) (6)	56 (7, 100) (10)	83 (57, 100) (9)	88 (73, 100) (6)	80 (47, 100) (8)	54 (3, 81) (8)	61 (9, 92) (5)	53 (31, 93) (3)	19 (19, 19) (1)
EMRO	99 (97, 100) (4)	90 (56, 100) (12)	66 (3, 100) (14)	37 (37, 37) (1)	85 (50, 98) (7)	76 (40, 100) (6)	61 (13, 100) (8)	55 (13, 97) (55)	69 (3, 100) (10)
EURO	90 (76, 97) (4)	90 (58, 100) (7)	92 (74, 100) (7)	95 (88, 100) (5)	94 (80, 100) (6)	80 (46, 100) (7)	70 (10, 100) (3)		80 (65, 91) (4)
SEARO	86 (67, 95) (3)	65 (2, 98) (3)	53 (10, 97) (2)		46 (6, 86) (2)	45 (32, 58) (2)	56 (50, 62) (2)	18 (10, 26) (2)	64 (52, 75) (2)
WPRO	56 (37, 94) (3)	58 (10, 100) (6)	68 (16, 100) (5)	64 (34, 97) (3)	66 (35, 94) (4)	57 (47, 65) (4)	35 (18, 53) (2)	52 (2, 86) (4)	49 (6, 81) (5)
WB Groups									
HIC	97 (97, 97) (1)	86 (56, 100) (4)	33 (3, 71) (5)	37 (37, 37) (1)	50 (50, 50) (1)	88 (77, 100) (2)	83 (83, 83) (1)	--	36 (3, 70) (2)
LIC	44 (19, 69) (2)	56 (10, 98) (7)	60 (18, 94) (9)	80 (73, 86) (2)	73 (56, 100) (8)	83 (66, 100) (2)	38 (25, 50) (2)	8 (4, 12) (2)	64 (19, 100) (6)
LMIC	79 (37, 100) (10)	67 (2, 100) (22)	68 (5, 100) (22)	96 (88, 100) (7)	77 (6, 100) (17)	58 (16, 95) (16)	53 (7, 100) (11)	27 (2, 97) (7)	63 (6, 95) (16)
UMIC	85 (38, 100) (8)	72 (7, 100) (16)	81 (16, 100) (15)	76 (34, 100) (7)	83 (47, 100) (9)	64 (3, 100) (13)	58 (9, 100) (10)	67 (35, 93) (5)	69 (46, 98) (8)
Originator Brand									
All Country	50 (3, 100) (19)	46 (1, 100) (40)	49 (1, 100) (41)	49 (3, 100) (8)	54 (4, 98) (28)	27 (2, 75) (6)	43 (2, 100) (25)	8 (1, 29) (9)	47 (2, 100) (29)
WHO Regions									
AFRO		28 (2, 90) (12)	38 (2, 70) (10)		40 (10, 85) (6)	21 (2, 46) (4)	25 (4, 83) (4)		44 (85, 2) (9)
AMRO	42 (3, 67) (5)	38 (11, 77) (9)	27 (6, 48) (8)	36 (16, 60) (3)	54 (17, 93) (8)		33 (13, 42) (4)	5 (2, 8) (3)	69 (69, 69) (1)
EMRO	66 (6, 100) (4)	69 (4, 100) (11)	76 (2, 100) (11)	47 (47, 47) (1)	75 (6, 98) (6)	5 (5, 5) (1)	71 (15, 100) (8)	29 (29, 29) (1)	63 (3, 100) (11)
EURO	34 (3, 73) (4)	80 (80, 80) (1)	70 (38, 100) (6)	53 (3, 100) (3)	31 (4, 97) (4)	75 (75, 75) (1)	13 (3, 20) (3)	5 (5, 5) (1)	19 (19, 19) (1)
SEARO	67 (76, 53) (3)	43 (23, 62) (3)	6 (8, 5) (2)		78 (63, 94) (2)		26 (2, 67) (3)	8 (8, 8) (1)	11 (8, 16) (3)
WPRO	49 (3, 88) (3)	51 (1, 78) (4)	37 (1, 66) (4)	75 (--) (1)	56 (38, 75) (2)		55 (36, 88) (3)	3 (1, 6) (3)	36 (16, 56) (4)
WB Groups									
HIC	100 (--) (1)	73 (18, 100) (4)	73 (6, 100) (4)	47 (--) (1)	86 (78, 93) (2)	--	88 (77, 100) (2)		80 (44, 100) (3)
LIC	3 (--) (1)	20 (2, 47) (7)	19 (2, 55) (7)	--	32 (10, 98) (5)	46 (45, 46) (1)	5 (5, 5) (1)		48 (2, 76) (4)
LMIC	33 (3, 72) (8)	39 (4, 91) (15)	58 (8, 100) (15)	25 (3, 54) (3)	42 (4, 94) (12)	2 (2, 2) (2)	32 (2, 100) (10)	14 (6, 29) (3)	45 (3, 100) (15)
UMIC	66 (37, 100) (9)	59 (1, 97) (14)	49 (1, 100) (15)	67 (33, 100) (4)	75 (38, 97) (9)	38 (5, 75) (3)	48 (3, 93) (12)	4 (1, 8) (6)	36 (5, 95) (7)

