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Original Research

The impact of telepharmacy on hypertension management in the United Arab Emirates

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Abstract

Objectives: To assess the effectiveness of telepharmacy services delivered by community pharmacies in hypertension management and examine its influence on pharmacists' ability to identify drug-related problems (DRPs). **Methods:** This was a 2-arm, randomised, clinical trial conducted among 16 community pharmacies and 239 patients with uncontrolled HTN in the U.A.E over a period of 12 months. The first arm (n=119) received telepharmacy services and the second arm (n=120) received traditional pharmaceutical services. Both arms were followed up to 12 months. Pharmacists self-reported the study outcomes, which primarily were the changes in SBP and DBP from baseline to 12-month meeting. Blood pressure readings were taken at baseline, 3, 6, 9, and 12 months. Other outcomes were the mean knowledge, medication adherence and DRP incidence and types. The frequency and nature of pharmacist interventions in both groups were also reported. **Results:** The mean SBP and DBP differences were statistically significant across the study groups at 3-, 6-, and 9-month follow-up and 3-, 6-, 9-, 12- month follow-up, respectively. In detail, the mean SBP was reduced from 145.9 mm Hg in the intervention group (IG) and 146.7 mm Hg in the control group (CG) to 124.5, 123.2, 123.5, and 124.9 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the IG and 135.9, 133.8, 133.7, and 132.4 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the CG. The mean DBP was reduced from 84.3 mm Hg in IG and 85.1 mm Hg in CG to 77.6, 76.2, 76.1, and 77.8 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the IG and 82.3, 81.5, 81.5, and 81.9 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the CG. Medication adherence and knowledge of participants in the IG towards hypertension were significantly improved. The DRP incidence and DRPs per patient identified by pharmacists in the intervention and control groups were 2.1% versus 1.0% (p=0.002) and 0.6 versus 0.3 (p=0.001), respectively. The total numbers of pharmacist interventions in the IG and CG were 331 and 196, respectively. The proportions of pharmacist interventions related to patient education, cessation of drug therapy, adjustment of drug dose, and addition of drug therapy across the IG and CG were 27.5% versus 20.9%, 15.4% versus 18.9%, 14.5% versus 14.8%, and 13.9% versus 9.7%, respectively (all with p<0.05). **Conclusion:** Telepharmacy may have a sustained effect for up to 12 months on blood pressure of patients with hypertension. This intervention also improves pharmacists' ability to identify and prevent drug-related problems in community setting.

Keywords: telepharmacy; hypertension; community pharmacies

INTRODUCTION

Hypertension (HTN), or elevated blood pressure (BP), is a noncommunicable chronic condition affecting 1.28 billion people, and leading to 7.5 million deaths per year worldwide.[1] Because of its enormous humanistic and monetary consequences as it is the most common chronic condition for which adults visit primary care facilities, hypertension costs the United States (US) economy more than $50 billion annually.[2,3] In Europe, hypertension affects more than 22% of the adult population.[4] A recent systematic review and meta-analysis estimated that hypertension affects 31% of the United Arab Emirates (UAE) population. Uncontrolled hypertension, which occurs when the blood pressure is poorly managed, may lead to serious and even life-threatening complications.[5] In spite of recent advancements in hypertension therapy and management, only 1 in 5 patients with hypertension have it controlled.[1] These figures are expected to be significantly higher in middle and low-income countries, possibly because of poverty, poor access to healthcare, and inappropriate dietary habits.[6] In addition to being vulnerable to disease complications, patients with hypertension are expected to experience a variety of drug-related problems (DRPs) given their exposure to multiple medications and poor awareness of safe use.[7,8]

Studies[9-12] carried out mostly in hospital settings have found that pharmacists have a significant role in hypertension management, particularly when other health professionals are swamped with other duties. In detail, Margolis et al[9], randomized 326 patients with uncontrolled hypertension into two groups, of which one received pharmaceutical care and the

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other received usual care, and followed them over 12 months after the intervention finished. Their results suggested that the BP of participants allocated to the intervention group was significantly reduced. A similar study,[13] with a shorter follow-up period, found that BP was controlled in 57.2% of participants who received pharmaceutical care versus 30.0% of participants in the control group. However, in changing circumstances, access to care becomes substantially challenging and alternative strategies are needed.

