The Effectiveness Of Telemonitoring In Treatment Adherence Cardiovascular Disease: A Systematic Review

Inda Rian Patma Putri, Zaenal Abidin, Elfa Lailatul Izza, Supriyono
Nursing Master's Degree Courses, Faculty of Nursing Airlangga University, Mulyorejo Street 60115 Surabaya, Indonesia
inda.rian.patma-2017@fkp.unair.ac.id ,

Abstract: Background. Cardiovascular disease is one of the leading causes of death in the world. The most important things as a determinant of success in the prevention of risk factors, controlling symptoms, delay the progression of the disease and prevent hospitalization in patients with cardiovascular disease are patients adherence to therapeutic regimens. Non-adherence to long-term therapy is still a global problem especially in chronic diseases such as cardiovascular disease. This requires the development of easy interventions, and can be applied in everyday practice. Methods: Systematic review consists of 5 steps: (1) identification of the instrument in the literature (database search); (2) identification of relevant literature based on the title and abstract; (3) inclusion and exclusion criteria; (4) obtain full text of the literature; (5) grading is based on components of the literature and analysis of the selected instrument. Search articles using the PICOT framework in the database; Ebscho, Science Direct, Elseiver, Sage Journals, Scopus, ProQuest, Journal Ners, limited to the last 7 years, 2010 to 2017 obtained 15 International Journal. Results: The magnitude and significant of telemonitoring effect on adherence in patient with cardiovascular disease. Conclusion: intervention with SMS system combined with smartphone gives good result in adherence patients with cardiovascular   disease.

1 BACKGROUND

Cardiovascular disease is the leading cause of mortality and disability, as well as the resulting loss of productivity in adults worldwide (Vervloet et al., 2012). Cardiovascular disease or heart disease is the disorder of the disorder, anatomical and hemodynamic systems. In a broader sense of the definition of heart disease (CHD, myocardial infarction, angina pectoris), cerebrovascular disease, hypertension, heart failure, heart valve disease, peripheral vascular disease, congenital heart disease and peripheral artery disease. Global mortality caused by cardiovascular disease increased 41% between 1990 and the year 2013, (Park, Beatty, Stafford, & Whooley, 2016). Inpatients with heart disease, secondary prevention is more appropriately done bycontrolling risk factors comprehensively.Difficulty in following long term therapy is often the obstacles in patients cardiovascular disorders. The reason most frequently found associated barriers in therapy factor is forgotten. Compliance is a condition the extent to which a person's behaviorallevel carry out treatment of lifestyle changes in accordance with the agreement and the recommendations given by the health care provider, (Vervloet et al., 2012). Compliance with therapy and treatment is very important to control symptoms, delaying progression of the

disease, and prevent hospitalization. However, non-adherence to long-term therapy is still a global problem mainly on chronic diseases such as cardiovascular disease, known up to 50% of patients with cardiovascular disease have a less compliance, (Gallagher et al., 2017). Complex interventions often spend a lot of time, requires labor intensive and high costs. Therefore required the development of interventions that are easy, and can be applied in daily practice. One example of easy and simple intervention is to remind a patient's response to therapy. Telemonitoring of patients heart failure is a promising new option. Telenursing / telehealth as part of telemonitoring is a way of providing nursing care with the use of telecommunications and information technology. the purpose of this study was to conduct a systematic review of the effectiveness of interventions in increasing compliance with telemonitoring in patients with cardiovascular disease. The results of the systematic review are expected to be applied to the health service. Systematic review is presented in the form of an article that consists of abstract, introduction, methods, results, discussion, PICOT, implications against the practice, a conclusion, and bibliography.

2 METHOD

Systematic review consists of 5 steps: (1) identification of the instrument in the literature (database search); (2) identification of relevant literature based on the title and abstract; (3) inclusion and exclusion criteria; (4) obtain full text of the literature; (5) grading is based on components of the literature and analysis of the selected instrument. Search articles using the PICOT framework in the database; Ebscho, Science Direct, Elseiver, Sage Journals, Scopus, ProQuest, Journal Ners, limited to the last 7 years, 2010 to 2017 obtained 15 International Journal.

