

JPHS 2020, 11; 403–410
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Society (RPSGB)
Received May 11, 2020
Accepted June 2, 2020
DOI 10.1111/jphs.12372
ISSN 1759-8885

Cost analysis and utilization of antihypertensive drug therapy in Saudi Arabia

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Abstract

Objectives Mentioned study is carried out to assess the prescription pattern, utilization of drug and cost analysis of antihypertensive medications used in the treatment of hypertension in a private hospital in Saudi Arabia.

Methods A retrospective cohort study was carried out in a private hospital in Saudi Arabia. Cost analysis and patterns of outpatient and inpatient antihypertensive drugs used among hypertensive patients between 1 January 2019 and 31 December 2019 were investigated, including incidence, prevalence, duration of use of therapy, class of antihypertensive drugs and therapy for cost-effective use.

Key findings Monotherapy (78.32%) was leading trends of antihypertensive therapy that followed fixed dose combination with or without multidrug therapy (21.68%). The most frequent antihypertensive class to be prescribed was nonselective beta-blockers (39.36%) followed by calcium channel blockers (16.51%). The status in terms of cost utilized average per unit was the highest for telmisartan (3.371 (0.90) SR (USD)). The propranolol was most cost-effective (average cost per unit 1.43 (0.38) SR) in relative to the other antihypertensive prescribed.

Conclusion Our study suggested that the prescription pattern of drugs used for the treatment of hypertension adhered with the JNC 8 guidelines. Monotherapy was reliably more recommended in the initial stages of hypertension. Higher percentage of patients (78.32%) was found to be on monotherapy. The Saudi Food and Drug Authority (SFDA) has overwhelmed for fixation of prices of drugs.

Keywords antihypertensive therapy; cost analysis; drug utilization; JNC 8

Introduction

Hypertension or elevated blood pressure (BP) is a most common problem felt by humans in their daily life, mainly early adulthood and old age. It is not a disease of itself, but it is a serious medical condition that is significantly alarming signal for the heart- and blood vessel-related mortality and morbidity.^[1] During 2010, patients with hypertension were estimated nearly 1.15 billion throughout the world. Mainly, two-thirds of hypertensive patients belonged to small- and middle-income nations.^[2] During 2015, it has been estimated that hypertension is more prominent in male (one in four) compared to female (one in five).^[3] Globally including Saudi Arabia, it has been projected that hypertension is one of the main causes of death, studied in 2010.^[4] It is estimated that the worldwide occurrence of hypertension would increase from 20.4% in 2000 to 25% in 2025.^[5]

The latest report regarding cardiovascular risk factors within Saudi community describes that the occurrence of hypertension is 31.4% which raised remarkably in comparison with previous study.^[4,6–8] Due to increased burden of hypertension in community of Saudi Arabia, it is the duty of healthcare provider to keep them aware and come forward for early detection and treatment. Pharmacotherapy of hypertension efficiently suppresses hypertension-related mortality and morbidity.^[9] The chief goal of antihypertensive treatment is to prevent morbidity and mortality related with hypertension. Ultimate number of patients with hypertension suggested single, two or more antihypertensive medications.^[1] Angiotensin-converting enzyme Inhibitors (ACEIs), angiotensin receptor blockers (ARBs), beta-blockers (BBs), calcium channel blockers (CCBs), centrally acting agents, diuretics and vasodilators have all been revealed to reduce problems of hypertension and may be used for early drug therapy.^[10,11] The Joint National Committee (JNC) during 2003 released series of guidelines that endorse the proper antihypertensive therapy on the

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basis of best available evidence. The guidelines endorse thiazide diuretics to be prescribed only or as part of combination treatment for most hypertensive patients deprived of compelling indications.^[11,12] Most latest published data indicated an increasing use of the more costly angiotensin-converting enzyme inhibitors (ACEIs) and calcium channel blockers (CCBs) in spite of the absence of evidence to support that they are superior to diuretics and beta-blockers (BBs) in suppressing morbidity and mortality of heart diseases.^[13] In spite of wide broadcasting of the JNC guidelines, prescribing practices have long-continued discrepancy with recommendations.^[14] Currently for the treatment of hypertension, Saudi Arabia follows JNC 8 guidelines.^[15] Appropriate antihypertensive drug treatment is significant as the occurrence of hypertension has risen radically in the last three decades.^[16] Somewhat deviance from evidence-based guidelines in hypertension treatment contributes to the high cost of medicines and makes problems in providing affordable prescription drugs.^[17] Irrational prescribing is a noticed challenge of the healthcare delivery system throughout the world.^[18] Drug utilization studies (DUS) are potent investigative tools to determine the role of drugs in society.^[19] Hence, the current study was designated and designed to evaluate antihypertensive drug utilization and to perform cost analysis towards antihypertensive therapy.