Authors' calculation using WHO/HAI data obtained from <http://www.haiweb.org/MedPriceDatabase/>. For countries with multiple years' availability data, only the latest year's data are used. WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. WB country groups: HIC: High-income countries; LIC: Low-income countries; LMIC: Lower-middle-income countries; UMIC: Upper-middle-income countries.

Table S5. Public Sector Procurement Price.

Country Groups	Amlodipine	Atenolol	Captopril	Enalapril	Furosemide	Hydrochlorothiazide	Lovastatin	Nifedipine
	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)
Lowest Price Generic								
All Country	3.0 (0.1, 8.7) (15)	2.1 (0.2, 10.5) (32)	3.0 (0.3, 32.0) (35)	2.8 (0.3, 11.1) (11)	1.9 (0.2, 9.5) (28)	15.6 (0.6, 54.4) (26)	10.6 (0.9, 30.4) (4)	1.7 (0.2, 6.4) (23)
WHO Regions								
AFRO		3.6 (0.5, 10.5) (7)	3.7 (0.9, 10.3) (7)	0.6 (0.3, 0.9) (2)	0.9 (0.2, 1.7) (7)	5.0 (0.6, 24.2) (7)		1.6 (0.2, 6.4) (7)
AMRO		1.7 (0.2, 3.2) (2)	1.3 (0.4, 3.7) (4)	0.3 (0.3, 0.3) (1)	1.1 (0.8, 1.7) (3)	12.7 (1.7, 34.2) (3)	30.4 (30.4, 30.4) (1)	
EMRO	1.5 (0.4, 4.6) (5)	1.8 (0.6, 5.1) (12)	3.7 (0.6, 32.0) (14)	1.8 (1.8, 1.8) (1)	2.2 (1.0, 4.0) (8)	27.0 (3.6, 54.4) (6)	7.4 (7.4, 7.4) (1)	1.7 (0.4, 4.1) (9)
EURO	2.2 (0.2, 4.9) (3)	1.7 (0.5, 4.2) (6)	1.9 (0.3, 4.1) (5)	1.0 (0.8, 1.4) (3)	1.9 (1.2, 2.9) (4)	20.6 (5.8, 35.8) (6)		1.4 (0.4, 3.1) (3)
SEARO	3.5 (0.1, 8.7) (3)	0.5 (0.3, 0.8) (2)	2.9 (1.2, 4.6) (2)	6.2 (2.9, 11.1) (4)	1.2 (1.0, 1.4) (2)	0.6 (0.6, 0.6) (1)		1.8 (0.7, 3.0) (2)
WPRO	5.4 (2.1, 7.6) (4)	2.4 (0.6, 4.1) (3)	2.1 (0.3, 3.7) (3)		4.2 (0.9, 9.5) (4)	15.5 (0.6, 26.7) (3)	2.3 (0.9, 3.7) (2)	2.3 (0.2, 4.4) (2)
WB Groups								
HIC	0.4 (0.4, 0.4) (1)	1.4 (0.7, 2.0) (3)	0.6 (0.6, 0.7) (4)	1.8 (1.8, 1.8) (1)	1.2 (1.0, 1.3) (2)	31.2 (11.2, 42.0) (3)		1.4 (1.1, 1.6) (2)
LIC		1.1 (0.5, 2.3) (5)	1.6 (0.9, 2.8) (5)	0.9 (0.9, 0.9) (1)	1.3 (0.9, 1.7) (5)	1.7 (0.7, 2.9) (3)		0.5 (0.2, 0.7) (3)
LMIC	3.0 (0.1, 8.7) (9)	3.0 (0.2, 10.5) (15)	4.8 (0.3, 32.0) (17)	3.3 (0.3, 11.1) (5)	2.3 (0.2, 9.5) (15)	16.2 (0.6, 54.4) (12)	18.9 (7.4, 30.4) (2)	1.8 (0.2, 6.4) (11)
UMIC	3.6 (0.5, 6.3) (5)	1.5 (0.6, 3.2) (9)	1.4 (0.3, 4.6) (9)	3.0 (0.3, 7.9) (4)	1.8 (0.9, 4.0) (6)	14.0 (0.6, 34.2) (8)	2.3 (0.9, 3.7) (2)	2.1 (0.2, 4.4) (7)
Originator Brand								
All Country	14.2 (1.4, 24.3) (6)	16.3 (6.3, 32.4) (3)	21.8 (12) (6.1, 94.1)	25.2 (14.0, 34.6) (3)	6.5 (2.3, 15.1) (3)			13.3 (2.4, 30.7) (7)
WHO Regions								
AFRO			32.0 (32.0, 32.0) (1)					
AMRO								
EMRO	11.5 (1.4, 18.7) (3)	8.2 (6.3, 10.1) (2)	31.9 (8.8, 94.1) (4)	26.9 (26.9, 26.9) (1)	2.3 (2.3, 2.3) (2)			8.7 (2.4, 23.2) (5)
EURO			9.8 (8.1, 11.8) (4)	14.0 (14.0, 14.0) (1)				
SEARO			19.5 (19.5, 19.5) (1)					
WPRO	16.9 (11.6, 24.3) (3)	32.4 (32.4, 32.4) (1)	21.5 (6.1, 37.0) (2)	34.6 (34.6, 34.6) (1)	15.1 (15.1, 15.1) (1)			24.9 (19.0, 30.7) (2)
WB Groups								
HIC	14.5 (14.5, 14.5) (1)	6.3 (6.3, 6.3) (1)	12.4 (12.4, 12.5) (2)	26.9 (26.9, 26.9) (1)				6.0 (5.4, 6.7) (3)
LIC					2.3 (2.3, 2.3) (1)			2.4 (2.4, 2.4) (1)
LMIC	8.2 (1.4, 14.9) (2)	21.3 (10.1, 32.4) (2)	31.9 (8.8, 94.1) (6)	34.6 (34.6, 34.6) (1)	15.1 (15.1, 15.1) (1)			21.1 (19.0, 23.2) (2)
UMIC	18.2 (11.6, 24.3) (3)		11.4 (6.1, 19.5)(4)	14.0 (14.0, 14.0) (1)	2.3 (2.3, 2.3) (1)			30.7 (30.7, 30.7) (1)