The PICOT / PECOT framework is: Population : Patients with heart / cardiovascular disease Intervention: Telemonitoring. Control: -
Outcomes: Patient compliance. Time: 2010 - 2017

Based on the determination of keywords according to the topics contained in the PICOT framework, and equipped with Boolean Logic methods (Ebscho, Science Direct, Elseiver, Sage Journals, Scopus, ProQuest, Journal Ners and Indonesia One Search) then the keywords in English used are "cardiovascular disease "," Heart disease ", AND" adherence "AND" telemonitoring "AND" telenursing "AND 'mobile-health

Figure 1: Prisma scheme
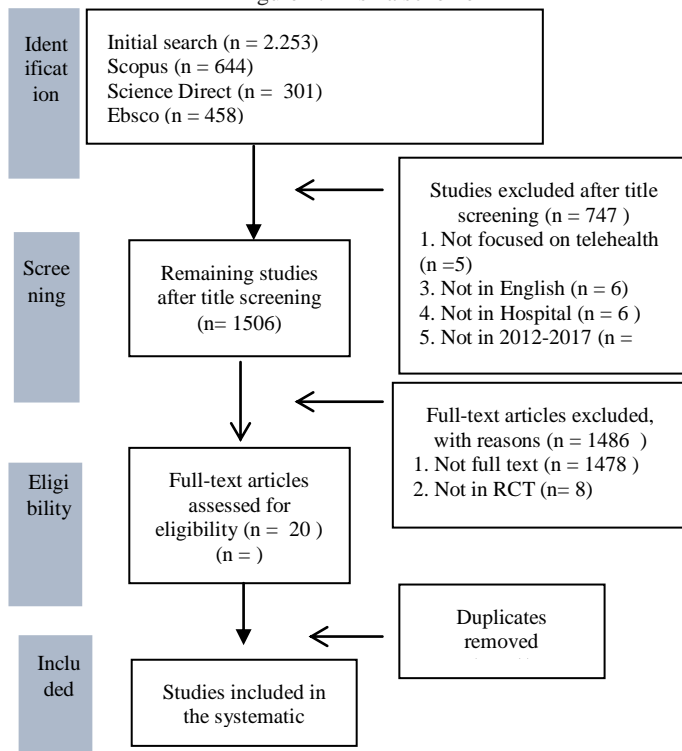
The inclusion criteria in this study are articles on telemonitoring and reminders with mobile phones (SMS, telephone), email, android applications. One result is adherence to therapy in patients with heart disease (coronary heart disease, myocardial infarction, angina pectoris, hypertension, heart failure, valvular heart disease, peripheral vascular disease, congenital heart disease, and peripheral arterial disease. Research

design is RCT (randomize control trial), Quasy experiment, pilot study,. Exclusion criterion is an article about giving intervention in addition to telemonitoring.

3   RESULT

This review systematic reviewed 15 selected articles from various countries. Overall, 12 out of 15 studies (80%) showed that using telemonitoring was effective in improving adherence. This review includes several studies of several heart diseases: heart failure (5), hypertension (2), coronary heart disease (2), acute coronary syndrome (2), general heart disease (3), myocardial infarction (1) samples varied between 37-53480 respondents Systematic review includes several design studies a mongother RCT, Quasycircling, pilot studies, obser vational, descriptive, which was intended to get an overview of the extensive coverage in the field of telemonitoring. Some of the intrventions used in telemonitoring study include SMS, phones combined with the glow cap system and application tools, email "health buddy", smartphone applications technology. Overall, 10 out of 13 studies show that the use of telemonitoring is effective in improving compliance in patients with heart disease, in particular adherence to therapy treatment. The majority of research studies (5 of 13) using SMS as an intrrervention, 3 research using a combination of email and phone with using the smartphone technology, as well as two studies using applications that are connected to the internet. Most studies reported the value of customer satisfaction and high acceptence toward interventions

