Scheduled Bulk SMS Program as Hypertension Education Media and Medication Reminder in Puskesmas 2 East Denpasar

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Abstract: This research is an operational research aimed to evaluate ongoing scheduled bulk SMS program in Puskesmas 2, East Denpasar. The evaluation comprised of health education media and medication reminder. Research was held prospectively with multiple posttest method. Within one-year evaluation of program implementation, 90 people satisfy the research criteria and managed to follow the procedure to the end of research. Questionnaire result from four examination (pretest and three times posttest) statistically analyzed using ANOVA with repeated values. Research result showed that scheduled bulk SMS Program statistically significant to improve perception about their medication regiment (as a health education media) ($F(1.928; 171.594) = 171.509$, $p<0.005$), and statistically significant to increase medication adherence (as a medication reminder) ($F(2.495; 222.092) = 149.293$; $p<0.005$).

1 INTRODUCTION

Cardiovascular disease mainly caused or made worse by uncontrolled high blood pressure, even some research boldly stated that blood pressure is directly correlated with cardiovascular mortality risk (Lewington *et al.*, 2002). Importance of controlling blood pressure emphasized when it was found that cardiovascular disease chance is decreased when patient manage to control their blood pressure (Staessen, Wang and Thijs, 2001; Staessen *et al.*, 2005) independently whether the patient manage to control their obesity and diabetes or not (Anand and Yusuf, 2011).

Management of high blood pressure is not as simple as taking medicine to treat the disease. Two important management need to be done daily to maintain low blood pressure, which are daily adherence to suggested blood pressure medication (Neal *et al.*, 2000), and life style changes to eliminate risk factors, such as alcohol and smoking (Whitworth and World Health Organization, 2003; Staessen *et al.*, 2005). Those two-management synergy needs to be maintained in long term to decrease cardiovascular disease morbidity and mortality.

A lot of intervention already been used to improve adherence, both for treatment and life style change with mixed and varying result (Haynes *et al.*, 2008). Lately medical treatment trend also undergoes digitalization. With worldwide access of mobile phone, lately it's more difficult to find patient with no access to mobile phone. Mobile phone already used before as medication support, lifestyle education delivery, discussion media with health care providers, or independent individual searches of health issues in Internet (Heron and Smyth, 2010).

According to Indonesia's Ministry of Communication and Informatics by the end of 2017, 371.4 million people have already had access to mobile phone, this is very big, considering total population of Indonesia at the time were 262 million (Kementerian Komunikasi dan Informatika Republik Indonesia, 2019). That means 142% of Indonesian population have access to personal communication device by the end of 2017 or on average 1.4 phones per person. This is possible as more and more people have multiple phone for different purposes. Further reading showed that only around 43% of that population have access to internet and social media, that means only half of Indonesia population have smartphones (Statista, 2019). As access of smartphones are limited, basic mobile phone services (phone calls, or short message services) are probably have better penetration compared with internet-based services.

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Researches based on Short Message Service (SMS) to improve adherence have varying result worldwide, but so far writer haven't found proper similar research in Indonesia. To name a few, significant research result are from Russia (Kiselev *et al.*, 2012), China (Lin *et al.*, 2014), and South Korea (Park and Kim, 2012). Not significant results are from Pakistan (Mohammed, Glennerster and Khan, 2016), Spain (Márquez Contreras *et al.*, 2004; Carrasco *et al.*, 2008), and Philippines (Philipines Department of Health, 2017). As previous researches were not yielding coherence and similar result, writer speculate there are region specific causes that causes different results. Parallel with writer's speculation, similar effort to improve adherence using SMS is performed by one of primary health care (puskesmas) in Denpasar, Bali. Writer then collaborate with said primary health care to evaluate program's result.

2 MATERIALS AND METHODS

2.1 Participants, Questionnaire, and SMS Program

Research subjects are all patients treated in Puskesmas 2, East Denpasar who meet the research criteria. Inclusion criteria were as follows: (1) over 18 years old (2) diagnosed as hypertension patient (3) receiving drugs and medication from Puskesmas 2, East Denpasar (4) literate, able to read (5) possess cell phone / smartphone. Exclusion criteria are also added to prevent result alteration: (1) palliative patient with life expectancy under one-year (2) patient also diagnosed with other chronic illnesses (diabetes, cancer, COPD) (3) dementia or with severe mental disorder. Control group was not formed, as this research is an evaluation of Puskesmas' new program to promote health, so all patients are included in the program. This attempt to increase treatment adherence were one of Puskesmas' innovation in yearly Outstanding Puskesmas contest.