Authors' calculation using WHO/HAI data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Countries with multiple years' data, the latest available year's data are used, and are converted into 2010 base year price. WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO:

European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. WB country groups: HIC: High-income countries; LIC: Low-income countries; LMIC: Lower-middle-income countries; UMIC: Upper-middle-income countries.

Table S6. Public Sector Patient Price.

Country Group	Amlodipine	Atenolol	Captopril	Enalapril	Furosemide	Hydrochlorothiazide	Losartan	Lovastatin	Nifedipine
	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)
Lowest Price Generic									
All Country	4.2 (0, 19) (16)	14.5 (0, 127.1) (30)	5.4 (0, 51.9) (34)	13.8 (0, 41.6) (15)	7.9 (0, 61) (31)	7.6 (0, 43.9) (23)	2.2 (0, 15.8) (11)	1.7 (0, 8.5) (5)	7.3 (0, 40.2) (18)
WHO Regions									
AFRO		22.9 (0, 61.3) (5)	9.1 (0, 22.3) (5)	4.8 (0, 9.6) (2)	7.8 (0, 17.0) (7)	3.5 (0, 7.1) (4)			11.0 (0, 40.2) (6)
AMRO	6.3 (0, 19.0) (3)	11.0 (0, 24.2) (6)	1.9 (0, 14.2) (8)	8.3 (0, 21.2) (5)	5.3 (0, 20.0) (7)	6.8 (0, 18.4) (6)	0.5 (0, 2.1) (4)	0 (0, 0) (2)	
EMRO	0.6 (0, 1.6) (4)	2.3 (0, 11.3) (9)	2.3 (0, 14.1) (12)		4.7 (0, 12.5) (7)	0 (0, 0) (4)	0 (0, 0) (2)		1.7 (0, 8.3) (7)
EURO	3.2 (0.6, 7.2) (3)	6.8 (2.8, 13.7) (4)	4.0 (0.7, 6.3) (4)	23.6 (6.2, 41.6) (4)	4.5 (2.9, 5.8) (4)	21.3 (11.5, 43.9) (5)	1.0 (0.8, 1.2) (2)		18.1 (17.5, 18.7) (2)
SEARO	6.0 (0, 13.8) (3)	46.5 (0, 127.1) (3)	11.0 (3.4, 18.7) (2)		2.3 (0, 4.6) (2)	0.6 (0, 1.2) (2)	7.9 (0, 15.8) (2)	0 (0, 0) (1)	5.7 (0, 11.5) (2)
WPRO	6.1 (3.9, 8.8) (3)	22.7 (0, 51.6) (3)	18.8 (0.6, 51.9) (3)	20.7 (0, 37.9) (3)	24.7 (0, 61.1) (4)	6.1 (0.4, 11.7) (2)	4.4 (4.4, 4.4) (1)	4.2 (0, 8.5) (2)	5.2 (5.2, 5.2) (1)
WB Groups									
HIC	0 (0, 0) (1)	0 (0, 0) (3)	0 (0, 0) (4)	0 (0, 0) (1)	0 (0, 0) (2)	0 (0, 0) (3)	0 (0, 0) (1)		0 (0, 0) (2)
LIC		10.0 (0, 20.0) (4)	6.7 (0, 14.2) (6)	15 (9.6, 20.4) (2)	7.4 (0, 20.0) (7)	4.5 (3.3, 6.6) (3)			3.0 (0, 7.5) (4)
LMIC	7.0 (0, 19.0) (8)	25.2 (0, 127.1) (14)	8.9 (0, 51.9) (13)	24.5 (0, 41.6) (6)	12.5 (0, 61.1) (14)	13.2 (0, 43.9) (9)	3.8 (0, 15.8) (5)	0 (0, 0) (2)	11.9 (0, 40.19) (7)
UMIC	1.6 (0, 5.4) (7)	4.8 (0, 24.2) (9)	2.5 (0, 18.7) (11)	5.1 (0, 24.1) (6)	2.4 (0, 10.0) (8)	5.3 (0, 18.4) (8)	1.0 (0, 4.4) (5)	2.8 (0, 8.5) (3)	7.1 (0, 17.5) (5)
Originator Brand									
All Country	14.5 (0, 38.7) (7)	28 (0, 139.8) (5)	45.7 (0, 217.3) (11)	40.5 (0, 119.6) (4)	17.5 (0, 51.3) (4)		2.9 (0, 8) (7)		10.5 (0, 58.2) (10)
WHO Regions									
AFRO									22.2 (22.2, 22.2) (1)
AMRO							0 (0, 0) (1)		0 (0, 0) (1)
EMRO					7.6 (7.6, 7.6) (1)		0 (0, 0) (1)		1.2 (0, 7.1) (6)
EURO	19.8 (14.0, 25.5) (2)		24.4 (14.8, 33.1) (4)	81.0 (42.5, 119.6) (2)	31.1 (11.0, 51.3) (2)		3.3 (3.1, 3.5) (2)		
SEARO	38.7 (38.7, 38.7) (1)		142.3 (67.3, 217.3) (2)				8.0 (8.0, 8.0) (1)		38.0 (17.7, 58.2) (2)
WPRO	11.8 (0, 23.5) (2)	69.9 (0, 139.8) (2)	60.5 (0, 121.0) (2)				2.7 (0, 5.5) (2)		
WB Groups									
HIC	0 (0, 0) (1)	0 (0, 0) (2)	0 (0, 0) (1)				0 (0, 0) (1)		0 (0, 0) (3)
LIC					7.6 (7.6, 7.6) (1)				14.6 (7.1, 22.2) (2)
LMIC	32.1 (25.5, 38.7) (2)	69.9 (0, 139.8) (2)	79.2 (0, 217.3) (5)	120 (120, 120) (1)	25.6 (0, 51.3) (2)		3.5 (3.5, 3.5) (1)		4.4 (0, 17.7) (4)
UMIC	9.4 (0, 23.5) (4)	0 (0, 0) (1)	21.4 (0, 67.3) (5)	14.2 (0, 42.5) (3)	11.0 (11.0, 11.0) (1)		3.3 (0, 8.0) (5)		58.2 (58.2, 58.2) (1)

Authors' calculation using WHO/HAI data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Countries with multiple years' data, the latest available year's data are used, and are converted into 2010 base year price. WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. WB country groups: HIC: High-income countries; LIC: Low-income countries; LMIC: Lower-middle-income countries; UMIC: Upper-middle-income countries.

Table S7. Private Sector Patient Price.