In response to the outbreak of coronavirus disease 2019 (COVID-19, the implementation of telepharmacy or remote pharmaceutical care has been unexpectedly accelerated worldwide.[14] However, a barrier to adopting telepharmacy services for hypertension management in community pharmacies is the inadequacy of evidence on long-term implementation outcomes. This study, therefore, aims to examine the effectiveness of remote pharmaceutical care provided by community pharmacies in hypertension management through 12 months of follow-up in one intervention group (telepharmacy services) and one control group (traditional pharmacy). We also assessed the impact of remote pharmaceutical care on the rate and severity of drug-related problems of patients with uncontrolled hypertension.

METHODOLOGY

Trial design and participants

This 2-arm follow-up of randomised clinical trial was conducted from June 2021 to August 2022 among 16 community pharmacies and 239 patients with uncontrolled HTN in the U.A.E. The first arm was referred to as "intervention arm", and it included 119 patients who were recruited by 8 community pharmacies providing telepharmacy services. The second arm was referred to as "control arm", and it included 120 patients who were recruited by 8 pharmacies providing standard pharmacy care. The study protocol, which followed Consolidated Standards of Reporting Trials (CONSORT) reporting guidelines, was approved by the Research Ethics Committee at the University of Sharjah (REC-22-03-17-03) and registered in ClinicalTrials.gov (NCT05488002).

Adults who had systolic BP (SBP) > 140 mmHg (>130 mmHg for patients with diabetes or chronic kidney disease) and diastolic BP (DBP) > 90 mmHg (>80 mmHg for patients with diabetes or chronic kidney disease) at the most recent pharmacy visit were candidates to participate in the study. To make sure candidates have uncontrolled HTN, 3 BP measurements were taken using a standardized protocol in the research pharmacy. The eligibility of participation was considered based on the mean of the three BP measurements. Candidates were excluded based on the following criteria; end-stage renal failure, stroke or surgery in the past 6 months, pregnancy, any mental problem that would limit ability to make decisions, and chronic heart diseases.

According to previous studies,[9,15] virtual services delivered by pharmacists may improve HTN management by 20%. By inserting this value to the G*power software,[16] and considering 80% statistical power, 95% confidence interval, and 10% attrition rate, the sample size for each study group was 120 participants.

The study procedure (recruitment, randomization, intervention, and outcomes)

This trial was carried out over five major steps. First, recruitment of 16 community pharmacies, which was performed through purposive sampling based on the following criteria. The intervention arm pharmacies had to operate telepharmacy services that include remote filling of prescriptions, virtual counselling, and home delivery of medications. The control arm pharmacies had to provide traditional pharmaceutical services that include face-to-face interaction with patients. Both intervention and control arm pharmacies had to be operated by pharmacists who are available for training and have at least two years of experience. The principal investigator (PI) approached managers of eligible pharmacies via telephone calls first, if accepted and gave their consent, pharmacists were approached and asked to give their consent. Out of 31 pharmacies screened, 16 comprising 31 pharmacists were recruited. The research team trained pharmacists how to fill out the data reporting form, recruit and handle participants. Second, each pharmacy was responsible for recruiting 15 patients with uncontrolled hypertension. This was performed by screening pharmacy costumers against eligibility criteria and approaching potential candidates. The purpose and the estimated period of the study, and the privacy measures taken by the research team was explained. All enrolled participants, who met eligibility criteria and agreed to participate, provided written informed consent (manually or electronically signed). Each pharmacist generated an excel sheet (Microsoft Corp., Redmond, WA) containing code names and mobile numbers of participants. All 16 excel sheets were merged, and a single datasheet for all participants was built. Third, after recruitment, participants were randomly allocated to two groups (intervention and control) using the random number generator in SPSS version 26. While the research team knew participants only by code names during allocation, the process was completely concealed from the pharmacists. Fourth, an automated BP monitor was given to participants allocated to the intervention arm, they were asked to take at least 6 measurements weekly. The BP goal was <135SBP/85DBP mmHg or <125SBP/75DBP mmHg for participants with renal or endocrine diseases. Participants assigned to the intervention arm received active telepharmacy services that included a virtual meeting every 2 weeks with the pharmacist. Participants were able to approach pharmacists during their working hours by phone calls, video calls, or messages. After six months, the meeting was carried out every month for another six months. During this one-hour meeting, the pharmacist's fundamental task was to review medications, detect any drug-related problems, and make necessary adjustments including dose change, cessation of a drug, adding a drug. Pharmacists were instructed to adjust HTN therapy if less than 75% of readings met BP target since last meeting. Another example of remote pharmacists' intervention is to reduce the drug dosage if the

