HOME BLOOD PRESSURE MONITORING (HBPM) EFFECT ON OFFICE BLOOD PRESSURE AND MEDICATION ADHERENCE AMONG HYPERTENSIVE PATIENTS ATTENDING PRIMARY CARE CLINIC IN UNIVERSITY HOSPITAL

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LIST OF ABBREVIATIONS

ABPM	Ambulatory blood pressure monitoring
ANCOVA	Analysis of covariance
BMI	Body mass index
BP	Blood pressure
CI	Confidence interval
CRF	Case report form
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
HBPM	Home blood pressure monitoring
HPT	Hypertension
HREC	Human Research Ethic Committee
MAS	Medication adherence score
MEMS	Electronic medication events monitoring system
NHMS	National Health and Morbidity Survey
NSP-NCD	National Strategic Plan for Non-Communicable Diseases
OBPM	Office blood pressure measurement
RCT	Randomized controlled trial
SBP	Systolic blood pressure
SD	Standard deviation
SMBP	Self-measurement of blood pressure
SPSS	Statistical Package for Social Sciences
WC	Waist circumference
WHO	World Health Organization

ABSTRAK

PEMANTAUAN TEKANAN DARAH DI RUMAH (‘HBPM’) DAN KESANNYA KE ATAS TEKANAN DARAH DI KLINIK DAN PEMATUHAN PENGAMBILAN UBATAN, DALAM KALANGAN PESAKIT HIPERTENSI DI KLINIK PRIMER HOSPITAL UNIVERSITI

Pengenalan:

‘HBPM’ kini semakin popular dan penggunaannya kini disyorkan oleh garis panduan tempatan dan antarabangsa dalam pengurusan kes hipertensi.

Objektif:

Untuk mengkaji kesan ‘HBPM’ terhadap tekanan darah klinik dan pematuhan pengambilan ubatan di kalangan pesakit hipertensi di Klinik Primer Hospital Universiti.

Metodologi:

Satu kajian rawak telah dijalankan dari Disember 2014 hingga April 2015, melibatkan 88 pesakit yang dibahagikan kepada kumpulan intervensi (yang melakukan ‘HBPM’) dan kumpulan kawalan. Pematuhan pengambilan ubatan diukur dengan menggunakan borang soal selidik Penilaian Komplian Ubat-Ubatan yang telah disahkan. Pesakit dilihat pada lawatan permulaan dan selepas dua bulan intervensi. Tujuan utama adalah untuk menilai perbezaan bacaan tekanan darah klinik dan skor pematuhan pengambilan ubatan sebelum dan selepas intervensi, melibatkan perbandingan dalam kumpulan dan di antara kumpulan.

Keputusan:

Bagi perbandingan dalam kumpulan; perubahan min tekanan darah sistolik (‘SBP’), tekanan darah diastolik (‘DBP’) dan skor pematuhan pengambilan ubatan (‘MAS’) adalah signifikan secara statistik. Namun, perubahan ini lebih ketara dilihat pada kumpulan intervensi berbanding kumpulan kawalan (‘SBP’ 17.6mmHg, ‘DBP’ 9.5mmHg, ‘MAS’ 1.5 vs ‘SBP’ 14.3mmHg, ‘DBP’ 6.4mmHg, ‘MAS’ 1.3). Selepas dua bulan, perbandingan di antara kumpulan menunjukkan perbezaan min terlaras bagi min ‘SBP’= 4.74 (95% CI -0.65 mmHg to 10.13 mmHg) (p=0.084); min ‘DBP’ = 1.41(95% CI -2.01 mmHg to 4.82 mmHg) (p=0.415) dan min ‘MAS’= 0.05 (95% CI -0.29 mmHg to 0.40 mmHg) (p=0.768). Tiada perbezaan yang signifikan bagi kesemua pembolehubah bagi perbandingan antara kumpulan di akhir kajian.

Kesimpulan:

Intervensi ‘HBPM’ selama 2 bulan menunjukkan penurunan bacaan tekanan darah klinik dan penambahbaikan dalam pematuhan pengambilan ubatan walaupun ianya tiada perubahan yang signifikan berbanding penjagaan hipertensi biasa. Oleh itu, kajian lanjut dengan tempoh yang lebih lama disarankan untuk menentukan kesan jangka panjang ‘HBPM’ ini.