There were two questionnaires used in this research, one for evaluating subject's attitude about their medication regiment, and one for evaluating subjective medical adherence of each patient. Assessing attitude and knowledge of research subjects done using Indonesian adaptation of 30 questions Drug Attitude Inventory (DAI30) (Hogan, Awad and Eastwood, 1983). Adherence to medication was scored using Morisky's 8 Items Medication Adherence Scale (MMAS-8) (Morisky *et al.*, 2008). These two-questionnaire tested for validity and reliability after translation, resulted in no needs for further editing aside from translation into Indonesian language.

Scheduled bulk SMS program were not built by writer, the program used was paid Android phone (Google, 2019) based program named Pulse (Klinker, 2019). Pulse was selected because of their useful feature within scope of this research. Features used in this research are: (1) scheduled SMS (2) bulk SMS option and grouping (3) repeat SMS option (4) automatic response by sender and by keyword (5) scheduling can be performed with other devices without changing phone number.

2.2 Research Procedure

This is an operational research using prospective analytic research with multiple posttest method without control group, held within February 2018 until February 2019 time span. All hypertension patients who came to check their health and procuring routine medicine in February 2018 (28 days) are invited into this research, before continuing, they are screened through inclusion criteria, exclusion criteria, and signing informed consent. Patients unwilling to join with any reason are convinced that they're going to have the same treatment as usual with patients who joins this research. This was to ensure that no patient feels forced to join, while medical adherence is also affected by patient's willingness to follow up through their treatment regimen.

Patients who join this research then interviewed for their demographic data (including age, sex, marriage status, education status, occupation, health insurance, medication used, medical complication, phone number, type of phone used, and phone signal around home), and baseline data as a pretest score using adapted DAI30 (patient's attitude toward their medication) and MMAS-8 (patient's adherence toward their medication) into Indonesian language.

After one-month process of screening and acquiring baseline pretest data in February 2018, scheduled bulk SMS program were performed. Patients are grouped by what kind of medications are they on, and date of follow up to puskesmas for their illness, then they will get targeted SMS based on their group to help improve their treatment adherence. For education purpose, patients are not grouped and receiving the same SMS. There are several types of SMS patients receive throughout this research those are:

- Reminder for medication time (specific for each patient's medication regiment)
- Reminder for illness follow up to puskesmas date and procuring more medicine (SMS sent

five days, three days, and one day before following up date for each patient)
- Short education about illness they suffer, medication taken, and healthy lifestyle (3-4 times per week)

Evaluation to check whether SMS sent manage to affect perception towards treatment regimen and medication adherence (posttest) was done three times, on June 2018, September 2018 and February 2019. Software used to analyze pretest and posttest data are Ms. Excel (Microsoft, 2019) and SPSS (IBM, 2019). Statistical analysis was done using ANOVA with repeated measures to know whether any data changes between test are statistically significant or not. Demographic descriptive analysis data will be presented as is, or as percentage.

3 RESULT AND DISCUSSION

3.1 Research Participants

Within one month of collecting baseline data, 98 patients are registered to join this research, but only 90 patients (91%) are able to finish through all posttest. From those eight people who didn't manage to finish this program, one died, one admitted to hospital because of stroke, and six lost to follow up. Table 1 shows demographic and baseline data of research participants who managed to join the program for one full year and finished three follow ups.