Country Group	Amlodipine	Atenolol	Captopril	Enalapril	Furosemide	Hydrochlorothiazide	Losartan	Lovastatin	Nifedipine
	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)
Lowest Price Generic									
All Country	6.7 (0.7, 22.8) (21)	40 (2.6, 162.7) (44)	24.2 (0.5, 90.9) (46)	43 (7, 126.9) (17)	22.2 (2.9, 79.2) (31)	33.7 (0.4, 108.4) (31)	4.4 (0.9, 16.6) (21)	40.8 (7.1, 133.4) (10)	18.3 (2.4, 83.8) (28)
WHO Regions									
AFRO	2.4 (2.4, 2.4) (1)	42.8 (21.9, 85.0) (10)	27 (9.2, 56.2) (12)	19.9 (12.3, 27.5) (2)	15.2 (4.1, 35.1) (7)	29.4 (6.6, 106.0) (6)	5.3 (3.2, 6.6) (4)	67.3 (67.3, 67.3) (1)	15.2 (4.0, 40.2) (10)
AMRO	9.1 (2.6, 22.8) (6)	47.8 (22.2, 137.5) (9)	25.3 (3.6, 81.3) (9)	36.7 (23.2, 69.5) (6)	30.7 (8.2, 79.2) (8)	39.1 (6.5, 108.4) (7)	3.5 (0.9, 6.8) (5)	35.8 (7.1, 74.0) (3)	83.8 (83.8, 83.8) (1)
EMRO	6.2 (0.8, 13.6) (4)	44.7 (4.1, 162.7) (11)	32.6 (3.4, 90.9) (12)	127 (127, 127) (1)	27.1 (5.6, 73.8) (6)	57.9 (23.9, 81.4) (6)	4.6 (1.3, 10.1) (6)	26.5 (26.5, 26.5) (1)	19.3 (2.4, 39.9) (8)
EURO	3 (1.1, 7.1) (4)	10.2 (2.6, 23.1) (6)	6.0 (1.3, 18.0) (6)	22.0 (7.0, 43.2) (5)	4.8 (2.9, 6.6) (5)	27.6 (10.3, 43.9) (6)	1.0 (0.9, 1.1) (2)		16.4 (12.1, 19.7) (3)
SEARO	8.7 (2.8, 13.7) (3)	63.6 (24.4, 139.6) (3)	12.2 (3.8, 20.7) (2)		5.6 (5.6, 5.6) (1)	8.5 (1.2, 15.8) (2)	9.0 (1.4, 16.6) (2)	75.2 (16.9, 133) (2)	13.0 (6.1, 19.9) (2)
WPRO	6.7 (4.2, 11.5) (3)	31.5 (8.3, 71.2) (5)	22.2 (0.6, 48.5) (5)	77.8 (36.5, 120.1) (3)	35.8 (9.3, 68.6) (4)	16.4 (0.4, 46.4) (4)	3.2 (2, 4.4) (2)	18.8 (8.5, 33.2) (3)	12 (6.1, 22.4) (4)
WB Groups									
HIC	13.6 (13.6, 13.6) (1)	75.0 (43.2, 162.7) (4)	52.5 (29.2, 90.9) (4)	127 (127, 127) (1)	73.8 (73.8, 73.8) (1)	55.7 (48.8, 62.7) (2)	4.8 (4.8, 4.8) (1)		28.7 (28.7, 28.7) (1)
LIC	3.3 (2.4, 4.3) (2)	37.3 (5.9, 85.0) (7)	19.7 (3.4, 40.1) (8)	24.3 (12.3, 36.2) (2)	15.9 (4.1, 35.1) (8)	12.3 (6.6, 17.9) (2)	4.3 (3.2, 5.4) (2)		8.0 (2.4, 17.6) (6)
LMIC	7.4 (1.1, 22.8) (10)	40.0 (2.6, 139.6) (19)	27.1 (1.3, 81.3) (19)	33.2 (10.7, 76.9) (7)	23.3 (4.5, 79.2) (13)	39.7 (1.2, 108.4) (15)	5.0 (1.1, 16.6) (10)	63.6 (16.9, 133.4) (5)	22.6 (5.4, 83.8) (13)