patient encountered side-effects. The pharmacist trained the patient on BP monitor, provided virtual counselling, and filled prescriptions if any. Furthermore, the pharmacist reviewed the BP readings with the patient, discussed medication adherence and tactics that can be adopted to improve patients' adherence to medication, and provided the patient with advice on lifestyle changes. During the study period, participants allocated to the control arm received traditional pharmaceutical care as usual. This could include face-to-face consultation and BP measurement. Fifth, the study primary and secondary outcomes were measured through a data collection form that was designed and sent to pharmacists who filled it out over the study period. The final draft of the data collection form delivered to the pharmacists was written in both Arabic and English. The primary outcomes were the changes in SBP and DBP from baseline to 12-month meeting. Blood pressure readings were taken at baseline, 3, 6, 9, and 12 months. Secondary outcomes were the incidence and types of DRPs detected by pharmacists in both study groups. The rate of DRPs was calculated by dividing the overall number of DRPs detected by the total number of drugs received by participants during the study period. The types of DRPs was adopted from AbuRuz et al.,[17] which classify DRPs into seven major categories including unnecessary drug, the need for adding new drug, safety risk, efficacy-related issues, poor knowledge, dosing issues, allergy, and drug-drug interactions. Furthermore, we assessed the number and types of pharmacist interventions in both arms. DRPs and pharmacist interventions were reported by pharmacists over the study period. Participants' adherence to medication was assessed in both arms using an eight-item adherence scale established by Morisky et al.[18] A "yes" response was coded as zero and a "no" response was coded as one. Participants with an overall score of 8 out of 8 was considered highly adherent to medication, and those with a score between 6 and 8 was considered to have moderate adherence to medication, and those with a score below 6 was considered to have poor adherence to medication.[19] Socio-demographic information were gathered at baseline and comprised age, sex, marital status, income, educational level, nationality, working status, and comorbidity.

Statistical analysis

The research team gathered all excel sheets filled by pharmacists, and generated a database, which was double checked by two independent researchers by comparing the information in the database with those filled out by the pharmacists in the original data collection forms. The statistical analysis was performed by a professional statistician using SPSS version 26 (SPSS Inc., Chicago, IL). Categorical variables were listed as absolute numbers with proportions and continuous variables as mean ± SD. To test whether the proportions of categorical variables were different between the study arms, $\chi 2$ test and Fisher exact probability test were used, as necessary. To assess whether the means of continuous variables (i.e. BP readings) were different between the study arms, the independent samples T tests was used. Findings with P-value < 0.05 were considered statistically significant.

RESULTS

Among 432 participants screened, 119 (mean [SD] age, 60.8 [11.5] years; 54.6% male) were randomised to the intervention group (IG) and 120 (mean [SD] age, 61.0 [12.3] years; 55.8%

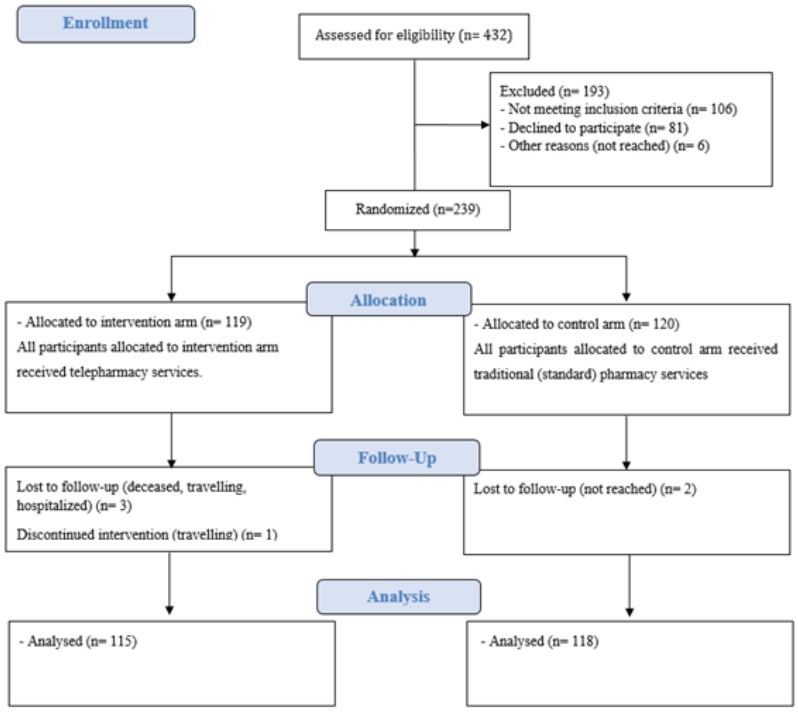

Figure 1. The flow diagram of the trial (according to CONSORT 2010 Statement)

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male) to the control group (CG). Among the participants who completed a baseline assessment in the IG and CG, 4 (2 travelled, 1 was deceased, and 1 was admitted to hospital) and 2 (not reachable) were excluded, respectively (Figure 1).