Table 1. Baseline Characteristics, n=90

Age	(Y.O)	**Years Diagnosed**	(year)
Mean	53.3	Mean	3.5
Std Deviation	14.2	Std Deviation	2.2
Range	30-79	Range	1-9
Sex		**Complication**	
Male	35.6%	Yes	34.4%
Female	64.4%	No	65.6%
Marriage		**Ever Change Medication**	
Not Married	6.7%		
Married	58.9%	Yes	23.3%
Widowed	34.4%	No	76.7%
Education			
None	15.6%		
Elementary	31.1%	**Phone Type**	
Junior High	25.6%	Handphone	61.1%
Senior High	15.6%	Smartphone	38.9%
Bachelor	10.0%		
Post Grad.	2.2%		
Occupation		**Bad Phone Signal**	
Informal	34.4%		
Private Sect.	22.2%	Yes	20.0%
Civil Sector	5.6%	Sometimes	70.0%
Professional	8.9%	No	10.0%
Entrepreneur	11.1%		
Unemployed	17.8%		
Medication		**Keep Phone Near**	
Amlodipine	20%	Yes	53.3%
Captopril	80%	No	46.7%

3.2 Drug Attitude Inventory

Drug Attitude Inventory is an adapted questionnaire used to define patient's perception and their level of trust to medication. Higher score associated with higher level of trust, and vice versa, lower score associated with lower level of trust to their medication. Figure 1 and Table 2 are boxplot and mean table for four data result (pretest, posttest 1, posttest 2, posttest 3) using this questionnaire.

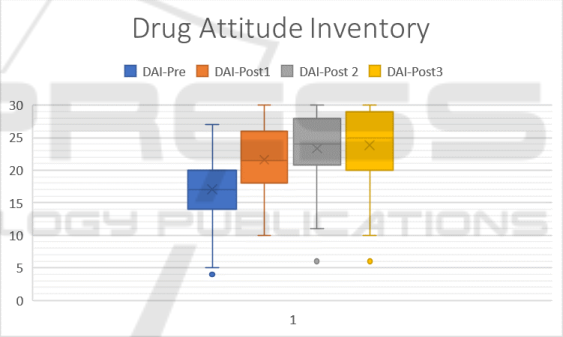

Fig. 1. DAI 30 Mean Result

Table 2. DAI 30 Descriptive Statistics

	Mean	Std. Dev.	N of Max Score	Δ with prior exam.
Pretest	17.066	4.7612	0	
Posttest 1	21.588	5.1970	8	4.5222
Posttest 2	23.355	5.4511	17	1.7667
Posttest 3	23.844	5.8883	18	0.4888

Boxplot diagram shows that there was considerable elevation of score from pretest to posttest 1. However, the increment of score result tends to decrease in posttest 2 and become negligible in posttest 3. With continuous increment of mean score within this research, ANOVA with repeated measure was performed to ensure whether those increment are statistically significant or not. Table 3-5 shows the result of said statistical analysis:

Table 3. DAI 30 Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	0.415	77.148	5	0.000	0.643	0.657	0.333

Table 4. DAI 30 Anova with Repeated Measures

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Greenhouse-Geisser	2573.697	1.928	1334.891	171.509	.000	.658
Error (Time)	Greenhouse-Geisser	1335.553	171.594	7.783			

Table 5. DAI 30 Bonferroni Post Hoc

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
1	2	-4.522*	.307	.000	-5.351	-3.693
2	3	-1.767*	.242	.000	-2.419	-1.114
3	4	-.489	.227	.206	-1.103	.125

Mauchly's Test of Sphericity (Table 3) indicated that the assumption of sphericity had been violated (X^2=0.415, p<0.005). Because sphericity had been violated, Anova with repeated measure result should be corrected. Greenhouse-Geisser correction was chosen because it resulted in epsilon of 0.643.

Greenhouse-Geisser adjustment on ANOVA with repeated measure result shows, in general mean value of DAI30 statistically differs between each examination time (F (1.928; 171.594) = 171.509, p<0.005) (Table 4). Mean score increment of DAI30 are observeable from pretest until all three posttest as can be seen on Table 2, respectively, 17.1±4.8; 21.6±5.2; 23.4±5.5 ; 23.8±5.9.

However, even though increment may always be observed, not all of them are statistically significant (Table 5). Significant score increase can be seen on pretest to posttest 1 with mean difference of -4.522±0.307 (p<0.005), and posttest 1 to posttest 2 -1.767±0.243 (P<0.005), unfortunately score difference between posttest 2 and posttest 3 is not significantly differs -0.489±0.227 (p=0.206).