.Most studies using intervention in the form of reminder messages indicating good result related treatment adherence. In addition the intervention used involves a combination of modalities, such as the existence of web-based applications, where it is found positive result. Other studies using other combinations obtained by the phone and one study did not indicate the importance of adherence change, where patients will receive weekly emails containing therapy programs and the need to comply with calls from the Maintenance Manager. While other interventions with a combination system of telephone cable strokes (electronic pill bottles that record the date and time when the bottle is opened connected to the internet system to automatically send data) and combination of email and mentoring phone conducted every week shows. that there is success in the indicator of adherence to a therapeutic regimen. In a study using smartphone intervention applications, in addition In order to improve the results of the adherence indicator the patient also reported satisfaction (n = 174 and n =

37). The advantages that can be observed in the intervention by using smartphone applications that are related interesting features. The smartphone app has the potential to address the complexity of disobedient behavior as well as lifestyle, with respect to comprehensive features, unique and interesting

	Title and author	Design	Sample	Type of telemonitoring & measured	Intervention	Control	Results	Time
1.	*The effect of short message system (SMS) reminder on adherence to ahealthy diet, medication, and cessation of smoking among adultpatients with cardiovascular diseases* (Akhu-Zaheya & Shiyab, 2017)	*Randomize Controlled Trial*	Cardivaskular disease n= 180	SMS System (Adherence to diet, treatment, smoking cessation)	SMS System (reminders of dietary adherence, medication, and smoking cessation motivation) + general treatment	General treatment (doctor visits, diagnostic procedures, labs, prescribing)	There is a significant difference between intervention and control groups. In the intervention group obtained: 1. Increased adherence to treatment (p=0,001) 2. Increased adherence to a healthy diet (p=0,000). 3. There were no significant differences in smoking cessation and the number of cigarettes in use (p=0,327), (p=0,34)	3 Months
2.	*A text messaging intervention to promote medication adherence for patients with coronary heart disease* (Park, Howie-Esquivel, Chung, & Dracup, 2014)	*Randomized controlled trial*	Coronary heart disease n= 90	SMS (adherence to antiplatelet and statin consumption: total number of doses taken, total percentage of prescriptions taken, presentation of schedule accuracy; feasibility and satisfaction with intervention)	1. SMS Reminder + health education (reminder therapy given morning for antiplatelet and night for statin + health education on Monday, wednesday and friday), total there are 74 SMS 2. SMS health education only on Monday, Wednesday and Friday (total of 14 SMS)	General treatment without reminder and educational SMS	- SMS reminder + education intervention group gets the best result. On the right dose indicator, taking prescribed and timely prescription doses, showed better results with values (p = 0.02) compared with educational SMS intervention. - Educational group SMS interventions are better in precise doses and exact schedule indicators than control groups (p=0,01) - Compliance response rates for antiplatelets therapy were higher than statins in the intervention group (p = 0,005). - adherence showed improvement, but statistically there was no significant difference between the two intrvensi groups (p = 0,16).	1 month
3.	*Effect of a reminder system using an automated short message service on medication adherence following acute coronary syndrome* (Khonsari et al., 2015)	*Randomized controlled trial*	Coronary Syndrome N=62 Average age: 57,9 malaysia	SMS (adherence to treatment, enhancement of heart function)	Automatic reminder SMS (each time it takes time to take medication) combination of internet (Web)	General treatment	- The intervention group had a higher level of adherence to treatment than the control group (p<0,001) - Significant differences found in cardiac functional status were found to be better in the intervention group (p <	8 weeks