ABSTRACT

HOME BLOOD PRESSURE MONITORING (HBPM) EFFECT ON OFFICE BLOOD PRESSURE AND MEDICATION ADHERENCE AMONG HYPERTENSIVE PATIENTS ATTENDING PRIMARY CARE CLINIC IN UNIVERSITY HOSPITAL

Introduction:

HBPM usage is increasingly popular nowadays and it is widely recommended by local and international guideline as part of the hypertensive care.

Objectives:

To evaluate HBPM effect on office BP and medication adherence among hypertensive patients attending primary care clinic in university hospital

Methods:

A randomized controlled trial was conducted from December 2014 to April 2015, involving 88 patients, allocated to either HBPM group or control group. Medication adherence was measured by a validated new Medication Adherence Score (MAS) questionnaire. Patients were seen at baseline and two months after intervention. The primary outcomes were to evaluate the differences of office BP and MAS at baseline and at two months within groups and in between groups.

Results:

For within group comparison, the mean changes of systolic BP (SBP), diastolic BP (DBP) and MAS were statistically significant for both groups. However, the

mean changes were greater seen in HBPM group than the control group (SBP 17.6mmHg, DBP 9.5mmHg, MAS 1.5 vs SBP 14.3mmHg, DBP 6.4mmHg, MAS 1.3). For comparison in-between group at two months, the adjusted mean difference for: mean SBP was 4.74 (95% CI -0.65 mmHg to 10.13 mmHg) (p=0.084); mean DBP was 1.41(95% CI -2.01 mmHg to 4.82 mmHg) (p=0.415) and mean MAS was 0.05 (95% CI -0.29 mmHg to 0.40 mmHg) (p=0.768). There were no significant differences between the two groups in all variables at 2 months of the study

Conclusion:

HBPM of two months results in greater reduction of office BP and improvement in medication adherence even though it is statistically no difference to usual care. Therefore, further studies with longer duration are recommended to assess the long term effect of HBPM.

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

Hypertension (HPT) is an important public health problem and it contributes to 4.5% of the disease burden worldwide (1). Globally, the prevalence of HPT in adults (≥25 years old) was around 40% with the number of uncontrolled HPT estimated around 1 billion in 2008 (2). World Health Organization (WHO) reported that 9.4 million deaths each year (13%) are attributed to HPT with 45% and 51% of deaths are due to heart disease and stroke respectively. This correlates with the fact that HPT is an established modifiable risks factor for cardiovascular, cerebrovascular and kidney disease (3-5). The burden of hypertensive-related morbidity and mortality is increasing year by year and this substantially contributes to the escalating costs of health care (6).

In Malaysia, as reported in the National Health and Morbidity Survey (NHMS) 2015; it was estimated that the prevalence of HPT in individuals aged 18 years and above was 30.3% (4). It was reported that the proportion of “undiagnosed HPT” still remained high at 17.2% with the finding of every two “diagnosed HPT”, there are three “undiagnosed HPT” (a ratio of 2:3) (4). Among those diagnosed with HPT, only about one-third of them (34.8%) achieved BP target of control (5). With the magnitude of problems as stated above, much effort need to be done in order to reduce the hypertensive prevalence to lesser than 24%; as to achieve the national target for year 2025 (4) and at the same time to tackle the issue of undiagnosed hypertension and failure to achieve BP control.

The National Strategic Plan for Non-Communicable Diseases (NSP-NCD) is among steps taken by our government in order to address the above issue. Prevention and promotion, clinical management, increasing patient compliance,

action with NGOS, professional bodies and other stakeholders, monitoring, research and surveillance, capacity building; and policy and regulatory interventions are among the seven strategies outlined in the NSP-NCD (7). The clinical management and monitoring part of the patients can be improved with the usage of out-off office BP measurement, in particular home-blood pressure monitoring.

Out-of-office blood pressure (BP) measurement defined as BP reading which is obtained from out of the clinic setting. This includes 24-hour ambulatory BP monitoring (ABPM) and home BP monitoring (HBPM). The usage of ABPM and HBPM are now gaining popularity in the management of hypertension (8), particularly in overcoming the limitation of office blood pressure measurement (OBPM).