Materials and Methods

The current study was conducted at a single centered, retrospective cohort study in inside and outside pharmacy department review of pharmacy database treatment patterns among Hypertension patients. One-year data for a period of January 2019 to December 2019 were retrieved from hospital pharmacy database of AGH Al-Khobar. Master list of all the patients was reviewed and from it, separate list of confirmed patients with hypertension was segregated and transferred to separate Microsoft Excel 2013. Patients who were not prescribed and dispensed any antihypertensive medicine were excluded from the study. Saudi Food and Drug Authority (SFDA) online database was used in retrieving prices of antihypertensive patients. All antihypertensive drugs were classified according to their mechanism of action and WHO Anatomical Therapeutic Chemical Classification System (ATC). World Health Organization (WHO) Defined Daily Dose (DDD) was used in the calculation of cost of each medication used every day, which was developed as a universal measure of drug consumption and provides a rough estimate of the utilization of different medications used for different indications including hypertension. The yearly acquisition costs for the recognized medications in the patients' hospital pharmacy database were estimated using the DDD due to the lack of data on the actual consumption rate of different medications for hypertension at a national level in Saudi Arabia.^[20] Result of average prescribed dose divided by average prescribed drug was used in the calculation of average unit dose cost per prescription. Cost of drug was expressed in Saudi Riyal (SR) and United State dollar (USD), and SR was converted into USD by using Google online SAR to USD currency converter.

Demographic characteristics were demonstrated as frequencies and percentages (with Wilson 95% confidence intervals for proportions). Chi-square (χ^2) test is used for the calculation of *P*-value, which helps in the estimation of adherence of prescribing pattern as per JNC 8 guidelines. *P*-value less than or equal to 0.05 was considered as significant. All statistical computations were done using Statistical Package of the Social Sciences (SPSS) IBM Corp Inc, Version (V. 21) (Armonk, NY, USA) used for the statistical analysis of data.

Results

Demographic characteristics of study participants

In AGH Al-Khobar from 1 January 2019 to 31 December 2019, a total of 23 554 items of antihypertensive drugs were dispensed in the inpatient and outpatient pharmacy department. As described in Table 1, among all the hypertensive patients more than half (59.48% (58.85–60.11) (14 010)) were male, while rest of them were female (40.51% (39.89–41.11) (9544)). Among all the hypertensive patients, highest number belongs to 51–60 years of age (31.42% (30.84–32.03) (7402)), second highest hospital-visited hypertensive patients were 61–70 years (21.91% (21.4–22.45) (5162)) followed by 41–50 years (17.09% (16.61–17.58) (4025)), 31–40 years (11.48% (11.08–11.89) (2704)) and 20–30 years of age (5.09% (4.82–5.38) (1200)). Among all hospital-visited patients, least number of patients belongs to age category of 91–100 years (0.63% (0.5–0.7) (150)) and 81–90 years (3.56% (3.33–3.8) (839)). Among all the hypertensive patients, 52.92% (*n* = 12 467) were from community of Saudi Arabia while 47.08% (*n* = 11 087) from non-Saudi.

Prescribing of antihypertensive drug among different age group and adherence of JNC 8 guidelines

As illustrated in Table 2, among all antihypertensive drugs, nonselective beta-blockers (NSBB) (C07AA) (39.36 (28.78–

Table 1 Baseline demographic characteristics of the studied patients

Characteristics	Total 23 554% (95% CI) (<i>n</i>)
Gender	
Male	59.48% (58.85–60.11) (14 010)
Female	40.51% (39.89–41.11) (9544)
Age (years)	
20–30	5.09% (4.82–5.38) (1200)
31–40	11.48% (11.08–11.89) (2704)
41–50	17.09% (16.61–17.58) (4025)
51–60	31.42% (30.84–32.03) (7402)
61–70	21.91% (21.4–22.45) (5162)
71–80	8.8% (8.44–9.17) (2072)
81–90	3.56% (3.33–3.8) (839)
91–100	0.63% (0.5–0.7) (150)
Nationality	
Saudi	52.92% (52.29–53.57) (12 467)
Non-Saudi	47.08% (46.43–47.71) (11 087)

Table 2 Pattern and frequency of prescribing of antihypertensive drug among different aged population as per JNC 8 guidelines