As statistical analysis result showed, scheduled bulk SMS program has better efficacy on the beginning of program, and slowly recede towards the end of 1-year period. However, this probably happened because max score of DAI30 questionnaire already reached by most subjects by the end of research, this leads to stagnation of mean score as no additional score may be achieved by subjects. Perhaps further research should be performed to establish whether after program ended, patient still be able to maintain their high attitude toward medication, or perhaps this program should be continued to maintain program result.

3.2 Morisky's Eight Items Medical Adherence

Morisky's Eight Item Medical Adherence measures patient's medication adherence. Different with DAI30, M8MA score interpreted as better if lower score is achieved. This because M8MA asks about factors that promote medication inconsistencies, more factors helped inconsistencies means worse medication adherence rate. Below is boxplot diagram and mean result of M8MA questionnaire from pretest to the third posttest.

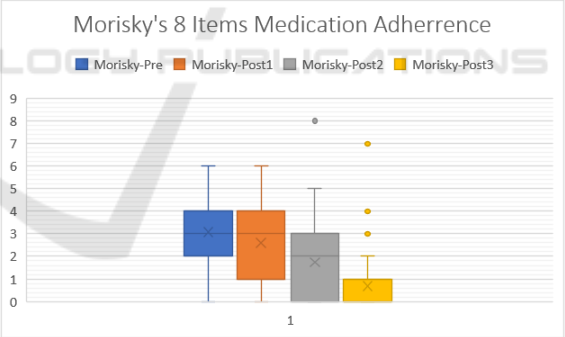

Fig. 2. M8MA mean result

Table 6. M8MA Descriptive Statistics

	Mean	Std. Dev.	N of Max Score	Δ with prior exam.
Pretest	3.0078	1.21070	1	
Posttest 1	2.6000	1.50505	6	0.4078
Posttest 2	1.7444	1.53287	25	0.8556
Posttest 3	0.6778	1.22546	58	1.0666

As can be seen from previous Figure 2 and Table 6, score reduction always happened between time period, and the difference keeps getting larger after each posttest. Even from pretest, there was already one sample with max adherence, and the

number of patients with max adherence keeps gradually increasing towards the end of research. Mean scores are pretest 3.0078±1.21070, posttest 1 2.6000±1.50505, posttest 2 1,7444±1.53287, and posttest 3 0.6778±1.22546.

Mauchly's test of sphericity in Table 7 indicates that the assumption of sphericity had been violated, with result of X^2=0.635; p<0.005. Huynh-Feldt correction is chosen to adjust result of ANOVA with repeated measures as it produced epsilon of 0.832.

ANOVA with repeated measures with Huynh-Feldt correction (Table 8) shows that mean score of M8MA statistically differs between each examination time (F (2.495; 222.092) = 149.293; p<0.005). Significant score reduction of M8MA (increasing adherence) are observed via Post Hoc test using Bonferroni correction on all four tests performed (Table 9). The score difference are 0.478±0.111 (p<0.005) between pretest and posttest 1, 0.856±0.093 (p<0.005) between posttest 1 and posttest 2, lastly 1.067±0.107 (p,0.005) between poosttest 2 and posttest 3.

This program tends to have better effect on M8MA score approaching the end of research, with more than 50% of patient managed to get full adherence by the end of research. This result differs with DAI30 that have better score increment in the beginning of research.

3.2 Discussions

Scheduled bulk SMS program have positive effect to patient's perception of their medication (DAI8) as well as the level of medication adherence (M8MA). However, said positive effect seems have different pattern in long term and long term. DAI8's score increment tends to decrease along the time points (Δ pretest-posttest 1 = 4.5222; Δ posttest 1-posttest 2 = 1.7667; Δ posttest 2-posttest 3 = 0.4888). Meanwhile, SMS manage to increase patient's adherence better in long run (Δ pretest-posttest 1 = 0.4078; Δ posttest 1-posttest 2 = 0.8556; Δ posttest 2-posttest 3 = 1.0666).

This difference of effect by time period may have happened because there are different fundamental goals of SMS program between educating and reminding patients. Education functions as new information giver thus may lead to saturated information, in which no new information are received by patients. Reminder on the other hand, is aimed to help patient remember when to take their medication, so repeated exposure may help increase adherence better.