Baseline characteristics of participants are shown in table 1 for all participants enrolled in the trial (n=239) and participants who completed the trial (n=233). Among the patients who assigned to the IG and completed the trial, 55.9% were male, 80.5% were married, and 8.5% were smokers. Additionally, around one-quarter (23.7%) had diabetes, 10.2% had history of cardiovascular diseases, and 6.8% had dyslipidaemia. At baseline, the means of SBP (SD) and DBP (SD) for patients in the IG who completed the trial were 146.7 (12.3) mmHg and 85.1 (11.6) mmHg, respectively. There were no statistically significant differences in baseline characteristics across the study groups (p>0.05).

The mean SBP was reduced from 145.9 mm Hg in IG and 146.7 mm Hg in CG to 124.5, 123.2, 123.5, and 124.9 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the IG and 135.9, 133.8, 133.7, and 132.4 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the CG (Table 2). Apart from baseline, the mean SBP of patients in the IG at 3-, 6-, and 9-month follow-up was significantly lower than that of patients in the CG (all p values<0.05). The mean SBP difference was not statistically significant across the study groups at baseline (p=0.61) and 12-month follow-up (p=0.06). The mean DBP was reduced from 84.3 mm Hg in IG and 85.1 mm Hg in CG to 77.6, 76.2, 76.1, and 77.8 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the IG and 82.3, 81.5, 81.5, and 81.9 mm Hg at 3-, 6-, 9-, and 12-month follow-up in the CG.

The mean score of medication adherence in the IG was significantly increased from 4.9 at baseline to 7.3, 7.9, 7.9, and 7.6 at 3-, 6-, 9-, and 12-month follow-up, respectively (Table 3). The mean scores of knowledge on HTN symptoms, risk factors, and healthy life style across the IG participants were significantly improved from 2.1, 1.8, and 1.4 at baseline to 4.2, 4.2, and 3.8 at 12-month follow-up, respectively. Apart from baseline, all knowledge-related scores of participants in the IG

Table 1. Baseline characteristics for all participants and participants completing the 12-month follow-up

	All participants (n=239)		**Participants completing the 12-month follow-up (n=233)**	
Variable	CG (n=120)	IG (n=119)	CG (n=118)	IG (n=115)
Male, n (%)	67 (55.8%)	65 (54.6%)	66 (55.9%)	63 (54.8%)
Age, mean (SD), year	61.0 (12.3)	60.8 (11.5)	61.0 (11.8)	60.9 (11.6)
Married, n (%)	96 (80.0%)	92 (77.3%)	95 (80.5%)	90 (78.3%)
Geographic region of origin, n (%)				
Middle East	102 (85.0%)	105 (88.2%)	102 (86.4%)	103 (89.6%)
Asia	8 (6.7%)	7 (5.9%)	7 (5.9%)	6 (5.2%)
Africa	5 (4.2%)	4 (3.4%)	5 (4.2%)	4 (3.5%)
America	3 (2.5%)	2 (1.7%)	2 (1.7%)	1 (0.9%)
Europe	1 (0.8%)	1 (0.8%)	1 (0.8%)	1 (0.9%)
Australia	1 (0.8%)	0 (0.0%)	1 (0.8%)	0 (0.0%)
Educational level				
Below secondary school	11 (9.2%)	9 (7.6%)	10 (8.5%)	9 (7.8%)
Secondary school	24 (20.0%)	21 (17.6%)	22 (18.6%)	20 (17.4%)
Above secondary school	85 (70.8%)	89 (74.8%)	86 (72.9%)	86 (74.8%)
Smoker*, n (%)	12 (10.0%)	10 (8.4%)	10 (8.5%)	9 (7.8%)
Diabetes, n (%)	29 (24.1%)	26 (21.8%)	28 (23.7%)	25 (21.7%)
History of CVD, n (%)	13 (10.8%)	11 (9.2%)	12 (10.2%)	9 (7.8%)
Dyslipidemia, n (%)	10 (8.3%)	9 (7.6%)	8 (6.8%)	7 (6.1%)
Obesity (body mass index ≥ 30)	17 (14.2%)	16 (13.4%)	17 (14.4%)	13 (11.3%)
Taking any antihypertensive drugs, n (%)	94 (78.3%)	92 (78.0%)	92 (78.0%)	90 (78.2%)
Number of antihypertensive drugs per patient, mean (SD)	1.9 (1.1)	2.2 (1.6)	1.8 (1.2)	2.0 (1.4)
SBP/DBP, mean (SD), mm Hg,	146.9 (12.5)/85.6 (11.8)	146.5 (13.2)/84.7 (11.3)	146.7 (12.3)/85.1 (11.6)	145.9 (13.2)/84.3 (11.1)

CG: control group, IG: intervention group, SD: standard deviation, BP: blood pressure. Variables are listed as numbers with percentages unless otherwise mentioned. A Smoker was defined as "*an adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes*". There were no statistically significant differences in baseline characteristics across the study groups (p>0.05).

