

Supplementary file 5. Main characteristics of prevalence surveys of cardiovascular medicines

Reference country / of collection	Active pharmaceutical ingredient (API)	Brand name	Outlet/ Sampling type	Reference specifications standard	Test (s) performed and analytical technique	No. Failed n/N(%)
Nazerali, 1996 [1] Zimbabwe	Epinephrine	Unknown	Public medical stores, hospital and health centres/ Convenience	USP 1990	API content <i>HPLC</i>	2 /11(18.2%)
Westenberger, 2005 [2] Unstated country	Warfarin	Unknown	Website/ Convenience	USP 26/ 2003	API content, API Identification, Dissolution, Impurity, Weight variation, Visual inspection <i>HPLC, Near-infrared spectroscopy (NIR), Thermogravimetric (TGA)</i>	0 /4(0%)
Schwertner, 2005 [3] Mexico	Digoxin	Lanoxin	Pharmacies/ Convenience	USP	API content <i>HPLC-DAD</i>	0/2 (0%)
Sheth, 2007 [4] India	Ramipril Atenolol Diltiazem	Unknown	Retail pharmacy (licenced) / Convenience	' Conduct of analysis as per Pharmacopoeial status mentioned on label.'	API content <i>Method Unstated</i>	0/86 (0.0%)
Qureshi, 2008 [5] Argentina, Austria, Brazil, Canada, China, Cyprus, Denmark, Egypt, Finland, France, Germany, Greece, Hungary, Luxembourg, Mexico, Netherlands, New Zealand, Poland, Portugal	Furosemide	Lasix and other products	Different outlets (retail pharmacy, wholesaler)/ Convenience	BP USP 22 European Pharmacopoeia	API content, Content uniformity, Disintegration, Dissolution, Mass uniformity <i>HPLC-UV IR spectrophotometry</i>	3/196 (1.5%)

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CDSCO, 2009 [6] India	Amlodipine, Atenolol, Atorvastatin	Amdepine Amlopress Amlosafe Aten-50 Atherochek10 Storvas-10 Tenolol Ziblok Zivast-10	Hospital/health centers	Indian Pharmacopeia	API content, Api Identification, Visual inspection <i>Method Unstated</i>	3/435 (0.7%)
Twagirumukiza, 2009 [7] Rwanda	Atenolol Captopril Hydrochlorothiazide Methyldopa Propranolol	Tenormin, Betanorm Catenol Capoten Captopril Denk, Cetopril Esidrex, HCTZ L&A, HCTZ Cipla Aldomet Belgium Methyldopa L&A Aldomet Pakistan Inderal Cepanolol	Public and official private pharmacies/ Convenience	USP 2006	API content, Dissolution <i>HPLC-UV/Vis</i> <i>UV-visible spectrophotometry</i>	2 /16(12.5%)
Markman, 2009 [8] Brazil	Simvastatin	Unknown	Compounding pharmacies/ Convenience	Brazilian Pharmacopeia, USP 2008	API content, Content uniformity, Dissolution, weight <i>HPLC-UV/Vis</i>	16/18 (88.9%)
Bate, 2010 [9] United States	Atorvastatin	Lipitor	Website/ Convenience	Not applicable	API content <i>Raman Spectroscopy</i>	0/25 (0.0%)
Luciane O. Lima, 2011 [10] Brazil	Methyldopa Enalapril Propranolol Furosemide	Unknown	Pharmacy/ Convenience	Brazilian Pharmacopeia	API content, content uniformity, weight, dissolution <i>UV-visible spectrophotometry</i>	3/9 (33.3%)
Marques-Marinho, 2011 [11] Brazil	Simvastatin	Unknown	Compounding pharmacies/ Convenience	Brazilian Pharmacopeia, USP 2009	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>RP-HPLC-UV/DAD</i>	16 /30 (53.3%)