Although OBPM is still considered as a gold standard for BP reading, there are several disadvantages that limit its use. In view of random fluctuations of BP throughout the day (BP variability) and the white-coat effect, OBPM is not representative of a patient's true BP (9). Consequently, there will be an overestimation of patient's BP, leading to unnecessary drug prescription (10). Therefore, a proper diagnosis and careful patients selection in starting treatment is very important and the usage of ABPM / HBPM may accomplish this objective.

1.1 AMBULATORY BP MONITORING (ABPM)

ABPM is first illustrated more than 40 years ago and traditionally it can provide the following three types of information, which include an estimation of "true" BP reading, the diurnal rhythm of BP, and BP variability (11). It provides multiple

BP measurements at specific intervals within 24- to 48-hours period. Thus, by reflecting the patient's actual BP, it shows a better estimate of end-organ damage associated with hypertension and gives a better prediction of cardiovascular events (12). It is also particularly useful in the clinical situation such as "white-coat" hypertension, drug-resistant hypertension, symptomatic hypotension or hypertension especially in the elderly (12) (13).

Despite its proven benefits, ABPM is currently limited for clinical use in view of its current cost and not widely available (13). With the limited clinical usage of ABPM, home blood pressure measurement (HBPM) now can be an alternative to ABPM and may have similar prognostic value. In view of its lower cost and greater patient's convenience; HBPM use is more popular than ABPM (13).

1.2 SELF-MONITORING OR SELF-MEASUREMENT OF BP (SMBP) / HOME BLOOD PRESSURE MONITORING (HBPM)

HBPM is introduced in the 1930s and its usage now is gaining acceptance among hypertensive patients (14). At present, in developed countries up to 70% of hypertensive patients are regularly assessing their BP at home (8). In Malaysia, Beth MRM found that 32.3% of hypertensive patient (whom hospitalized in a private hospital) are doing their home BP monitoring at home (15).

HBPM has many proven benefits compared to OBPM. A systematic review by Stergiou GS has shown that HBPM is better in term of diagnosing uncontrolled hypertension, assessing treatment response and improving patients compliance, thus potentially provides cost saving (13). Therefore, HBPM usage is now generally acknowledged by physicians worldwide (8).

1.2.1 Advantages of HBPM:

HBPM is proven to have several advantages over OBPM, and it is less costly and user-friendly compared to ABPM. With the recent technologies, the HBPM monitors (which use the oscillometric method for measurement) are now using an automated BP machine which are more reliable and show accurate readings (16). It allows multiple readings to be taken at person's usual environment and at their normally active day. Therefore, it provides a "true" BP value that is devoid of the white coat and placebo effects (16).

HBPM reading is shown to be lower than clinic BP (systolic BP of 10-20 mmHg, diastolic BP of 5-10 mmHg) (9, 13), and its readings are closer to the average BP recorded by ABPM; thus it serves the best predictor for cardiovascular risk (16). Therefore, it can improve a diagnostic and predictive accuracy.

<u>1.2.1.1 HBPM and its evaluation of white-coat hypertension and white-coat effect</u>

White-coat hypertension is defined as high BP reading that occurs only in a medical care setting. An individual is hypertensive during repeated OBPM (>140/90 mmHg), but ABPM/HBPM is normal (<135/85 mmHg); and it involves 20% of patients with established diagnosis of hypertension. White-coat effect is the phenomenon that leads to it, whereby it is related to anxiety or a hyperactive alerting response. The specificity of HBPM to detect this problem is 88.6%, and the sensitivity is 68.4% (13, 16, 17).

1.2.1.2 HBPM and its evaluation of masked hypertension

Masked hypertension or reverse white-coat hypertension (isolated home or isolated ambulatory hypertension) is defined as normal OBPM reading (<140/90 mmHg) but elevated ABPM or HBPM reading (>135/85 mmHg). In other words, hypertension is hidden until ABPM or HBPM is performed. Its prevalence is about 10% in the general population. It has similar cardiovascular risk as sustained hypertension. A study done in France (SHEAF study) found that 9% of masked hypertension patients had twice the risk of CVD events as the group in whom both office and home BP were controlled (16, 17).