Table 2. Changes of blood pressure from baseline

	Blood pressure in IG (n=115)		Blood pressure in CG (n=118)		
Variable	**Mean (95%CI)**	**Reduction from baseline**	**Mean (95% CI)**	**Reduction from baseline**	***P value**
Systolic blood pressure					
Baseline	145.9 (143.3 to 149.1)	N/A	146.7 (143.5 to 148.7)	N/A	0.61
3 months	124.5 (122.4 to 128.6)	-21.4 (-24.2 to -18.6)	135.9 (132.4 to 138.4)	-10.8 (-12.2 to -8.9)	<0.001
6 months	123.2 (121.8 to 125.5)	-22.7 (-25.3 to -19.1)	133.8 (131.3 to 137.6)	-12.9 (-15.6 to -10.3)	<0.001
9 months	123.5 (121.2 to 125.6)	-22.4 (-23.8 to -18.9)	133.7 (131.2 to 137.6)	-13 (-11.4 to -10.9)	<0.001
12 months	124.9 (122.8 to 129.3)	-21 (-24.6 to -18.8)	132.4 (130.8 to 135.5)	-14.3 (-16.1 to -12.5)	0.06
Diastolic blood pressure					
Baseline	84.3 (81.9 to 87.5)	N/A	85.1 (82.3 to 87.6)	N/A	0.36
3 months	77.6 (75.4 to 79.3)	-6.7 (-9.5 to -4.8)	82.3 (80.1 to 84.3)	-2.8 (-4.8 to -1.4)	0.009
6 months	76.2 (74.6 to 78.4)	-8.1 (-10.5 to -6.9)	81.5 (79.9 to 83.8)	-3.6 (-5.2 to -1.9)	0.006
9 months	76.1 (74.6 to 78.5)	-8.2 (-10.2 to -6.5)	81.5 (79.8 to 83.6)	-3.6 (-5.1 to -1.9)	<0.001
12 months	77.8 (75.3 to 79.5)	-6.5 (-9.1 to -5.2)	81.9 (80.1 to 84.5)	-3.2 (-4.8 to -2.3)	0.04

*P values indicate differences between the study groups. Bold values are significant results. CI: confidence interval, IG: intervention group, CG: control group, N/A: not applicable

Table 3. Medication adherence and knowledge scales across the study groups

	IG (n=115)						CG (n=118)						
Variable	**Baseline**	**3 months**	**6 months**	**9 months**	**12 months**	***P value**	**baseline**	**3 months**	**6 months**	**9 months**	**12 months**	***P value**	**¥P value**
Knowledge of HTN symptoms	2.1 (1.1)	3.9 (1.9)	4.1 (2.3)	4.2 (2.4)	4.2 (2.4)	**.002**[a] .14[b]	2.2 (1.3)	2.6 (1.8)	2.9 (1.5)	2.9 (1.6)	3.0 (1.7)	.06[a] .75[b]	.39[c] **.03**[d] **.01**[e] **.001**[f] **.01**[g]
Knowledge of HTN risk factors	1.8 (1.2)	4.2 (2.3)	4.4 (2.6)	4.2 (2.2)	4.2 (2.2)	**.001**[a] .26[b]	1.7 (0.9)	2.2 (1.4)	2.3 (1.2)	2.4 (1.5)	2.2 (1.3)	.08[a] .82[b]	.85[c] **.001**[d] **.007**[e] **.005**[f] **.004**[g]
Knowledge of HTN healthy life style behaviours	1.4 (0.6)	3.2 (1.8)	4.1 (2.4)	4.1 (2.4)	3.8 (2.1)	**.006**[a] .09[b]	1.5 (0.7)	1.9 (1.1)	2.2 (1.2)	2.4 (1.6)	2.3 (1.4)	.15[a] .13[b]	.13[c] **.03**[d] **.001**[e] **.003**[f] **.04**[g]
Medication adherence	4.9 (2.8)	7.3 (3.1)	7.9 (2.3)	7.9 (2.4)	7.6 (1.8)	**<.001**[a] .35[b]	4.6 (1.9)	5.9 (2.7)	6.1 (3.1)	5.7 (2.3)	6.3 (2.6)	.06[a] .61[b]	.21[c] **.04**[d] .07[e] **.005**[f] **.03**[g]