						0,001).	
4.	*Electronic messaging support service programs improve adherence to lipid-lowering therapy among outpatients with coronary artery Disease* (Fang & Li, 2016)	*exploratory randomised control study*	Coronary artery diseaseN=280 China	SMS	1. SMS (reminder about treatment schedule) + Micro messenger application (contains health education information related to coronary artery disease) 2. Reminder SMS only	Telephone (once month reminder treatment schedule)	1. Intervention Group with SMS + Messenger application has better cumulative compliance than phone group (control) 2. Group SMS + Micro applications have better cumulative compliance than short message service groups	6 months
5.	*Mobile Phone Text Messages to Support Treatment Adherence in Adults With High Blood Pressure (StAR)* (Bobrow et al., 2016) *Randomized Trial (Single-Blind)parallel*		Hypertension N= 1372 Afrika Utara Average age 54,3	SMS (treatment adherence)	1. Interactive SMS (information and feedback of patient response) 2. SMS information	General treatment	intervention with SMS can improve adherence and may lower blood pressure at 12 months	12 months
6.	*Telemonitoring adherence to medications in heart failure patients (TEAM-HF)* (Gallagher et al., 2017)	*Pilot Randomized Clinical Trial*	CHF n=40 Average age 64 th	Phone (combined with glow cap system) Time: 1 month (adherence to diuretic treatment, return visit, follow-up visit)	*Telepon + glow cap system*	just a glow cap system without phone alerts	In the intervention group, all the results obtained were much better than the control group : - Return visit 30 days - Not attending follow-up visit - Comply with treatment (diuretic):	1 month
7.	Efficacy of a nurse-led email reminder program for cardiovascular prevention risk reduction in hypertensive patients: (Cicolini et al., 2014)	*Randomized controlled trial*	Hypertension n= 203	Phone and email (treatment therapy adherence, blood pressure, BMI, fruit consumption and alcohol reduction, fasting blood glucose, LDL (cholesterol, triglycerides and physical activity)	Phone and email (receive emails each week (contains programs on the need for healthy lifestyle-based compliance based guidelines) and Phone calls from maintenance managers	General treatment	- In the intervention group showed better results. related to BMI, alcohol consumption, smoking, fruit consumption, physical activity, blood pressure, LDL and total cholesterol (all p <0.05) - improved adherence to therapy, did not show significant differences between the two groups.	6 months (follow up 1,3 and 6 months)
8.	*A Mobile Health Intervention Supporting Heart Failure Patients and Their Informal Caregivers: A*	*Randomized Comparative Effectiveness Trial*	CHF N=331 Amerika Serikat	Phone and Email	Intervention : A. Interactive Voice Response (phone and email) per week + companion (CarePartner). B. IVR (Interactive Voice Response)	General treatment	- In the IVR + patient group, assistance was found to be better in the treatment compliance indicator - fewer reports of respiratory problems and weight gain in the intervention group (P <0.5) - there was no significant difference in improving the quality of life of HF patients (P> .21).	12 Months