1.2.1.3 HBPM and its correlation with hypertensive-target organ damage

HBPM is proven to be useful in predicting the hypertensive-target organ damage mainly the CVD events and mortality. A large cohort study in Japan showed that HBPM predicted the risk of stroke better than office BP readings. In this study, the risk of stroke increased 29% for each 10 mmHg increase in home systolic BP readings versus 9% for office readings. Another large cohort study found that each 10 mmHg increase above 135/85 mmHg was associated with 17% increase in risk of cardiovascular disease, even when office blood pressure was normal (14). Longitudinal studies found that systolic HBPM was a stronger predictor of diabetic nephropathy / end-stage renal disease and death (16).

1.2.2 Effects of HBPM on BP Control:

In general, office BP reading of <140/90 mmHg is taken as controlled BP. To achieve equivalence with clinic-measured BP, home BP readings should be adjusted by -5/5mmHg. Thus, a home BP reading of 135/85 mmHg taken at

home is equivalent to a reading of 140/90 mmHg in a clinic setting. For home BP reading, a mean systolic BP of >135mmHg and/or diastolic BP >85mmHg is considered as elevated, whereas systolic BP of <130mmHg and/or diastolic BP < 80mmHg respectively, is considered as normal (18).

BP control among treated hypertensive patients has been reported to vary between 5.4% and 58% worldwide (19). In United States, the condition remains poor; with approximately only 30% of patients categorized as controlled in spite of treatment (20). Similarly in Malaysia, based on National Health and Morbidity Survey (NHMS) 2011, only 34.8% of those treated for hypertension achieved BP target of control (21). In J-HOME study done in Japan, 42% of the sample had their BP controlled by office BP criteria (<140/90 mmHg), and only 34% had their home BP control (<135/85 mmHg) (16).

Home monitoring may improve the BP control by improving the patient's compliance towards treatment (9). HBPM makes patients more aware of their BP level, thus may increase their illness perceptions and subsequent health behaviours (14, 16, 22).

In meta-analysis of 18 randomized control trials (RCT), patients using HBPM have their BP improved by approximately 2.2 mmHg systolic and 1.9 mmHg diastolic BP. Although this reductions are small but it is significant, and it may contribute to an overall reduction in hypertensive-related complications (22).

In another systematic review and meta-analysis of 37 RCT, patients who were in home-based BP monitoring group, showed an improvement in both SBP and DBP (2.63 mmHg and 1.68 mmHg respectively) as compared to control group (23).

Cappuccio et al (2004) demonstrated that there was increment in the proportion of patients who achieved BP control among those using HBPM rather than standard BP monitoring (24).

Studies done on HBPM intervention alone seems to show a modest effect as compared to combined-intervention. Among the important additional co-interventions include patient education, tele-monitoring / internet communication systems, and intensive nurse led follow-up and patient led titration of drugs (14).

Green BB et al (2008) with three arm intervention study showed a greater net systolic and diastolic BP reduction (-13.2mmHg, -4.6mmHg respectively) and improved BP control in HBPM plus secure patient website training plus pharmacist care intervention (25).

McManus (2010) with intervention study of HBPM and self-titration of medications combined with tele-monitoring showed that systolic BP decreased by 17.6mmHg in intervention group and 12.2mmHg in control group; with difference in between group of 5.4mmHg (14).

1.2.3 Effects of HBPM on Medication Adherence:

A potential mechanism towards the achievement of BP control is by improving the patient's medication adherence (16). Medication adherence is "the extent to which the medication-taking behaviour of a patient corresponds with agreed recommendations from a health care provider" (26). Adherence patients are defined as those who accept their physician's advice to start drug therapy and who take their medication at least 80% of the time. Non-adherence means constant neglect rather than just temporary forgetfulness or neglect of treatment (27).

Multiple factors have been suggested to influence patient adherence to prescribed therapies. These include treatment profile (class of drug prescribed, number of pills per day, side effects of medication, high number of pills to be taken daily), sociodemographic factor (age, gender, low socioeconomic status), patients factor (lack of motivation or social support, poor patient's involvement due to lack of knowledge regarding hypertension forgetfulness, absence of symptoms, patient's treatment satisfaction), patients quality of life (psychological problems, especially depression) and other health care system issues (28) (29) (30).