UMIC	5.7 (0.8, 9.9) (8)	31.3 (4.1, 89.8) (14)	15.5 (0.6, 58.8) (15)	46.1 (7.0, 120.1) (7)	20.5 (2.9, 49.9) (9)	26.2 (0.4, 78.5) (12)	3.7 (0.9, 10.1) (8)	18.0 (7.1, 33.2) (5)	17.9 (6.1, 39.9) (8)
Originator Brand									
All Country	28.7 (6.2, 72.5) (15)	184 (30.7, 960) (33)	71.8 (15.9, 143) (35)	179.3 (44.8, 277) (7)	139.8 (9.5, 545) (26)	70.8 (30.3, 117.5) (3)	11.8 (3.9, 25.3) (20)	116.6 (62, 171.1) (2)	72.6 (8.1, 158.2) (25)
WHO Regions									
AFRO		216 (90.6, 384) (9)	90.9 (47.9, 139.1) (9)		227 (91.1, 545) (6)	47.4 (30.3, 64.5) (2)	16.9 (8.4, 25.3) (2)		82.7 (19.3, 122)(8)
AMRO	41.6 (25.6, 72.5) (4)	245 (78.4, 960) (9)	73.3 (28.7, 118.7) (7)	199 (112, 277) (3)	122 (46.3, 198) (8)		12.5 (10.0, 14.1) (4)	171 (171, 171) (1)	156 (156, 156) (1)
EMRO	22.6 (12.5, 32.9) (3)	124 (69.2, 224) (8)	61.3 (34.3, 88.2) (10)	250 (250, 250) (1)	118 (10.7, 202) (6)		10.1 (6.1, 15.5) (7)	62.0 (62.0, 62.0) (1)	60.2 (9.2, 158) (9)
EURO	16.5 (6.2, 25.6) (3)	42.9 (42.9, 42.9) (1)	32.43 (15.9, 47.1) (5)	82.8 (44.8, 120.7) (2)	18.2 (11.6, 24.8) (2)	118 (118, 118) (1)	12.6 (4.0, 21.3) (2)		34.6 (34.6, 34.6) (1)
SEARO	28.8 (9.2, 39.4) (3)	145 (30.7, 293) (3)	143 (143, 143) (1)		130 (9.5, 250) (2)		16.6 (9.9, 23.2) (2)		64.7 (8.1, 121) (2)
WPRO	29.9 (19.8, 39.9) (2)	156 (90.8, 229) (3)	89 (47.5, 126) (3)	243 (243, 243) (1)	151 (131, 171) (2)		7.9 (5.0, 10.5) (3)		73.3 (38.0, 103) (4)
WB Groups									
HIC	22.3 (22.3, 22.3) (1)	336 (97.8, 960) (4)	72.2 (40.3, 118.7) (4)	250 (250, 250) (1)	158 (145, 170) (2)		7.1 (7.0, 7.1) (2)		67.1 (45.7, 86.0) (3)
LIC		166 (90.6, 366) (5)	105 (72.6, 139) (4)		105 (10.7, 149) (5)	30.3 (30.3, 30.3) (1)			38.0 (9.2, 85.5) (3)
LMIC	25.9 (6.2, 42.2) (6)	190 (30.7, 384) (11)	75.3 (25.1, 143) (14)	165 (121, 209) (2)	168 (9.5, 545) (10)		14.4 (4.0, 25.3) (7)	62.0 (62.0, 62.0) (1)	82.8 (8.1, 158) (14)
UMIC	31.5 (12.5, 72.5)(8)	140 (42.9, 277) (13)	57.6 (15.9, 92.2) (13)	169 (44.8, 277) (4)	124 (11.6, 356) (9)	91 (64.5, 117.5) (2)	11.1 (5.0, 21.3) (11)	171 (171, 171) (1)	68.4 (38.0, 107) (5)