All variables are shown as mean with standard deviation. *p value measures differences within the same arm (i.e. intervention, control) (a: for differences between "baseline" and "3 months": b: for differences between "3 months", "6 months", "9months", and "12 months". ¥P value measures differences between arms (c: differences in "baseline" between intervention and control arms, d: "3 months", e: "6 months", f: "9 months", and g: 12 months), Bold values are significant results.

were significantly higher than that of participants in the CG.

The total number of DRPs was 113, of which 74 were reported by pharmacists in the IG and 39 reported by pharmacists in the CG. The DRP incidence and DRPs per patient identified by pharmacists in the intervention and control groups were 2.1% versus 1.0% (p=0.002) and 0.6 versus 0.3 (p=0.001), respectively (Table 4). The findings of this study showed that there were significant differences in the proportions of efficacy-related and safety-related problems of DRPs between the IG and CG. Specifically, the proportions of DRPs related to efficacy and safety across the IG and CG were 24.3% versus 20.5% (p=0.021) and 39.2% versus 30.8% (p=0.001), respectively. The proportions of other DRPs classes, namely, unnecessary treatment, untreated condition, poor knowledge, poor adherence, and necessity for monitoring were similar across the study groups.

The total numbers of pharmacist interventions in the IG and CG were 331 and 196, respectively. The proportions of pharmacist interventions related to patient education, cessation of drug therapy, adjustment of drug dose, and addition of drug therapy across the IG and CG were 27.5% versus 20.9%, 15.4% versus 18.9%, 14.5% versus 14.8%, and 13.9% versus 9.7%, respectively (all with p<0.05) (Figure 2). The proportions of

Table 4. Analysis of drug-related problems reported by pharmacists during the study

Variable	Total (n=233)	Intervention arm (n=115)	Control group (n=118)
Total medications, n	7,296	3,566	3,730
*Patients with MRPs, n	68	41	27
*Total MRPs, n	113	74	39
*MRPs incidence (total MRPs/ total medications×100)	1.5%	2.1%	1.0%
*MRPs per patient (total MRPs/total no. of patients)	0.5	0.6	0.3
MRP classification			
Unnecessary treatment	17 (15.04%)	11 (14.9%)	6 (15.4%)
Untreated condition	6 (5.3%)	4 (5.4%)	2 (5.1%)
***Efficacy-related problems**	26 (23.0%)	18 (24.3%)	8 (20.5%)
Need for additional/combination therapy	9 (34.6%)	6 (33.3%)	3 (37.5%)
Need for more effective drug	6 (23.0%)	4 (22.2%)	2 (25.0%)
Low dose	6 (23.0%)	4 (22.2%)	2 (25.0%)
Drug-Drug interaction	5 (19.2%)	4 (22.2%)	1 (12.5%)
***Safety-related problems**	41 (36.3%)	29 (39.2%)	12 (30.8%)
High dose	19 (46.3%)	13 (44.8%)	6 (50.0%)
Contraindication	11 (26.8%)	8 (27.6%)	3 (25.0%)
Potential risk for adverse drug reaction	8 (19.5%)	6 (20.7%)	2 (16.7%)
Allergy	3 (7.3%)	2 (6.9%)	1 (8.3%)
Poor knowledge	15 (13.3%)	10 (13.5%)	5 (12.8%)
Poor adherence	6 (5.3%)	1 (1.4%)	5 (12.8%)
Necessity for monitoring	2 (1.8%)	1 (1.4%)	1 (2.6%)

*p≤0.05. DRPs: drug-related problems. Bold refers to a major DRP class. Data are presented as numbers with percentages n (%), unless stated otherwise.