Drug category (ATC)	Total 23 554, % (95% CI) (n)	20-30% (95% CI) (n)	31-40 Total % (95% CI) (n)	41-50 Total % (95% CI) (n)	51-60 Total % (95% CI) (n)	61-70 Total % (95% CI) (n)	71-80 Total % (95% CI) (n)	81-90 Total % (95% CI) (n)	91-100 Total % (95% CI) (n)	P-value
ACEIs (C09A)	9.45 (9.09-9.84) 2228	0.22, (0.18-0.03) 54	0.86, (0.76-0.01) 204	1.74, (1.58-1.92) 410	3.57, (3.34-3.81) 842	1.94, (1.77-2.12) 458	2.05, (0.69-0.92) 188	2.75, (0.22-0.36) 65	0.0029, (0.01-0.06) 7	<0.01
ARBs (C09C)	12.87 (12.46-13.31) 3033	0.2 (0.16-0.28) 49	1.07 (0.95-1.21) 253	1.74 (2.12-2.5) 542	4.57 (4.31-4.84) 1077	3.01 (2.8-3.24) 709	1.07 (0.96-1.22) 254	0.55 (0.46-0.65) 130	0.80 (0.05-0.13) 19	<0.01
CCBs (C08)	16.51 (16.04-16.99) 3889	1.07 (0.95-1.10) 253	1.88 (1.72-2.70) 445	2.43 (2.24-2.63) 573	4.81 (4.55-5.1) 1135	3.57 (3.34-3.81) 841	1.79 (1.63-1.97) 422	0.80 (0.7-0.093) 190	0.127 (0.09-0.018) 30	<0.01
CCB/ACEIs (C09DB)	4.65 (4.39-4.93) 1096	0.059 (0.04-0.1) 14	0.61 (0.53-0.73) 145	1.05 (0.93-0.11) 248	1.54 (0.14-0.17) 365	0.95 (0.83-1.08) 224	0.27 (0.22-0.36) 65	0.10 (0.08-0.16) 25	0.04 (0.03-0.09) 11	<0.01
Centrally acting agents (C02A)	2.20 (2.03-2.41) 520	0.61 (0.53-0.73) 146	1.2 (1.07-1.35) 283	0.28 (0.2-0.3) 67	0.046 (0.03-0.09) 11	0.05 (0.04-0.1) 13	0	0	0	<0.01
Diuretics (C03)	3.06 (2.86-3.3) 722	0.19 (0.14-0.25) 45	0.161 (0.12-0.22) 38	0.38 (0.31-0.47) 90	0.96 (0.84-1) 227	0.90 (0.8-1.04) 214	0.275 (0.22-0.36) 65	0.135 (0.1-0.02) 32	0.04 (0.03-0.09) 11	<0.01
Diuretics/ACEIs (C09DA)	1.8 (1.65-1.99) 426	0	0.076 (0.05-0.13) 18	0.30 (0.25-0.39) 72	0.68 (0.59-0.8) 162	0.53 (0.44-0.63) 125	0.152 (0.11-0.21) 36	0.05 (0.04-0.1) 13	0	<0.01
Diuretics/ARBs (C09DA)	5.91 (5.63-6.23) 1394	0.046 (0.03-0.09) 11	0.21 (0.17-0.29) 51	0.05 (0.63-0.85) 173	2 (1.88-2.24) 482	1.75 (1.87-2.24) 437	0.73 (0.63-0.85) 172	0.27 (0.22-0.36) 65	0.01 (0-0.03) 3	<0.01
Diuretics/CCB/ARB (C08G)	3.35 (3.13-3.59) 790	0.04 (0.03-0.09) 11	0.3 (0.25-0.39) 73	0.60 (0.51-0.71) 142	1.16 (1.03-1.3) 274	0.70 (0.61-0.83) 167	0.42 (0.35-0.52) 101	0.09 (0.06-0.14) 22	0	<0.01
Diuretics/NSBB (C07CA)	0.24 (0.19-0.32) 58	0	0.01 (0-0.03) 3	0.07 (0.05-0.13) 18	0.08 (0.06-0.09) 21	0.04 (0.02-0.07) 10	0.02 (0.01-0.06) 6	0	0	<0.01
NSBB (C07AA)	39.36 (28.78-29.94) 6916	2.34 (2.15-2.54) 552	4.05 (3.82-4.32) 956	5.43 (5.15-5.73) 1279	8.57 (8.22-8.93) 2019	5.74 (5.45-6.04) 1353	2.15 (1.97-2.34) 507	0.93 (0.82-0.82) 507	0.12 (0.08-0.08) 507	<0.01

Table 2 (Continued).