9.	*Effect of Reminder Devices on Medication Adherence REMIND* (Choudhry et al., 2017)	*Randomized Clinical Trial*	Chronic disease n=53480 average age 45 th Amerika serikat	Reminder tool (medication adherence)	Reminder tool: 1. Bottle of pills with strips that can change every drug taking 2. Bottle pills with digital timer 3. Standard medicine bottles	Without tools and reminders	There was no statistically significant difference in the likelihood of optimal adherence between control and any of the devices	12 months
10.	*Effects of tailored telemonitoring on heart failure patients' knowledge, self-care, self-efficacy and adherence* (Boyne, Vrijhoef, Wit, & Gorgels, 2010)	*randomized controlled trial*	Heart failure n=382	Application tool "health buddy"	Application tool "Health Buddy": (monitor tool that sends data to the central server) + interactive dialog	ordinary care: receive oral and written information) is active	- The intervention group had significantly improved compliance outcomes compared to the control group (p <0.001). - self-care ability in the intervention group was better than control group (p <0.001) - Self efficacy in the intervention group increased after 6 months - in the intervention group there was an increase in compliance indicators (p <0.001), adherence to fluid intake (p = 0.019). Compliance for - recommended physical activity increased (p = 0.023) after 3 months - treatment adherence increased after 6 months (p = 0.012) and 12 months (p = 0.037) compared with control group	12 months
11.	*Effects of interactive patient smartphone support app on drug adherence and lifestyle changes in myocardial infarction patients*: (Johnston et al., 2016)	Randomized Controlled Trial	Infark miokard N= 174 Average age 58 th (Swedia)	Application *smartphone* 8 weeks	Web-based smartphones that contain an application about compliance (e-diary) and health education modules (BMI, physical activity, BP measurement)	simple application of compliance without health education	- adherence to treatment was better in the intervention group than in the control group (p = 0.25) - Patient satisfaction was higher in the intervention group (p = 0.001) - Results in the intervention group were better related to smoking cessation rate, increased physical activity - quality of life improved, but statistically did not show significant results.	8 weeks
12.	*Features and usability assessment of a patient-centered mobile application*	Survey deskriptif	Heart failure N=37	Application *mobilephone*	*Application mobilephone (health Mapp)*	General treatment	Increased confidence in the intervention group	6 weeks

(HeartMapp) for self-management of heart failure (Athilingam et al., 2016)							
13. Meication reminder APPs to improve medication adherence in Coronary Heart Disease (MedApp-CHD) Study: (Santo et al., 2017)	*Randomised controlled trial protocol*	Coronary heart disease n= 156	Application *mobile smartphone* (adherence to treatment, knowledge, clinical state: BP, cholesterol)	1) interactive smartphone apps + reminders 2) standard smartphone apps + reminders	Just a reminder without using the smartphone app	This intervention had an effect on medication adherence, but there was no effect on the clinical state of the heart and the incidence of hospital admission.	3 months
14. A Randomized Trial on Home Telemonitoring for the Management of Metabolic and Cardiovascular Risk in Patients with Type 2 Diabetes (Iljaž, Brodnik, Zrimec, & Cukjati, 2017)	Randomized Controlled Trial	Heart disease risk patients with type 2 diabetes n=302	Tools with Sensors connected to internet networks and databases (quality of life, BP, lipid profile, visit schedule)	(HT) Home telemonitoring with weight sensor method, glucometer sensor and sphygnomnometer. connected to the internet network and connect the database to be monitored by health personnel.	General treatment n = 149	- Patients with HT were found to significantly decrease glycated hemoglobin level P = 0.001. - There is no difference about the quality of life, weight, blood pressure and lipid profile. - There are only significant differences regarding the specialist visit to the patient of P = 0.06	12 weeks
15. Fluid status telemedicine alerts for heart failure: (Böhm et al., 2016)	Randomized Controlled Trial	Patients risk heart failure n=466	Short message system (SMS) and phone connected to the sensor in the patient (liquid status)	Connecting an ICD (implantable Cardioverter defibrillator) device with an SMS system, in follow up with a telephone by a health worker.	General treatment N=223	- indicators of increased fluid status in patients with heart failure risk with ICD did not provide significant results.	

The relationship between types of measurements and outcomes

SMS/Text Message
Most of the studies were conducted using mail tets as interventions. In the use of SMS is almost all people reported an increase in compliance. In Jordan, studies using interventions SMS reminder for adherence of treatment, showed significant result to increase adherence to treatmnet and healthy diet. The use of SMS is combined with other modalities to improve compliance and accuracy in dose treatment. For example a study in Malaysia that combines SMS with a technology Web-based applications and internet shows better results related indicators of compliance with treatment and functional status of the heart, as well as the majority of the participants report on satisfaction in use of SMS in the system. In other experiments in China, experiments conducted for 6 months with a combination of SMS and smartphone technology (Micro Letter) shows better results in the treatment of compliance in patients with coronary artery disease. The combination of interactive SMS intervention, also gives better results when compared to just the giving message only. Research involving 90 persons with heart disease are given 2 intervention, i.e. SMS reminder treatments (daily schedule) with the addition of health information and automatic message that asks as a confirmation of acceptance, as well as intervention with just SMS only, Both have a more significant results than the control group. Intervention with SMS in General contains personal data about patient indications and appropriate motivation and barriers as well as treatment-related information / health education related diseases. Based on the results of the study the use of SMS can support monitoring of compliance against the particular intervention treatment in patients with cardiovascular disease.