Authors' calculation using WHO/HAI data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Countries with multiple years' data, the latest available year's data are used, and are converted into 2010 base year price. WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. WB country groups: HIC: High-income countries; LIC: Low-income countries; LMIC: Lower-middle-income countries; UMIC: Upper-middle-income countries.

Table S8. Public Sector Affordability.

Country Group	Amlodipine	Atenolol	Captopril	Enalapril	Hydrochlorothiazide	Losartan	Nifedipine
	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)
Lowest Price Generic							
All Country	1.7 (0, 4.4) (9)	0.8 (0, 2.2) (6)	0.9 (0, 3.2) (17)	1.4 (0.3, 4.5) (6)	0.6 (0, 3.6) (9)	1.8 (0.1, 4.3) (5)	1.8 (0.4, 3.2) (6)
WHO Regions							
AFRO		1.4 (1.4, 1.4) (1)	1 (0.9, 1.1) (3)	1.6 (1.6, 1.6) (1)	0.3 (0.2, 0.3) (2)		1.9 (1.1, 2.6) (2)
AMRO	4.4 (4.4, 4.4) (1)	0.5 (0.4, 0.6) (2)	1.2 (1.2, 1.2) (1)	0.9 (0.9, 0.9) (1)	0.4 (0.4, 0.4) (1)	2.5 (2.5, 2.5) (1)	
EMRO	0.4 (0, 0.8) (2)	0.1 (0, 0.1) (2)	1 (0.1, 3.2) (4)	1.7 (0.3, 4.5) (3)		0.1 (0.1, 0.1) (1)	1.8 (0.4, 3.2) (2)
EURO	2.0 (0.3, 3.7) (2)		0.7 (0.1, 1.2) (4)	0.9 (0.9, 0.9) (1)	1.4 (0.3, 3.6) (3)	1 (1, 1) (2)	2.6 (2.6, 2.6) (1)
SEARO	2.4 (2.4, 2.4) (1)	2.2 (2.2, 2.2) (1)	0.6 (0.3, 0.9) (2)		0 (0, 0) (1)		
WPRO	1.2 (1, 1.5) (3)		0.9 (0, 2.5) (3)		0.2 (0, 0.3) (2)	4.3 (4.3, 4.3) (1)	0.7 (0.7, 0.7) (1)
WB Groups							
HIC							
LIC		0.3 (0.1, 0.4) (2)	0.9 (0.3, 1.2) (4)	1.6 (1.6, 1.6) (1)	0.2 (0.2, 0.2) (1)		0.8 (0.4, 1.1) (2)
LMIC	2 (0.3, 4.4) (7)	1.4 (0.6, 2.2) (3)	1.2 (0.3, 3.2) (9)	1.9 (0.4, 4.5) (3)	0.9 (0, 3.6) (5)	1.8 (1, 2.5) (2)	2.8 (2.6, 3.2) (3)
UMIC	0.5 (0, 1) (2)	0 (0, 0) (1)	0.3 (0, 0.9) (4)	0.6 (0.3, 0.9) (2)	0.2 (0, 0.4) (3)	1.8 (0.1, 4.3) (3)	0.7 (0.7, 0.7) (1)
Originator Brand							
All Country	4.3 (1.9, 6.7) (4)		4.5 (1.7, 9.1) (5)	2.85 (1.9, 3.8) (2)		4.0 (3, 5.3) (3)	4.7 (1.2, 8.2) (2)
WHO Regions							
AFRO							
AMRO							
EMRO	1.9 (1.9, 1.9) (1)						1.2 (1.2, 1.2) (1)
EURO	4.2 (4.2, 4.2) (1)		4.5 (1.7, 9.1) (3)	2.9 (1.9, 3.8) (2)		3.4 (3, 3.8) (2)	
SEARO	6.7 (6.7, 6.7) (1)		3.0 (3.0, 3.0) (1)				
WPRO	4.4 (4.4, 4.4) (1)		5.9 (5.9, 5.9) (1)			5.3 (5.3, 5.3) (1)	8.2 (8.2, 8.2) (1)
WB Groups							
HIC							
LIC							1.2 (1.2, 1.2) (1)
LMIC	5.5 (4.2, 6.7) (2)		5.9 (2.8, 9.1) (3)	3.8 (3.8, 3.8) (1)		3 (3, 3) (1)	
UMIC	3.2 (1.9, 4.4) (2)		2.4 (1.7, 3) (2)	1.9 (1.9, 1.9) (1)		4.6 (3.8, 5.3) (2)	8.2 (8.2, 8.2) (1)

Authors' calculation using WHO/HAI data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Countries with affordability data for multiple years, only the latest year data are used. WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. WB country groups: HIC: High-income countries; LIC: Low-income countries; LMIC: Lower-middle-income countries; UMIC: Upper-middle-income countries.

Table S9. Private Sector Affordability.