Drug category (ATC)	Total 23 554, % (95% CI) (n)	20–30% (95% CI) (n)	31–40 Total % (95% CI) (n)	41–50 Total % (95% CI) (n)	51–60 Total % (95% CI) (n)	61–70 Total % (95% CI) (n)	71–80 Total % (95% CI) (n)	81–90 Total % (95% CI) (n)	91–100 Total % (95% CI) (n)	P-value
BB (C07AB)	3.5 (3.28–3.75) 826	0.12 (0.09–0.18) 30	0.3 (0.25–0.38) 71	0.45 (0.37–0.54) 105	1.14 (1.01–1.28) 269	0.87 (0.77–0.97) 207	0.40 (0.34–0.05) 96	0.12 (0.09–0.18) 221	0.07 (0.05–0.13) 29	<0.01
Vasodilators (C01D)	1.34 (1.19–1.48) 314	0.07 (0.04–0.11) 17	0.22 (0.17–0.29) 52	0.17 (0.13–0.24) 42	0.26 (0.21–0.34) 63	0.34 (0.27–0.42) 81	0.16 (0.12–0.22) 38	0.05 (0.03–0.09) 12	0.03 (0.02–0.07) 9	<0.01

Abbreviations: ACEIs, angiotensin-converting enzyme inhibitors; ARBs, angiotensin II receptor blockers; BB, beta-blocker; CCBs, calcium channel blockers; diuretics/NSBB, diuretics/nonselective beta-blockers; NSBB, nonselective beta-blockers.

29.94) 6916, $P = < 0.01$ were prescribed to the highest number of patients which is also prescribed among all age groups but age group 51–60 years utilized highest number of NSBB (8.57% (8.22–8.93) 2019) followed by 61–70 years (5.74% (5.45–6.04) 1353), 41–60 years (5.43% (5.15–5.73) 1279), 31–40 years (4.05% (3.82–4.32) 956), 20–30 years 2.34% (2.15–2.54) 552, 71–80 years (2.15% (1.97–2.34) 507), 81–90 years (0.93% (0.82–1.07) 221) and 91–100 years (0.12% (0.08–0.18) 29). Second highest anti-hypertensive drug prescribed among all the drugs was calcium channel blockers (CCBs) (C08) (16.51% (16.04–16.99) 3889, $P = < 0.01$) prescribed to almost all age group of hypertensive patients in which CCBs were utilized highest among patients of age group 51–60 years (4.81% (4.55–5.1) 1135, $P = < 0.01$) followed by 61–70 years (3.57% (3.34–3.81) 841), 41–50 years (2.43% (2.24–2.63) 573), 31–40 years (1.88 (1.72–2.70) 445), 71–80 years (1.79% (1.63–1.97) 422), 20–30 years (1.07 (0.95–0.10) 253), 81–90 years (0.80 (0.7–0.093) 190) and 91–100 years (0.127 (0.09–0.0.18) 30). Third highest antihypertensive drug prescribed among all other drugs was ARBs (C09C) (12.87% (12.46–13.31) 3033, $P = < 0.01$); among all ARB users, highest number of user belongs to patients aged 51–60 years (4.57% (4.31–4.84) 1077) which is followed by 61–70 years (3.01% (2.8–3.24) 709), 41–50 years (1.74% (2.12–2.5) 542), same number of users are from 31–40 and 71–80 years (1.07% (0.96–1.22) 254), and least number of prescribed was among age group of 91–100 years (0.80% (0.05–0.13) 19), 81–90 years (0.55% (0.46–0.65) 130) and 20–30 years (0.2 (0.16–0.28) 49). Other prescribed antihypertensive was ACEIs (C09A) (9.45% (9.09–9.84) 2228, $P = < 0.01$) prescribed to the every aged group in which 51–60 years aged patients utilized highest among all age group (3.57% (3.34–3.81) 842) followed by 81–90 years (2.75% (0.22–0.36) 65), 71–80 years (2.05% (0.69–0.92) 188), 61–70 years (1.94% (1.77–2.12) 458) and 41–50 years (1.74% (1.58–1.92) 410) and least drug utilization patient belongs to 91–100 years (0.0029% (0.01–0.06) 7) and 20–30 years (0.22% (0.18–0.03) 54). Diuretics/ARBs (C09DA) were also prescribed among patients of all ages (5.91% (5.63–6.23) 1394, $P = < 0.01$); order of utilization among all age group of patient was 51–60 years (2% (1.88–2.24) 482), 61–70 years (1.75% (1.87–2.24) 437), 71–80 years (0.73 (0.63–0.85) 172), 81–90 years (0.27% (0.22–0.36) 65), 31–40 years (0.21 (0.17–0.29) 51), 41–50 years (0.05 (0.63–0.85) 173), 20–30 years (0.046% (0.03–0.09) 11) and 91–100 years (0.01% (0–0.03) 3). CCB/ACEIs (C09DB) were also prescribed among all the group of hypertensive patients (4.65% (4.39–4.93) 1096, $P = < 0.01$) which followed by 51–60 years (1.54% (0.14–0.17) 365), 41–50 years (1.05% (0.93–0.11) 248), 61–70 years (0.95% (0.83–1.08) 224), 31–40 years (0.61% (0.53–0.73) 145), 71–80 years (0.27% (0.22–0.36) 65), 81–90 years (0.10% (0.08–0.16) 25), 20–30 years (0.059% (0.04–0.1) 14) and 91–100 years (0.04% (0.03–0.09) 11). Diuretics (C03) were also prescribed among all the aged (3.06% (2.86–3.3) 722, $P = < 0.01$) hypertensive patients; frequency of prescribing among different aged population was 51–60 years (0.96% (0.84–1) 227), 61–70 years (0.90 (0.8–1.04) 214), 41–50 years (0.38% (0.31–0.47) 90) 71–