Ramli et al found that 56% of the study subjects whom taking anti-hypertensives, anti-diabetics or anti-asthmatic drugs were non-compliant to their medications. Another study which was done at outpatient clinic in Penang showed that 51.3% of patients whom being interviewed had poor adherence to anti-hypertensives medications (26).

The evidence to support the effectiveness of HBPM in improving medication adherence among hypertensive patients are limited (20). Despite this fact, HBPM has been recommended as a good strategy to improve patient's adherence to antihypertensive medications (20).

Review of 11 RCTs by Ogedegbe and Schoenthaler reported that 54% of the trial has significant improvement in medication adherence attributed to the intervention. Five out of six studies were complex interventions and the intervention effects more seen in the trials that tested HBPM together with other adherence-enhancing strategies (16).

McKenney et al found that the mean compliance for the intervention group was significantly higher than that of the control group (95.1% vs 76.8%; p=0.0002) and this difference was greater as the number of compliance techniques increased (20).

Shulman reported that patient's compliance is better among those who feel that they are actively involved in their care. Similarly, Nessman et al showed that patients who monitor their BP at home and choose their own medication in a group sessions (according to a standard step-wise regime), has a better BP control and higher compliance toward treatment (31).

Therefore, HBPM is recommended for the evaluation of the treatment response and it may also improve the medication adherence. In addition, it also has the potential to improve the quality of care, thus reducing the number of clinic visits and resulting in the reduction of overall healthcare cost (16).

1.3 JUSTIFICATION AND RATIONALE

With all the evidence summarized above, HBPM is proven to be a useful strategy to improve the care of hypertensive patients. It is the time for our patients to practice HBPM as part of their self-care in the same way that home blood glucose monitoring is performed by the diabetic patient.

Majority of studies that examined the effects of HBPM were conducted in the western countries. Many of these studies have shown promising results towards the improvement of BP control and medication adherence.

Up to our knowledge; there is not much intervention study on HBPM done in Malaysia, in particular study on its effect towards BP control and medication

adherence. Therefore, we are interested in looking into our own local data. Findings from this study can be a platform for future research on HBPM in Malaysia and we are hoping that we can come out with a proper HBPM module in order to educate our patients on self BP monitoring.

CHAPTER 2: OBJECTIVES AND HYPOTHESIS

2.1 OBJECTIVES

2.1.1 GENERAL OBJECTIVE:

To evaluate the effect of home blood pressure monitoring (HBPM) on office BP and medication adherence among hypertensive patients attending Primary Care Clinic in University Hospital

2.1.2 SPECIFIC OBJECTIVES:

<u>To assess the effect of HBPM on office BP:</u>

i. To determine changes of mean SBP (of office BP reading) within HBPM and control group from baseline to 2 months period
ii. To determine changes of mean DBP (of office BP reading) within HBPM and control group from baseline to 2 months period
iii. To compare changes of mean SBP (of office BP reading) between HBPM and control group at 2 months period
iv. To compare changes of mean DBP (of office BP reading) between HBPM and control group at 2 months period

<u>To assess the effect of HBPM on medication adherence:</u>

v. To determine changes of mean medication adherence score (MAS) within HBPM and control group from baseline to 2 months period
vi. To compare changes of mean medication adherence score (MAS) between HBPM and control group at 2 months period

2.2 HYPOTHESIS

2.2.1 Null hypothesis:

i. There are no significant differences in mean SBP (of office BP reading) within HBPM and control group from baseline to 2 months period
ii. There are no significant differences in mean DBP (of office BP reading) within HBPM and control group from baseline to 2 months period
iii. There are no significant differences in changes of mean SBP (of office BP reading) between HBPM and control group at 2 months period
iv. There are no significant differences in changes of mean DBP (of office BP reading) between HBPM and control group at 2 months period
v. There are no significant differences in mean medication adherence score (MAS) within HBPM and control group from baseline to 2 months period
vi. There are no significant differences in changes of mean medication adherence score (MAS) between HBPM and control group at 2 months period