(Phone Voice Response) / IVR
Intervention-based IVR (interactive voice response) can provide information on the status of validation patients. Random research conducted with intervention combination IVR + email + Companion (care giver) in 331 patients in the United States suggests that intervention is effective against an increase in compliance. Similary intervention with a combination of phone and glow cap system (i.e. the use of a bottle of pills that can record the date and time when the bottle is opened, then the network is connected to the internet so that it can automatically send the data online, followed by telephone to

follow up) shows an increase in adherence to the terapeuthic results of the diuretic and accuracy in taking a dose of medicine. Not all research using the phone showed significant result studies conducted in Italy with a combination of phone and email does not show significant results towards compliance, but an increase in physical activity and consume a healthy diet. Interventions using the telephone, IVR with a combination of email is easy and does not require high costs as well as save time because it takes a 20-minute daily. However, the limitations may be obtained in connection with the age of respondents, where older people may have difficulty using email as a method of a reminder.

Smartphone Applications
Rapid development of smartphones, has made the application in smartphones as a potential tool for improving adherence to treatment, (Santo et al., 2017). Some studies use a smartphone application with the intervention indicator related patient treatement with heart disease. Study of application system-based Smartphone with a Web-based data analysis, in Sweden with a sample number of 174 people, deliver effective results on compliance and satisfaction of the respondents. Similarly, random research on 156 patients using the interactive smartphone application intervention and reminders, showing its effects on adherence to treatment on coronary heart patients, but there is no influence on the State of Clinical cardiac. This feature allows the use of interventions that are interesting, but the mobile data needed in its implementation.

The relationship of time and learning outcomes
Seven studies have follow up time is shorter than 6 months. n the group, almost all studies reported significant results for increased compliance, except 1 study that reported the lack of significance of the results the case study with a time more than equal to 6 months were reported there were 1 study that do not have to significantly to the results.

4 DISCUSSION

Telemonitoring is the intervention with the use of telecommunications and information technology to monitor the status of the clinic patients, in this case to provide nursing care that is not limited to distance. This review provides evidence of the effectiveness of the intervention of patients with electronic reminders in the improvement of compliance of patients with heart disease.

Adherence to treatment is very important to control symptoms, delaying the development of, and prevent recurrence of heart disease. Substantial progress in information technology and mobile, as well as more rampant mobile-health becomes an alternative promising new tools for the improvement of health services by improving compliance with therapy treatment. The intervention uses of monitoring / reminders are based primarily on the principles of behavior analysis. .Some of the research that has been analyzed by using the theory of behavior change theory and Bandura SRT (Self regulation response). According to the theory of Bandura, the behavior depends on stimulus both internally (from within one's self) and external (associated with the environment) where in this case, the behavior of infidelity can be changed with the repetition of the external stimuli that is with reminder (Park et al., 2014). The theory of SRT (Self Regulation Theory) also the basis in the intervention of telemonitoring. This theory uses the experience of health that is based on the assumption of the patient, their role in health care as well as acceptance of health providers. Patients are expected to imitate behavior, introduced independently or with the support of health care providers (Akhu-Zaheya & Shiyab, 2017). This study provides evidence of the effectiveness of short term (6 month <) on an electronic reminder intervention in improving treatment of compliance in patients with heart disease. Not all research provides an overview of the results, but most show results enhancement towards compliance with treatment. Electronic reminder to be evaluated here among other things: the use of SMS (as well as in combination with Web systems), telephone / interactive voice response (combination with email, application tool), a device application reminders (health buddy, sensors), smartphone. Currently SMS still widely applied as a reminder interventions towards compliance. Effectiveness in this regard is evidenced by several studies, stating the result increased compliance. Economic value is also derived from this intervention, other than cheap and widely available and everyone is using it. SMS course may tend to be less interactive, will be more effective with a mechanism for actively in communication (2-way). Some studies linked the contents of SMS used customized personal, related names, dosage of medication, and always accompanied by a motivation that is adapted to the condition of the patient and the barriers experienced by patients. As well as the existence of a combination with other modalities such as smartphone applications, create a more interesting