80 years (0.275 (0.22–0.36) 65), 20–30 years (0.19% (0.14–0.25) 45), 31–40 years (0.161% (0.12–0.22) 38), 81–90 years (0.135% (0.1–0.02) 32) and 91–100 years (0.04% (0.03–0.09) 11). BB (C07AB) was prescribed to the all age group (3.5% (3.28–3.75) 826) of hypertensive patients; their frequency of prescribing was among 51–60 years (1.14% (1.01–1.28) 269), 61–70 years (0.87 (0.77–0.01) 207), 41–50 years (0.45% (0.37–0.54) 105), 71–80 years (0.40% (0.34–0.05) 96), 31–40 years (0.3 (0.25–0.38) 71), and equal number of patients belongs to the 20–30 and 81–90 (0.12% (0.09–0.18) 30) and from 91–100 years (0.07% (0.05–0.13) 18). Diuretics/CCB/ARB (C08G) were prescribed to almost all group patients (3.35% (3.13–3.59) 790) except 91–100 years hypertensive patients. The

frequency of use among all the group of diuretics/CCB/ARB (C08G) was 51–60 years (1.16 (1.03–1.3) 274), 61–70 years (0.70% (0.61–0.83) 167), 71–80 years (0.42% (0.35–0.52) 101), 41–50 years (0.60% (0.51–0.71) 142), 31–40 years (0.3% (0.25–0.39) 73), 81–90 years (0.09% (0.06–0.14) 22) and 20–30 years (0.04% (0.03–0.09) 11). Centrally acting agents (C02A) were prescribed (2.20% (2.03–2.41) 520) to only limited age group of patients; their frequency of prescribing was 31–40 years (1.2% (1.07–1.35) 283), 20–30 years (0.61% (0.53–0.73) 146), 41–50 years (0.28% (0.2–0.3) 67), 61–70 years (0.05 (0.04–0.1) 13) and 51–60 years (0.046% (0.03–0.09) 11). Diuretics/ACEIs (C09DA), vasodilators (C01D) and diuretics/NSBB (C07CA) were also prescribed to only limited number of patients (1.8% (1.65–1.99) 426), (1.34% (1.19–1.48) 314) and (0.24% (0.19–0.32) 58) respectively, and their frequency among patients of different age is available in detail in Table 2.

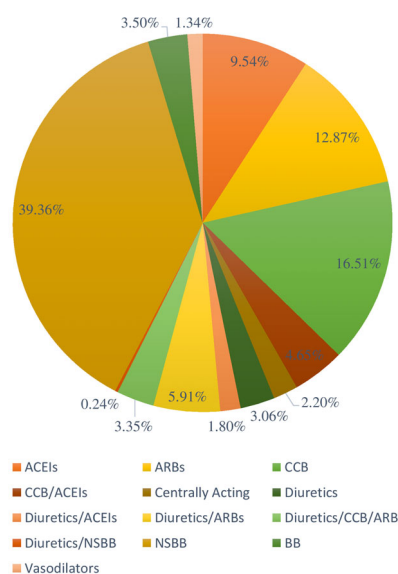


Figure 1 Frequency of prescribing combinational drugs versus single antihypertensive drug.

Category wise rank of prescribing of antihypertensive medications prescribed

Rank of use of antihypertensive drugs is illustrated in Figure 1, NSBB (C07AA)>CCBs (C08)>ARBs (C09C)>ACEIs (C09A)>diuretics/ARBs (C09DA)>CCB/ACEIs (C09DB)>BB (C07AB)>diuretics/CCB/ARB (C08G)>diuretics (C03)>centrally acting agents (C02A)>diuretics/ACEIs (C09DA)>vasodilators (C01D)>diuretics/NSBB (C07CA). Figure 2 used for describing of monotherapy versus combination therapy prescribing pattern monotherapy prescribed to the 78.23% (18 554) patients while combination therapy prescribed to the 21.68% (5000) antihypertensive hospital visited patients.