CHAPTER 3: METHODOLOGY

3.1 STUDY DESIGN

Randomized, non-blinded (open-labeled) two-arm parallel controlled trial

3.2 STUDY DURATION

23rd December 2014 until 17th March 2015

3.3 OPERATIONAL AREA

Primary care clinic in university hospital

3.4 REFERENCE POPULATION

All hypertensive patients in primary care clinic in university hospital

3.5 SOURCE POPULATION

All hypertensive patients who attended primary care clinic in university hospital

3.6 SAMPLING FRAME

All hypertensive patients who attended primary care clinic in university hospital from 23rd December 2014 to 17th March 2015 who fulfilled the inclusion and exclusion criteria. The criteria applied for both intervention and control group.

Inclusion Criteria:

i. Aged 18 years and above
ii. Stage I and stage II essential hypertension
iii. On antihypertensive medications

Exclusion Criteria:

i. Secondary hypertension
ii. Resistant hypertension
iii. Unstable cerebrovascular/cardiovascular disease
iv. Chronic kidney disease stage IV and V or end-stage renal disease
v. Pregnancy
vi. Previous usage of home blood pressure monitoring (HBPM) (prior to participating in this study)

3.7 SAMPLE SIZE CALCULATION

The sample size calculations were done for objectives of the study and the biggest sample size was chosen (as shown in table 1). Sample size calculations were done using Power and Sample Size Calculation Software for comparing two means.

For objective 1, sample size calculation was to determine changes of mean SBP (of office BP reading) within HBPM and control group from baseline to 2 months period.

Based on study by Màrquez et al (2004), the standard deviation of mean SBP (post-intervention) was 11.2mmHg. The other parameters were as follows:

α = Level of significance : 0.05

Power $(1-\beta)$ = 0.8

σ = Standard deviation for SBP (post-intervention) was 11.2mmHg

δ = Expected detectable difference in the mean SBP between HBPM group and control group was10.0mmHg

m = (ratio between HBPM group & control group): 1

After considering 20% of non-response rate, the calculated sample size was 25 subjects per group. Therefore the total sample size required for objective 1 was 50 subjects.

Table 1: Sample size calculation for objectives of the study

Parameter to compare	Standard deviation (σ)	Detectable difference (δ)	Ratio	Sample size	+ 20% drop-out
SBP	11.2	10	1	21	25 per group
DBP	7.6	5	1	37	44 per group
MAS	18.1	12	1	37	44 per group

The biggest sample size was from the calculation of mean DBP and mean Medication Adherence Score (MAS). Therefore the total sample size required for this study was 88 subjects (44 patients per group).

3.8 RESEARCH TOOLS

3.8.1 Respondent Pro Forma Sheet:

This Respondent Pro Forma Sheet consisted of four sections which include information regarding socio-demographic data; patient's medical profile; anthropometric measurements and office BP reading and New Medication Adherence Scale questionnaire. The patient was interviewed and the researcher filled-in the required information. The following data were obtained during the interview session:

a) Socio-demographic data including age, gender, race, marital status, background educational level, occupation and smoking status
b) Patient's medical profile (obtained from patient's medical record) including duration of hypertension, number of anti-hypertensive taken, comorbid of diabetes mellitus and dyslipidemia
c) Anthropometric measurements including measurement of height and weight (to obtain the Body Mass Index), waist circumference; and office BP reading were documented. All the measurements were taken using the standard protocol.
d) New Medication Adherence Scale questionnaire consisting of seven questions.

3.8.2 Tools for anthropometric measurement

i. Weight and height measurement:

   A standardized secca scale was used to measure the patient's weight in kg and height in cm.

   Patients were asked to empty their pockets and to stand on bare feet before the measurements were taken. Body mass index (BMI) was

calculated from the measurement of weight and height by using the formula: BMI = Weight (kg) / Height^2 (m) ^{2}

ii. Waist Circumference:

A soft tape was used to measure the patient's waist circumference in cm. The patients were asked to stand with their feet 25 to 30cm apart with weight evenly distributed. The arms hang on each side of the body at an angle of 30^0. The measurement was taken at the end of a normal expiration, at mid-distance circumferentially between the lowest rib margins and top of iliac crest. The measurement was made twice, taking the average as the final reading.