and complete with the features available. As the development of technology, the use of smartphones is also increasing. Smartphone applications offer features that are interesting and interactive so that this intervention produces satisfaction for users. Intervention with smartphone also has the potential to overcome the complex behavior of his disobedience of the treatment or lifestyle. In reviews several studies with Smartphones, obtained not only increase compliance against treatment, but also in the change of lifestyle improvements in patients with cardiovascular disorders and quality of life of the patient. But research-based smartphone is still relatively few, ongoing test results will help to develop accurate evidence of other related matter. Several controlled trials using telephone / IVR (Interactive voice response) combined with other modalities of intervention provide effective results in patient compliance, especially in medicine. However, the interaction with the IVR requires a patient's willingness to participate when the call or the phone system

The Implications To The Practice
Compliance in therapy is the crucial to the case of cardiovascular disease. With adherence to the regimen of therapy then can control symptoms, delaying progression of the disease, and prevent hospitalization. Interventions that are easy to be applied to everyday is sides, both healthcare providers and patients themselves. Telemonitoring is a great alternative to give promising interventions. With him some intervention of telemonitoring, as can be used in consideration of alternative interventions by healthproviders. Applications smartphone or SMS with a combination of web-based applications shows good results in the study.

5 CONCLUSION

Telemonitoring is an easy intervention to be applied daily. Telemonitoring devices such as SMS that are combined with Web applications, and Smartphones are more easily applicable to the patient, so that it can be an alternative in interventions to improve adherence to treatment. Advances in technology make the smartphone into an alternative that is promising, but needed more evidence based research to related learning outcomes that will beobtained.

REFERENCES

Akhu-Zaheya, L. M., & Shiyab, W. Y. 2017. The effect of short message system (SMS) reminder on adherence to a healthy diet, medication, and cessation of smoking among adult patients with cardiovascular diseases. *International Journal of Medical Informatics*, *98*, 65–75. https://doi.org/10.1016/j.ijmedinf.2016.12.003

Athilingam, P., Labrador, M. A., Remo, E. F. J., Mack, L., San Juan, A. B., & Elliott, A. F. 2016. Features and usability assessment of a patient-centered mobile application (HeartMapp) for self-management of heart failure. *Applied Nursing Research*, *32*, 156–163. https://doi.org/10.1016/j.apnr.2016.07.001

Bobrow, K., Farmer, A. J., Springer, D., Shanyinde, M., Yu, L. M., Brennan, T., … Levitt, N. 2016. Mobile Phone Text Messages to Support Treatment Adherence in Adults with High Blood Pressure (SMS-Text Adherence Support [StAR]): A Single-Blind, Randomized Trial. *Circulation*, *133*(6), 592–600. https://doi.org/10.1161/CIRCULATIONAHA.115.017530

Böhm, M., Drexler, H., Oswald, H., Rybak, K., Bosch, R., Butter, C., … Brachmann, J. 2016. Fluid status telemedicine alerts for heart failure: A randomized controlled trial. *European Heart Journal*, *37*(41), 3154–3163. https://doi.org/10.1093/eurheartj/ehw099