Country Group	Amlodipine	Atenolol	Captopril	Enalapril	Hydrochlorothiazide	Losartan	Nifedipine
	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)	% (min, max) (n)
Lowest Price Generic							
All Country	1.4 (0, 5.2) (16)	1.3 (0, 9.8) (25)	2.5 (0, 10.1) (34)	1.6 (0.3, 4.7) (12)	1.0 (0, 3.6) (27)	2.3 (0.1, 4.2) (8)	3.9 (0.4, 16.5) (10)
WHO Regions							
AFRO	0.9 (0.9, 0.9) (1)	2.8 (0.3, 9.8) (6)	5.7 (0.5, 10.1) (9)	2.1 (2.1, 2.1) (1)	0.9 (0.2, 3.3) (7)		5.4 (1, 16.5) (4)
AMRO	2.2 (0.8, 5.2) (4)	1.2 (0.6, 2.4) (5)	1.2 (0.3, 1.9) (5)	1.4 (0.9, 2.9) (5)	1.2 (0.1, 2.2) (4)	2.7 (0.7, 4) (3)	
EMRO	0.5 (0, 0.8) (4)	0.7 (0, 2.6) (6)	1.2 (0.1, 3.2) (9)	0.7 (0.7, 0.7) (1)	1.1 (0.5, 2.3) (5)	2.1 (0.1, 4) (2)	1.9 (0.4, 3.4) (2)
EURO	2 (0.3, 3.7) (2)	0.7 (0.3, 1.4) (3)	1.9 (0.2, 4.5) (6)	1.9 (0.3, 4.7) (4)	1.6 (0.2, 3.6) (6)	1.1 (1, 1.1) (2)	5.7 (2.5, 8.9) (2)
SEARO	1.3 (0.3, 2.3) (2)	1.4 (0.4, 2.4) (2)	0.7 (0.3, 1.1) (2)		0.2 (0, 0.3) (2)		
WPRO	1.3 (0.8, 2) (3)	0.4 (0.1, 0.6) (3)	1 (0, 2.4) (3)	1.3 (1.3, 1.3) (1)	0.4 (0, 1.2) (3)	4.2 (4.2, 4.2) (1)	1.3 (0.9, 1.7) (2)
WB Group							
HIC		2.6 (2.6, 2.6) (1)	0.4 (0.4, 0.4) (1)	0.7 (0.7, 0.7) (1)	0.8 (0.8, 0.8) (1)		
LIC	0.9 (0.8, 0.9) (2)	2.9 (0.2, 9.8) (5)	3.9 (0.4, 10.1) (7)	2.1 (2.1, 2.1) (1)	0.3 (0.2, 0.4) (2)		0.8 (0.4, 1.1) (3)
LMIC	1.8 (0.3, 5.2) (10)	1.1 (0.1, 2.4) (10)	2.9 (0.3, 9.9) (18)	1.9 (0.4, 4.7) (5)	1.4 (0, 3.6) (15)	2.8 (1, 4) (3)	6 (1.7, 16.5) (6)
UMIC	0.7 (0, 1.1) (4)	0.5 (0, 1.2) (9)	0.6 (0, 1.9) (8)	1.3 (0.3, 2.9) (5)	0.6 (0, 2) (9)	2 (0.1, 4.2) (5)	0.9 (0.9, 0.9) (1)
Originator Brand							
All Country	4.2 (1, 9.6) (12)	3.5 (0.4, 10.4) (21)	9.9 (0.6, 32.4) (24)	5.4 (1.4, 11.7) (6)	1.7 (0.6, 2.7) (6)	7.5 (3.4, 11.5) (4)	10.3 (1.6, 33.1) (6)