3.8.3 Tools for BP measurement

i. Office BP measurement:

Automatic BP monitor Omron model HEM-7203 was used to measure the office BP.

The machine was properly validated, maintained and regularly recalibrated according to the manufacturers' instruction by maintenance technician. An appropriate BP arm-cuff with correct size was used during the measurement.

For the measurement, the patients were asked to be seated in a correct technique (seated on a chair with legs uncrossed, with his/her back supported and arm outstretched on the table). They were asked to be rested, not talking and relaxed for at least 5 minutes prior to the BP measurement. The BP machine was placed at the heart level during the measurement. Two BP recordings were obtained from the right arm of

the patients at 5 minutes interval. The mean of this two office BP reading was taken at baseline and at 2 months of intervention.

ii. Home BP monitoring:

Automatic BP monitor Omron model HEM-7120 was used for measurement of home BP.

For this purpose, the patients were provided with a new set of Omron HEM-7120 and a BP diary. Each set of Omron HEM-7120 consisted of a main unit, arm cuff, instruction manual and 4 “AA” batteries.

Omron HEM-7120 used an IntelliSense Technology in which it applied the right amount of pressure for fast, accurate and more comfortable measurements. It used oscillometric method for the measurement and able to measure the pressure range from 0 to 299mmHg and pulse of 40 to 180 beats per minute. This model was listed under Malaysian Ministry of Health and approved by British Hypertension Society (www.bhsoc.org) for usage at home and may also be used in the clinic setting (refer Appendix 4 for HBPM diary).

3.8.4 New Medication Adherence Scale Questionnaire

This questionnaire consented for use in this study by Ramli et al, who done a study on ‘Medication adherence among hypertensive patients of primary health clinics in Malaysia’ in 2012. The questions in the Medication Adherence Scale used in the study were developed using two different adherence questionnaires, which were the Hill-Bone Adherence to Blood Pressure Therapy Scale and the 8-item Morisky Medication Adherence Scale MMAS.

The 8-item Morisky Medication Adherence Scale MMAS was one of the most frequently used self-reporting tools to measure patients' adherence to the prescribed medicine and it contained eight questions to assess the patients' adherence towards the behavior of medication-taken in an outpatient setting. The Hill-Bone Compliance to Blood Pressure Therapy Scale was another self-reporting tool and it contained 14 questions including eight questions that assessed medication-taking behaviors in hypertensive patients. High reliability and validity had been reported for these two tools of adherence measurement. The Hill-Bone scale had been shown to have good internal consistency and reliability with a Cronbach's α of 0.68.

This New Medication Adherence Scale Questionnaire had seven questions in total in which they were selected from the above two questionnaires and condensed to form the modified Medication Adherence Scale, relevant to the local setting. Prior to its use in the study, it was subjected to evaluation and validation. Cronbach's α was calculated to be 0.782, reflecting a good internal consistency and reliability. Interrater agreements (between the two interviewers) indicated good consistency with the Kappa value of 0.796. There were two version of this questionnaire: New Medication Adherence Scale Questionnaire (English version) and 'Borang Penilaian Komplian Ubat-Ubatan' (Malay version).

In this New Medication Adherence Scale Questionnaire, the patients were required to choose their responses from a set of possible answers. Each question in this questionnaire had a four-point Likert-type response format. Each response carried a score: 1= selalu *(all of the time),* 2= kerap kali *(most of the time)*, 3= kadang-kadang *(some of the time)*, 4= tidak pernah *(none of the*

time). The total scores were added for each patient and it could range from 7 (minimum) to 28 (maximum). Lower scores reflected poorer adherence to medication therapy. A full score of 28 or a score of 27 (due to 1 point deducted from any one of the "unintentional adherence" questions, which were question 1 or question 6), were defined as adherers. A score of 27 (due to 1 point deducted from other questions) or a score of 26 and below were categorized as non-adherers (refer Appendix 3 Section D for New Medication Adherence Scale Questionnaire).