Cost analysis of antihypertensive therapy

Cost analysis of prescribed antihypertensive drugs is illustrated in Table 3a & b; in our study, cost of every drugs was determined in terms of average duration of therapy and

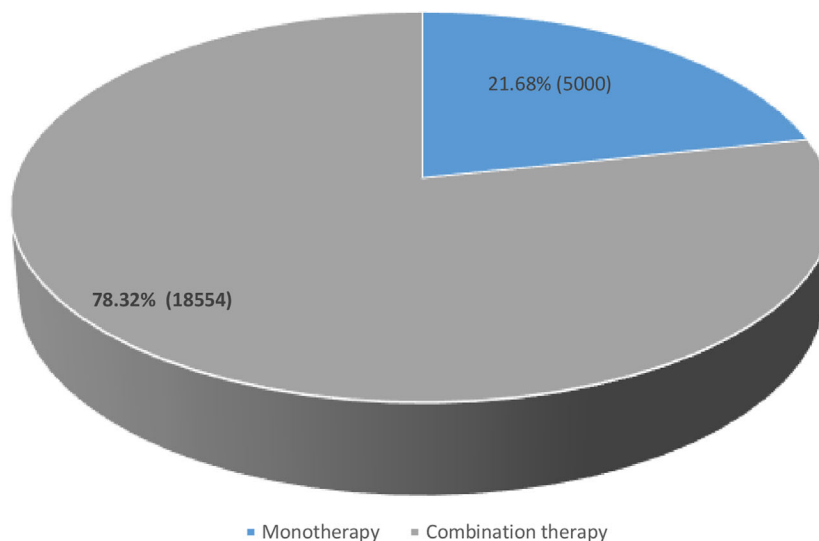


Figure 2 Types of antihypertensive drugs used in the treatment of hypertensive patients.

Table 3 (a) Cost analysis of antihypertensive drug used among studied patients. (b) Cost analysis of antihypertensive drug used among studied patients

a				
Drug	ATC CODE	WHO DDD (mg)	Average therapy duration in days	Average cost per unit in SR (USD)
Amlodipine	C08CA01	5	39.22	2.10 (0.56)
Atenolol	C07AB03	75	50.19	1.09 (0.29)
Bisoprolol	C07AB07	10	49.91	1.06 (0.28)
Captopril	C09AA01	50	18.33	0.93 (0.25)
Carvedilol	C07AG02	37.5	35.09	1.73 (0.46)
Enalapril	C09AA02	10	53	1.76 (0.47)
Hydralazine	C02DB02	100	17.63	1.03 (0.27)
Hydrochlorothiazide	C02DB02	25	41.65	0.86 (0.23)
Indapamide	C09BA04	2.5	53.75	1.15 (0.31)
Labetalol	C07AG01	600	7.93	1.05 (0.28)
Lercanidipine	C08CA13	10	60.48	1.97 (0.52)
Lisinopril	C09AA03	10	54.54	1.11 (0.30)
Losartan	C09CA01	50	56.39	1.66 (0.44)
Methyldopa	C02AB01	1000	17.44	0.44 (0.12)
Metoprolol	C07AB02	150	26.61	0.69 (0.18)
Nifedipine	C08CA05	30	19.15	1.91 (0.51)
Olmesartan	C09CA08	20	57.21	2.68 (0.71)
Perindopril	C09AA04	4	49.35	2.52 (0.67)
Propranolol	C07AA05	160	41.47	0.67 (0.18)
Ramipril	C09AA05	250	42.16	1.43 (0.38)
Telmisartan	C09DA07	40	58.90	3.371 (0.90)
Valsartan	C09CA03	80	50.12	2.48 (0.66)

b			
Drug	ATC CODE	Average therapy of duration in days	Average cost in unit dose prescription wise in SR (USD)
Amlodipine, valsartan	C09DB01	49.96	3.80 (1.01)
Amlodipine, valsartan, hydrochlorothiazide	C09DX01	49.91	5.12 (1.36)
Bisoprolol fumarate, hydrochlorothiazide	C07BB07	56.58	1.43 (0.38)
Candesartan, hydrochlorothiazide	C09DA06	55.17	2.81 (0.75)
Enalapril, hydrochlorothiazide	C09BA02	72.96	3.4 (0.91)
Irbesartan, hydrochlorothiazide	C09DA04	53.14	3.7 (0.99)
Olmesartan, hydrochlorothiazide	C09DA08	60.13	3.99 (1.06)
Perindopril arginine, indapamide	C09BA04	59.52	2.31 (0.62)
Telmisartan, hydrochlorothiazide	C09DA07	56.12	3.30 (0.88)
Valsartan, hydrochlorothiazide	C09DA03	49.44	2.86 (0.76)

average cost per unit in SR (USD) which is separated in single drug therapy (Table 3a) and combination therapy (Table 3b), and in Table 3b, DDD data are not mentioned because it was not available in reference source.