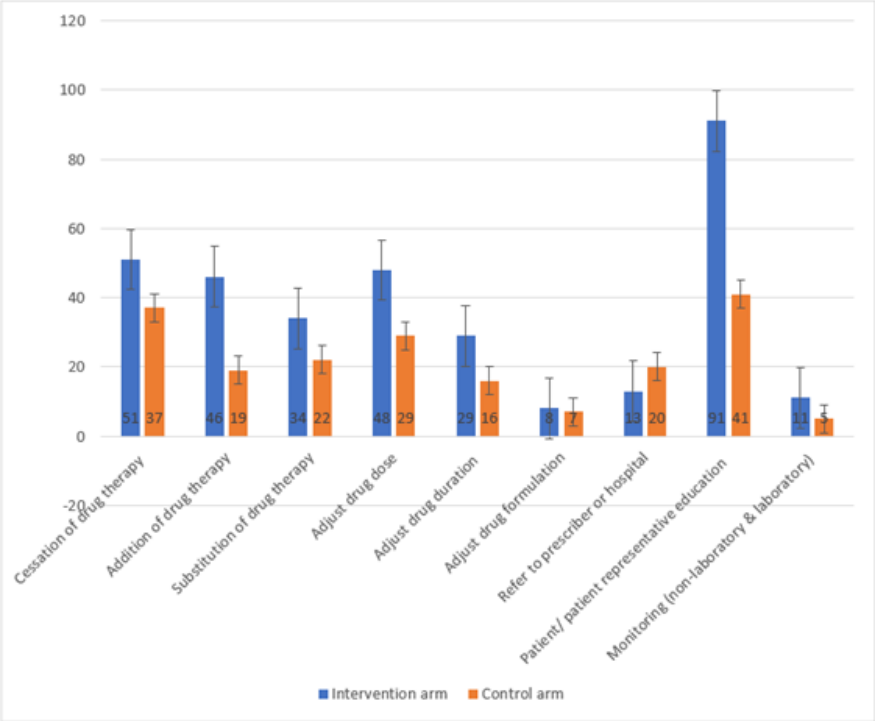

Figure 2. Frequency and types of pharmacist interventions in the intervention (n=331) and control (n=196) arms

pharmacist interventions related to substation of drug therapy, adjustment of drug duration and formulation, referral to hospital, and monitoring were similar across the study groups (all with p>0.05).

DISCUSSION

Hypertension poses serious health problems,[1] which are expected to be exacerbated in changing circumstances given the emerging challenges in access to healthcare and overburdened health professionals. Community pharmacists, with technology integration at its peak, have potential to take a bigger role in hypertension management and ensure medication safety in primary care.[14] Therefore, in this study, we assessed the impact of telepharmacy services delivered by community pharmacies on BP of patients with uncontrolled hypertension. We also examined the effect of this technology on their capacity to detect drug-related problems. To our knowledge, no similar studies have been carried out in the Middle East. This study, given its unique intervention, will advance hypertension management in the region and provide a better understanding of the benefits of information technology integration in community pharmacies.

The SBP of patients who received telepharmacy services after 3, 6, and 9 months of the intervention was significantly lower than those who received traditional pharmaceutical services. The DBP of patients who received telepharmacy services after 3, 6, 9, and 12 months of the intervention was also significantly lower than DBP of patients in the CG. This outcome demonstrates how telepharmacy integration can be a promising tool in controlling the blood pressure of patients with hypertension. However, the mean SBP difference between the IG and CG was not statistically significant after 12 months of the intervention. This could be an indication of how SBP is more difficult to control than DBP.[20] Therapeutic approaches should appropriately target controlling SBP to reduce risk for vascular complications. The impact of telepharmacy implementation on hypertension in community setting has been rarely addressed, and most studies found in the literature address the effectiveness of telemonitoring on BP. Remote pharmacist monitoring and recommendation were found effective in controlling the BP of patients with uncontrolled hypertension.[9,21] Another trial reported that telemonitoring and pharmacist management of patients with hypertension can significantly improve BP, particularly for younger participants and those without diabetes.[22] These findings from different studies seem easy to understand in the context of benefits provided by remote pharmaceutical care, which include timely and convenient services with minimum cost. Telepharmacy models enable pharmacists to conveniently provide patients with clinical recommendations that are more personalised and follow-up with them without fear of spreading infections or losing another patient or a potential costumer; hence, patients' clinical outcomes can be significantly improved.

Telepharmacy services adopted in the IG of this study led to a statistically significant improvement in medication adherence of patients with hypertension. This can be mostly related with the levels of participants' knowledge and awareness of hypertension complications, symptoms, and risk factors, which were significantly improved in this study. Additionally, this outcome can be interpreted in the context communication level between pharmacists and participants, which we believe it was boosted by the diversity and quality of telepharmacy infrastructure used in the study. This comprised a variety of tools including video and audio calls, and social media communication. The literature contains conflicting reports regarding the impact of telepharmacy on medication adherence of patients with hypertension. Fuentes et al,[15] reviewed 17 articles on the impact of virtual pharmacist interventions on medication adherence of patients with hypertension and concluded that remote pharmacist interventions can be integral in improving medication adherence of hypertensive patients. However, Guadamuz et al,[23] reviewed the dispensing records of pharmacies with telepharmacy tools and those with traditional pharmaceutical services, and concluded that telepharmacy users were less adherent to their antihypertensive agents than users of traditional pharmacies. These conflicting findings seem easy to understand in the context of considerable variation in telepharmacy infrastructure adopted in each study. In this regard, follow-up calls to patients with hypertension by pharmacists was significantly associated with an improvement in medication adherence, a randomized trial reported.[24] However, they did not find any influence on blood pressure of participants, which supports the claim that partial integration of information technology into healthcare may not achieve maximum clinical benefits.[25]