3.9 SAMPLING METHOD

All hypertensive patients who came to the primary care clinic in university hospital during one month period of data collection (from 23rd December 2014 till 20th January 2015) were targeted for recruitment into the study. A total number of 420 patients with hypertension were screened for fulfillment of inclusion and exclusion criteria inside the consultation room. Prior to that, each of the doctors in every consultation room was briefed on the patients' selection criteria and flow of the eligible patient. Those who fulfilled the above criteria were subsequently referred to the researcher for further explanation regarding the study. From total of 420 patients, 140 patients fulfilled the criteria and 52 of them not consented / refused to join the study. Therefore, 88 patients who gave their consent were enrolled into the study.

From the consultation room, the patients were taken to another room, which was more quiet and comfortable. Inside the room, the researcher gave related information and comprehensive explanation regarding the study to each of the eligible patients. A standardize information were given to each of them. They

were given ample of time to consider their decision whether to involve or not in the study. For those who were interested in participating in the study, a written informed consent was obtained from them.

Subsequently, the decision to recruit the patients into either HBPM group or control group was based on the randomization table (elaborated in the randomization method section 3.10). The patients were only identified based on their entry number and were allocated into the specific group as they were recruited. There were total of 88 eligible subjects with 44 subjects in each group.

3.10 RANDOMIZATION METHOD

The total numbers of eligible subjects were randomized either into the home BP monitoring (HBPM) group or control group based on randomization table that had been prepared earlier. This randomization table which used the randomization blocks of four was produced by computer-generated randomization method (refer Appendix 5 for Randomization Table).

3.11 DATA COLLECTION PROCEDURE

Generally, there were two visits throughout this study period for both groups (baseline and at two months after the intervention). However; for HBPM group, they had an interim follow-up at one month from the baseline date through a phone call. At baseline, the patients from both groups were interviewed by the researcher. The Respondent Pro forma Sheet was then filled-up and the patient needed to answer the New Medication Adherence Score, assisted by the researcher. The patients' medical records were reviewed at the same time and their related medical profiles were noted. The clinical measurements of patient's

height, weight, and waist circumference; and office BP were taken according to the standard protocol. All the above baseline data were recorded in the case report form. In addition to the above measures, both groups were given a brief counselling regarding the lifestyle modification including advice on physical activities or exercise and low-salt diet consumption in relation to the management of hypertension. For both groups, their anti-hypertensive medications dosages were maintained (no increments of dosages or additional of anti-hypertensive medications throughout the study period).

For the control group, the baseline session took about 20 minutes to be completed. Generally, the control group followed the usual care in the clinic provided by their healthcare provider. They were given an appointment date to be seen again in two months' time for the second visit of the study.

For HBPM group, the baseline session took about 30 minutes to be completed. They were given explanation regarding the home BP monitoring protocol as outlined in this study. They were introduced to the device; the automatic BP monitor Omron model HEM-7120, and they were shown on how to operate the machine. The appropriate BP arm-cuff size was given to each of them. The patients and their caretaker were explained on proper technique of performing home BP measurement.

The similar principle of office BP measurement was applied for home BP measurement. In addition, the patients were instructed to take home BP reading of ideally seven days in a week. The measurements were done at about the same time in two occasions per day, once in the morning and once in the evening. The morning reading was taken before the drug intake (from 6am to 12

noon), whereas the evening reading was taken before the meal intake (from 6pm to 12 midnight).

For each occasion, the patients need to perform two BP measurements taken at 1 to 2 minutes apart. After each measurement, the results need to be immediately recorded in a home BP diary given to them (Appendix 4). They were asked to perform this HBPM throughout the study period within two months duration. The patients in HBPM group were also given an appointment date in two months' time for the second visit of the study in which during that time they need to return back the BP machine and their home BP diary.

For HBPM group, there was an interim follow-up through a phone call at one month from baseline. The patients were asked regarding the progress of the home BP monitoring, any concerns or problems related to the HBPM. The patients were reminded to continue their home BP monitoring as instructed until the completion of the study.

Both groups were seen again at two months from the baseline visit for the post-intervention data collection. During this second visit, two readings of office BP were measured and all the participants were required to answer again the New Medication Adherence Scale Questionnaire. For HBPM group, their home BP diaries were reviewed. All the post-intervention data were recorded in the case report form. The study ended at this point. Figure 1 showed the flow chart of the study.

Figure 1: Flow Chart of the Study