Cost analysis of single drug therapy prescribed to the hypertensive patients

Details are available in Table 3a; among all monotherapy, lercanidipine (C08CA13) was prescribed for highest duration (60.48 days) of therapy and their average cost per unit was 1.97 (0.52) SR (USD). Telmisartan (C09DA07) was utilized as the second highest (58.90 days) antihypertensive drug, and their average cost per unit wise was 3.371 (0.90) SR (USD). Olmesartan (C09CA08) was utilized as the third highest duration (57.21 days) among all antihypertensive

drug, and their average cost unit wise was 2.68 (0.71) SR (USD). Rest of the drug utilized as in terms of duration of therapy and cost wise are as follows: losartan (C09CA01): average duration of therapy was 56.39 days and their cost was 1.66 (0.44) per unit; lisinopril (C09AA03): average duration of therapy 54.54 days and their average cost per unit wise 1.11 (0.30) SR (USD); indapamide (C09BA04): average duration of therapy 53.75 days and their average cost per unit wise 1.15 (0.31) SR (USD); enalapril (C09AA02): average duration of therapy 53 days and their average cost per unit wise 1.76 (0.47) SR (USD); valsartan (C09CA03): average duration of therapy 50.12 days and their average cost per unit wise 2.48 (0.66); atenolol (C07AB03): average duration of therapy 50.19 days and their average cost per unit wise 1.09 (0.29) SR (USD); perindopril (C09AA04): average duration of therapy

49.35 days and their average cost per unit wise 2.52 (0.67) SR (USD); bisoprolol (C07AB07): average duration of therapy 49.91 days and their average cost per unit wise 1.06 (0.28) SR (USD); ramipril (C09AA05): average duration of therapy 42.16 and their average cost per unit wise 1.43 (0.38) SR (USD); propranolol (C07AA05): average duration of therapy 41.47 days and their average cost per unit wise 0.67 (0.18); hydrochlorothiazide (C02DB02): average duration of therapy 41.65 days and their average cost per unit wise 0.86 (0.23) SR (USD); amlodipine (C08CA01): average duration of therapy 39.22 days and their average cost per unit wise 2.10 (0.56) SR (USD); carvedilol (C07AG02): average duration of therapy 35.09 days and their average cost per unit wise 1.73 (0.46) SR (USD); metoprolol (C07AB02): average duration of therapy 26.61 days and their average cost per unit wise 0.69 (0.18) SR (USD); nifedipine (C08CA05): average duration of therapy 19.15 days and their average cost per unit wise 1.91 (0.51) SR (USD); captopril (C09AA01): average duration of therapy 18.33 days and their average cost per unit wise 0.93 (0.25) SR (USD); hydralazine (C02DB02): average duration of therapy 17.63 days and their average cost per unit wise 1.03 (0.27) SR (USD); methyl dopa (C02AB01): average duration of therapy 17.44 days and their average cost per unit wise 0.44 (0.12); and labetalol (C07AG01): average duration of therapy 7.93 days and their average cost per unit wise 1.05 (0.28).

Cost analysis of combinational drug therapy prescribed to the hypertensive patients

Details are available in Table 3b; among all combinational therapy, enalapril and hydrochlorothiazide (C09BA02) were prescribed for highest duration (72.96 days) of therapy and their average cost per unit was 3.4 (0.91) SR (USD). Olmesartan and hydrochlorothiazide (C09DA08) were utilized as the second highest (60.13 days) antihypertensive drug and their average cost per unit wise was 3.99 (1.06) SR (USD). Perindopril arginine (C09BA04) was utilized as the third highest duration (59.52 days) among all antihypertensive drug and their average cost unit wise was 2.31 (0.62) SR (USD). Rest of the drug utilized as in terms of duration of therapy and cost wise are as follows: telmisartan and hydrochlorothiazide (C09DA07): average duration of therapy was 56.12 days and their average cost per unit wise was 3.30 (0.88) SR (USD); bisoprolol fumarate and hydrochlorothiazide (C07BB07): average duration of therapy 56.58 days and their average cost per unit wise 1.43 (0.38) SR (USD); candesartan and hydrochlorothiazide (C09DA06): average duration of therapy 55.17 days and their average cost per unit wise 2.81 (0.75) SR (USD); amlodipine and valsartan (C09DB01): average duration of therapy 49.96 days and their average cost per unit wise 3.80 (1.01) SR (USD); amlodipine, valsartan and hydrochlorothiazide (C09DX01): average duration of therapy 49.91 days and their average cost per unit wise 5.12 (1.36) SR (USD); and valsartan and hydrochlorothiazide (C09DA03): average duration of therapy 49.44 and their average cost per unit wise 2.86 (0.76) SR (USD).