The findings of this study indicate that pharmacists in the IG were able to identify more DRPs than pharmacists in the control group, which can be attributed to three main elements; communication with patients, the magnitude, and nature of clinical data available. Telepharmacy removes communication barriers with patients, especially in changing circumstances, and provides pharmacists with more clinical information about patients' therapy and life style.[26] This information, which can be used to identify DRPs, are easily accessible through telepharmacy than traditional services, because patients are not worried of spending more time with their professionals and contracting an infection when they are online. This explains the high number of pharmacist interventions related to patient education in our study. Efficacy and safety-related issues were the most common types of DRPs identified by pharmacists in the IG, which is consistent with several previous studies.[7,27-29] That explains why around one-third of pharmacist interventions in the IG in our study were addition or cessation of drug therapy.

To sum up, the findings of this trial could be helpful for advancing hypertension management and ensuring medication safety, especially in changing circumstances. On a broader scope, our findings present telepharmacy as an applicable strategy to control blood pressure of patients with hypertension, improve their medication adherence, and awareness of the disease. Moreover, our findings shed light on how telepharmacy

improves pharmacists' ability to detect and prevent DRPs. Nonetheless, the clinical benefits of our intervention could not be sustained for the long term without continuous optimization and reevaluation of telepharmacy tools. We are also deeply concern whether the extension of the role of the pharmacists can influence their collaboration with other professionals, especially physicians; hence, further studies on physician-pharmacist collaborative practice in hypertension management are necessary to optimize therapy and ensure patient safety.

Limitations

This study has several limitations. First, the self-report nature of the outcome assessment may introduce reporting bias, which could affect the reliability of our findings.[30] Second, the study only examined process-based parameters such as the change in blood pressure, the incidence and types of DRPs, and medication adherence. Nonetheless, outcome-based parameters such as mortality, hospitalization, or recovery were beyond the scope of the study. Moreover, the cost difference between telepharmacy and traditional pharmacy and time spent on pharmacist intervention were not assessed in this study. Third, although missing data are expected given the self-reporting nature of the study and the vast volume of costumers in community pharmacies, the effect of this parameter on the validity of the findings was not assessed. Thus, we recommend further studies of a broader scope to maximize benefits of telepharmacy in hypertension management.

CONCLUSION

Telepharmacy may be useful for controlling the blood pressure and improving medication adherence of patients with hypertension. Furthermore, this tool increases pharmacists' ability to identify and prevent drug-related problems in community setting. Therefore, the findings of the current study assured the integral role of pharmacists in disease management and highlighted the importance of telepharmacy as an effective tool for enhancement of patients' clinical outcomes.

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DECLARATION OF COMPETING INTEREST

The authors have no relevant financial or non-financial interests.

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ETHICS APPROVAL

The Ethics aspects of this study was approved by the Research Ethics Committee at the University of Sharjah (REC-22-03-17-03).

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APPENDIX

CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	1
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	1
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	2
	2b	Specific objectives or hypotheses	3
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	3
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	3
Participants	4a	Eligibility criteria for participants	3
	4b	Settings and locations where the data were collected	3
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	4
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	5
	6b	Any changes to trial outcomes after the trial commenced, with reasons	
Sample size	7a	How sample size was determine	3
	7b	When applicable, explanation of any interim analyses and stopping guidelines	5
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	4
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	4
Allocation Concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	4
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	5
	11b	If relevant, description of the similarity of interventions	5
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	5
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	5
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	6
	13b	For each group, losses and exclusions after randomisation, together with reasons	6
Recruitment	14a	Dates defining the periods of recruitment and follow-up	6
	14b	Why the trial ended or was stopped	6
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	6
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	6
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	6
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	6
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	6

Harms	19	All-important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	8
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	7
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	7
Other information			
Registration	23	Registration number and name of trial registry	8
Protocol	24	Where the full trial protocol can be accessed, if available	8
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up to date references relevant to this checklist, see www.consort-statement.org.