WHO Regions							
AFRO		6.3 (1.9, 10.4) (6)	18.5 (2.8, 32.4) (8)		1.1 (0.6, 1.5) (2)		21.5 (9.8, 33.1) (2)
AMRO	6.5 (3.4, 9.6) (2)	3.3 (1.3, 5.2) (5)	3.9 (2.1, 6) (3)	8.4 (4.6, 11.7) (3)	1.9 (1.5, 2.2) (2)	10.9 (10.2, 11.5) (2)	
EMRO	3.4 (1, 8.9) (4)	1.7 (0.4, 3) (4)	3 (0.6, 6.7) (6)	1.4 (1.4, 1.4) (1)			2.8 (1.6, 4) (2)
EURO	3.8 (3.2, 4.3) (2)	1.6 (0.9, 2.2) (2)	8.5 (1.8, 17.6) (5)	2.9 (2, 3.8) (2)	2.7 (2.7, 2.7) (1)	3.4 (3.4, 3.4) (1)	6.1 (6.1, 6.1) (1)
SEARO	3.9 (1, 6.8) (2)	3.4 (0.4, 6.3) (2)	12 (12, 12) (1)				
WPRO	4.3 (3.7, 4.9) (2)	1.6 (0.8, 2.3) (2)	6.1 (6.1, 6.1) (1)		1.9 (1.9, 1.9) (1)	4.8 (4.8, 4.8) (1)	6.9 (6.9, 6.9) (1)
WB Groups							
HIC		2.7 (2.7, 2.7) (1)	0.6 (0.6, 0.6) (1)	1.4 (1.4, 1.4) (1)			4 (4, 4) (1)
LIC		6.5 (2.7, 10.4) (4)	21.9 (14, 32.4) (4)		1.5 (1.5, 1.5) (1)		1.6 (1.6, 1.6) (1)
LMIC	5.1 (1, 9.6) (7)	3.6 (0.4, 9.2) (7)	10.2 (0.8, 23.1) (13)	6.4 (3.8, 9) (2)	1.9 (1.9, 1.9) (1)	3.4 (3.4, 3.4) (1)	16.3 (6.1, 33.1) (3)
UMIC	3 (1, 4.9) (5)	2.2 (0.7, 5.2) (9)	2.9 (1.3, 6) (6)	6.1 (2, 11.7) (3)	1.8 (0.6, 2.7) (4)	8.8 (4.8, 11.5) (3)	6.9 (6.9, 6.9) (1)

Authors' calculation using WHO/HAI data obtained from <http://www.haiweb.org/MedPriceDatabase/>. Countries with affordability data for multiple years, only the latest year data are used. WHO Regions - AFRO: African Region, AMRO: Region of the Americas, SEARO: South-East Asia Region, EURO: European Region, EMRO: Eastern Mediterranean Region, and WPRO: Western Pacific Region. WB country groups: HIC: High-income countries; LIC: Low-income countries; LMIC: Lower-middle-income countries; UMIC: Upper-middle-income countries.