Discussion

Suitable antihypertensive drug treatment is important as the occurrence of hypertension has increased radically in last three decades.^[21] Any deviance from evidence-based guidelines in hypertension treatment contributes to the high cost of medications and generates complications in providing inexpensive prescription drugs.^[22] In this study, the incidence of hypertension was seen more in males compared to females (1.49 : 1), which resembles to the findings of Gupta et al.,^[23] and Guang Hui Dong et al.^[24] In Saudi Arabia, levels of hypertension have been stated to range from 26.1% among the population of age 30–70 years in 1995–2000^[7] to 25.5% among the population of age 15–64 years in 2005 which was also revealed in this study.^[4,6] Out of eight classes of drugs prescribed as monotherapy in our study, NSBB (C07AA) was found to be prescribed most frequently followed by CCBs (C08) and ARBs, though ACEIs (C09A) and diuretics are the first line of medication for the management of hypertension as per JNC 8 guidelines. Diuretics were prescribed more commonly as fixed dose combination (FDC) in our study which reveals to studies carried out in some countries including United States and India.^[10,12] JNC 8 guidelines advocate starting treatment with two drugs, either as individual doses or in FDC, when either the SBP is >20 mm Hg or DBP is >10 mm Hg above the recommended goal of <140/90 mm Hg if age less than age <60 years.^[25]

The FDC of BBS and CCBs was the second most arranged in this study because of its efficiency and cost-effectiveness.^[26] Use of FDC has benefit over polytherapy as it improves acquiescence to the treatment regimen. It has also been suggested that fixed dose combinational therapy is frequently less costly than various dosage regimen or high-dose monotherapy.^[27] Use of FDC has a benefit over combination therapy as it enriches compliance to the treatment regimen. It has also been recommended that fixed dose combination is again less costly than multiple dosage regimen or high-dose monotherapy.^[27] Prescription with combinational therapy revealed the major use of NSBB and CCBs (57%) which was in line with multiple other studies conducted previously.^[28–30] The result of cost evaluation exhibited that methyl dopa had the lowest average cost per unit wise and then metoprolol and hydrochlorothiazide followed by other classes; these results were similar with other studies which evaluated the cost-effectiveness of the obtainable antihypertension.^[31,32] Analysis of the relative cost-effectiveness of the treatments indicated that monotherapy was least costly followed by FDC and combinational therapy. This result was supported by results of other studies which observed that patients on three or four drug regimens had meaningfully higher treatment costs.^[33]

The current study has few limitations. Initially, the main challenge with design in general as retrospective study. We could not assess the patient's adherence to the therapy. Patients with severe comorbid illness like chronic kidney disease (CKD) and congestive heart disease (CHF) were not comprised in this study. Having these limitations, treatment pattern of antihypertensive drugs was comparatively uniform.

Conclusions

Our retrospective cohort study evaluated the prescription pattern of drugs used for the treatment of hypertension and noticed that the prescribing pattern adhered with the JNC 8 guidelines for the hypertension treatment. Monotherapy was reliably more recommended in the initial stages of hypertension to accomplish target goal of BP, and nonselective beta-blockers were the drugs of first choice, while calcium channel blockers were the second choice for hypertensive patients as a single drug treatment and overall utilization. The cost analysis displayed that single drug therapy to be more economical. But in combinational therapy, diuretics are being utilized in combination with angiotensin receptor blocker (5.91 %) and the pattern supports JNC 8 guidelines. Higher percentage of patients (78.32%) was found to be on monotherapy. The Saudi Food and Drug Authority (SFDA) has overwhelmed for fixation of prices of drugs.

Declarations

Conflict of interest

The Author(s) declare(s) that they have no conflicts of interest to disclose.

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Acknowledgements

My special thanks to Madam Dr. Aisha Al-Mana, Head of Board of trustee MACHS, for giving me an opportunity for research publication, providing unpublished data, and her kind support and encouragement. I would also like to express my thanks to Prof. Emad AlShwaimi, Dean, MACHS, to facilitate in obtaining research data.

Study place

A retrospective observational study was carried out in Al-Mana Group of Hospital (AGH), Al-Khobar, Saudi Arabia. AGH Al-Khobar is 250-bedded teaching private hospital with 74 outpatients clinic to provide healthcare facilities to the community of Saudi Arabia.

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