Boyne, J. J. J., Vrijhoef, H. J. M., Wit, R. De, & Gorgels, A. P. M. 2010. Telemonitoring in patients with heart failure, the TEHAF study: Study protocol of an ongoing prospective randomised trial. *International Journal of Nursing Studies*, *48*(1), 1–9. https://doi.org/10.1016/j.ijnurstu.2010.05.017

Choudhry, N. K., Krumme, A. A., Ercole, P. M., Girdish, C., Tong, A. Y., Khan, N. F., … Franklin, J. M. 2017. Effect of Reminder Devices on Medication Adherence. *JAMA Internal Medicine*, *177*(5), 624. https://doi.org/10.1001/jamainternmed.2016.9627

Cicolini, G., Simonetti, V., Comparcini, D., Celiberti, I., Di Nicola, M., Capasso, L. M., … Manzoli, L. 2014. Efficacy of a nurse-led email reminder program for cardiovascular prevention risk reduction in hypertensive patients: A randomized controlled trial. *International Journal of Nursing Studies*, *51*(6), 833–843. https://doi.org/10.1016/j.ijnurstu.2013.10.010

Fang, R., & Li, X. 2016. Electronic messaging support service programs improve adherence to lipid-lowering therapy among outpatients with coronary artery disease: An exploratory randomised control study. *Journal of Clinical Nursing*, *25*(5–6), 664–671. https://doi.org/10.1111/jocn.12988

Gallagher, B. D., Moise, N., Haerizadeh, M., Ye, S., Medina, V., & Kronish, I. M. 2017. Telemonitoring Adherence to Medications in Heart Failure Patients (TEAM-HF): A Pilot Randomized Clinical Trial. *Journal of Cardiac Failure*, *23*(4), 345–349. https://doi.org/10.1016/j.cardfail.2016.11.001

Iljaž, R., Brodnik, A., Zrimec, T., & Cukjati, I. 2017. E-healthcare for diabetes mellitus type 2 patients – a randomised controlled trial in Slovenia. *Slovenian Journal of Public Health*, *56*(3), 150–157. https://doi.org/10.1515/sjph-2017-0020

Johnston, N., Bodegard, J., Jerström, S., Åkesson, J., Brorsson, H., Alfredsson, J., … Varenhorst, C. 2016. Effects of interactive patient smartphone support app on drug adherence and lifestyle changes in myocardial infarction patients: A randomized study. *American Heart Journal*, *178*, 85–94. https://doi.org/10.1016/j.ahj.2016.05.005

Khonsari, S., Subramanian, P., Chinna, K., Latif, L. A., Ling, L. W., & Gholami, O. 2015. Effect of a reminder system using an automated short message service on medication adherence following acute coronary syndrome. *European Journal of Cardiovascular Nursing*, *14*(2), 170–179. https://doi.org/10.1177/1474515114521910

Park, L. G., Howie-Esquivel, J., Chung, M. L., & Dracup, K. 2014. A text messaging intervention to promote medication adherence for patients with coronary heart disease: A randomized controlled trial. *Patient Education and Counseling*, *94*(2), 261–268. https://doi.org/10.1016/j.pec.2013.10.027

Santo, K., Chow, C. K., Thiagalingam, A., Rogers, K., Chalmers, J., & Redfern, J. 2017. MEDication reminder APPs to improve medication adherence in Coronary Heart Disease (MedApp-CHD) Study : a randomised controlled trial protocol, 1–10. https://doi.org/10.1136/bmjopen-2017-017540

Vervloet, M., Linn, A. J., van Weert, J. C. M., de Bakker, D. H., Bouvy, M. L., & van Dijk, L. 2012. The effectiveness of interventions using electronic reminders to improve adherence to chronic medication: a systematic review of the literature. *Journal of the American Medical Informatics Association*, *19*(5), 696–704. https://doi.org/10.1136/amiajnl-2011-000748