Similar approach of study based around SMS to improve adherence tends to have various result. Further reading suggested that SMS program have better effect on medication adherence in a large countries such as Russia (Kiselev *et al.*, 2012) and China (Lin *et al.*, 2014). Smaller countries inclined to have less positive effect from SMS intervention, such as research in Spain (Carrasco *et al.*, 2008) (Márquez Contreras *et al.*, 2004), Pakistan (Mohammed, Glennerster and Khan, 2016), and Philippines (Philipines Department of Health, 2017). Other factor that may influence research is length of study, better result can be observed in research with more than six months intervention (Kiselev *et al.*, 2012; Lin *et al.*, 2014; Márquez Contreras *et al.*, 2019) compared with less than six months intervention (Márquez Contreras *et al.*, 2004; Philipines Department of Health, 2017).

Table 7. Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.635	39.882	5	.000	.808	.832	.333

Table 8. M8MA Anova with Repeated Measures

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Huynh-Feldt	299.942	2.495	120.197	149.293	0.000	0.627
Error (Time)	Huynh-Feldt	178.808	222.092	0.805			

Table 9. M8MA Post Hoc Bonferonni

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
1	2	0.478	0.111	0.000	0.179	0.777
2	3	0.856	0.093	0.000	-.605	1.106
3	4	1.067	0.107	0.000	0.778	1.355

Previous researches support our research result, Indonesia is a large country with thousands of islands (Nurul Fitri Ramadhani, 2017), this leads to better SMS reach area compared with countries with smaller area. As previously mentioned in introduction, SMS was chosen as media because of its accessibility and cost. This research also reinforces previous research result that longer intervention by SMS performed evidently helped patients to maintain their medication adherence.

There are several research limitations that needs to be considered. First one is presence of outlier data in this research. With the ongoing increment score of DAI30 there were always outliers with very low score along the research, similar with DAI30, M8MA also have several outliers within the group but writer notices different pattern of outlier. DAI30 have outliers on all time points from pretest to the third posttest, but in M8MA outliers only happened on second and third posttest. By analyzing bottom 5 score acquirer, there are at least two people that constantly getting low score. Furthermore, their scores are not constantly increasing as other participants do.

There are several possible reasons why this happened, language barrier, weak comprehension to the questions and laziness and/or ignorance to follow order of research. Language barrier happened because even though the questionnaire already translated into Indonesian language, and Indonesian language is the national language in the country, there are minority of the population (especially geriatrics) who only understand local languages (Cohn and Ravindranath, 2014). Geriatrics also have other problems aside from language disparity that affects questionnaire result, such as vision degeneration (Saw *et al.*, 2003), cognitive impairment (Mardiyanto, Jahja and Limyati, 2017), or both (Ong *et al.*, 2012). Other factor author managed to grasp was laziness of the respondents. With total of 38 questions to answer -if each question is to be read in at least 15 until 30 seconds- respondents needs at least 10 minutes to finish, but there are several respondents that submit the paper within 2-3 minutes. This may be because of laziness or ignorance to the questionnaire result. Further research should address the same problem if happened by eliminating those samples or performing in depth interview to understand factors affecting program efficacy.

Second research limitation is there were no control group in this research because the nature of this research as an operational research to evaluate ongoing program performed on all patient in the primary health care. Third research limitation is this research only performed in one health center. Second and third research limitation may be diminished by larger research on multiple health center using randomized controlled trial.

4 CONCLUSION

To conclude this research, scheduled bulk SMS program is statistically significant to increase DAI30 score (increase medication perception) and decrease M8MA score (increase medication adherence) ($F (1,928; 171,594) = 171,509$, $p<0,005$ and $F (2,495; 222,092) = 149,293$; $p<0,005$ respectively). This program is advised to be adapted in larger scale and longer term, seeing SMS program inclined to perform better in larger area and continuously. Since this method have high effectiveness despite the low cost, primary health care may be able to deliver better result compared with secondary and tertiery health center or hospital, as most long-term treatment of chronic illnesses patients are treated within the scope of primary health care.

COMPETING INTEREST

Authors hereby declare that they have no competing interests.

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