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Yusuf, Inua, 2011 [12] Afghanistan	Atenolol	Unknown	Public and private pharmacy/ Convenience	United States Pharmacopeia	API content, API identification, Dissolution <i>HPLC</i>	3/30 (10.0%)
Karlage, 2012 [13] US, Mexico	Warfarin	Generic Coumadin Rofarmin	Pharmacy / Random	USP	API content <i>HPLC-DAD</i>	0/4 (0.0%)
Patel, 2012 [14] South Africa	Hydrochlorothiazide (HCTZ)	Adco-retic HCTZ Ridaq Hexazide	Public and private health sectors outlets- unspecified/ Convenience	BP 2005, USP 2006	API identification, Dissolution test, Uniformity of weight <i>Fourier transformed infrared spectroscopy (FTIR)</i>	0/4 (0.0%)
Kahsay, 2013 [15] Belgium	Clopidogrel- Acetylsalicylic Acid	Duoplavin Coplavix Clopitab Clopilet Plagril Clavix Noklot Deplatt, Dospin Antiplar	Unknown/Unkn own	European Pharmacopoeia and USP 2010	API content, impurity, dissolution, content uniformity <i>Liquid Chromatography (LC)-UV/Visible photodiode array</i>	8 /10(80%)
Al-Qatamin, 2014 [16] Jordan	Clopidogrel Atorvastatin Bisoprolol Valsartan-HCTZ	Plavix, Lipitor Concor Co-diovan	Pharmacies/ Random and convenience	USP	API content, Visual inspection, Impurity <i>HPLC-UV</i>	0/172 (0%)
Fukami, 2015 [17] Japan	Atorvastatin	Lipitor Lipiget Atorlip Lipvas Aztor	Website/ Convenience	Japanese Pharmacopeia	API content, Visual inspection, Dissolution <i>HPLC</i>	1/6 (16.7%)
Macquart De Terline, 2016 [18] <i>Benin, Burkina Faso, Congo-Brazzaville, Côte D'Ivoire, Guinea,</i>	Acenocoumarol Amlodipine Atenolol Captopril Furosemide Hydrochlorothiazide Simvastatin	Unknown	Private pharmacy and street market/ Random and Convenience	In-house methods and specifications	API content <i>RP-HPLC-MS/MS</i>	249/1530 (16.3%)

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<i>Mauritania, Niger, the Democratic Republic of the Congo, Senegal, and Togo</i>						
Petersen, 2017 [19] <i>Cameroon, Democratic Republic of the Congo, Nigeria, Kenya, Uganda, Ghana, India</i>	Captopril Atenolol Bisoprolol Furosemide Hydrochlorothiazide	Unknown	Private outlet (formal and informal drug vendors)/ Convenience	BP 2015	API content, API identification, Disintegration <i>Colorimetry, Thin Layer Chromatography (TLC)</i>	1/50 (2.0%)
Schafermann, 2018 [20] <i>Togo</i>	Atenolol Furosemide Hydrochlorothiazide	Atenolol Denk Furo Denk Furosemide Esidrex HCTZ	Licensed pharmacy/ informal vendor/ Convenience	USP 2016	API content, Visual inspection, Dissolution <i>HPLC-UV</i>	1/24 (4.8%)
Kakio, 2018 [21] <i>China, Myanmar, Indonesia</i>	Candesartan	Blopress XINXIN Candelong-8 Advant	Hospital/ Pharmacy/ Convenience	Japanese Pharmacopoeia	API content, Visual inspection, Dissolution* <i>HPLC-UV</i>	19/37 (51.4%)
Ashames, 2019 [22] <i>Libya</i>	Atenolol Furosemide	Unknown	Local pharmacies/ Convenience	BP 2015	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Visible spectrophotometer</i>	0/9 (0%)
Ndichu, 2019 [23] <i>Nigeria</i>	Nifedipine	Unknown	Registered pharmacies/ Random	International Pharmacopoeia, USP, Food and Drug Administration	API content, Visual inspection, Impurity <i>HPLC-MS</i>	78/102 (76.5%)
Julie Redfern, 2019 [24] <i>Nigeria</i>	Amlodipine Lisinopril	Unknown	Private pharmacies/ Random	United States Pharmacopoeia	API content, Visual inspection <i>HPLC-PDA</i>	101/361 (28.0%)
Rahman, M.S, 2019 [25]	Amlodipine	Unknown	Pharmacy, Depot/	British Pharmacopoeia,	API content, Content uniformity, Dissolution	7/79 (8.9%)

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Cambodia			Convenience	United States Pharmacopeia	<i>HPLC-DAD</i>	
Khurelbat. D, 2020 [26] Mongolia	Amlodipine	Unknown	Pharmacy outlets/ Random	British Pharmacopoeia, Pharmacopoeia of the People's Republic of China, Mongolian National Pharmacopoeia	API content, Visual inspection, Weight variation, Disintegration, Friability, Dissolution <i>HPLC-UV</i>	8/118 (6.8%)
Sakuda, Mirai, 2020 [27] Myanmar	Candesartan	Unknown	Hospitals, pharmacies, and wholesalers/ Unspecified	British Pharmacopoeia, United State Pharmacopoeia, Japanese Pharmacopoeia	API content, Content uniformity, Dissolution <i>Method Unstated</i>	1/10 (10.0%)
RP, reverse phase; HPLC, High-performance liquid chromatography; MS, Mass spectrometry; UV, Ultraviolet; TLC, Thin Layer Chromatography; FTIR, Fourier transformed infrared spectroscopy; LC, Liquid Chromatography; DAD, Diode-Array Detection; NIR, Near-infrared spectroscopy, TGA, Thermogravimetric; HTCZ, Hydrochlorothiazide; BP, British Pharmacopoeia; USP, United States Pharmacopoeia; API, Active Pharmaceutical Ingredient *Samples were tested by both high-performance liquid chromatography (HPLC) and Raman spectrophotometry, with inconsistent results between the two techniques. Only the reference HPLC results were retained in our analysis.						

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