MODEL FOR MONITORING CHRONIC DISEASES IN MHEALTH APPLICATIONS: A CASE OF ASIAN COUNTRY

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Abstract - Health is a basic requirement to improve the quality of life. Providing effective health care is an essential component towards the social and economic development of a country. In Asian country, chronic diseases accounted for 71% of all deaths in 2002. The WHO in its report Preventing Chronic Disease: A Vital Investment has highlighted the inaction of most governments of the low and middle income countries in tackling the problem urgently, is clear and unacceptable. An evolution of primary health care system beyond the acute care model to embrace the concept of caring for long term health problems is imperative in the wake of the rising epidemic of chronic diseases and its crushing burden resulting in escalating healthcare costs. This paper aims to identify the elements involved in mHealth monitoring system for chronic diseases patients focus in Asian conuntry. The proposed mHealth vital sign monitoring system in this paper is aimed to help clinicians and patients by illustrating the trace of critical physiological parameters, generating early warning/alerts and indicating any significant changes to the data, consultation, medicine and treatments. The model was validated with different set of collected data from public user (patients), developers and practitioners. But, in this paper, the analysis of validation focus on public user only that involved a patients and system developers.

Keywords - Chronic Diseases, Monitoring System, Mobile Health

I. INTRODUCTION

Health care is one of the most important dependencies for economic sustainability and growth of a country. The national economic and social development depends on the state of health. The monitoring of smart mobile phones have created an unprecedented opportunity to provide healthcare services to unprivileged people in an instantaneous, interactive and customized way. Mobile health, popularly known as mHealth is transforming healthcare delivery by making it more accessible, affordable and available. The use of remote monitoring is expected to continue its growth at a compound annual growth rate (CAGR) of 47.9 percent to reach 50.2 million by 2021. Remote monitoring opens new possibilities for treating patients in an outpatient setting, a crucial capability in developing countries where access to hospital beds and clinics is limited. This group of applications consists of one- or two-way communications to monitor health conditions, maintain caregiver appointments, or ensure medication regimen adherence. Some applications may also include inpatient and out-patient sensors for monitoring multiple conditions.

Chronic diseases include heart disease, stroke, cancers, chronic respiratory diseases, diabetes and mental disorders are now accounted for 47% of the global burden of disease and 60% of all deaths. World Health Organisation (WHO) in its ground-breaking report Preventing Chronic Diseases: a Vital Investment shows that 80% percent of chronic disease deaths occurred in the low and middle income countries and 50% of these deaths occurred prematurely in people under 70 years of age, disputing the long-held notions that chronic diseases are mainly affecting affluent countries and older generations. In Malaysia, WHO estimated that chronic diseases accounted for 71% of all deaths in 2002, using calculation based on the standard methods to maximise cross-country comparability. The first Malaysian Burden of Disease and Injury Study showed that the top two leading causes of deaths in the year 2000 for both sexes were ischaemic heart disease and cerebrovascular disease; and the total years of life lost for the Malaysian population in 2001 was 1.7 million years with almost two-thirds of this burden of premature deaths resulted from chronic diseases. Of the total burden of disease measured using Disability Adjusted Life Years (DALYs), approximately 69% was contributed by chronic diseases.mHealth is a general term for the use of mobile phones and other wireless technology in medical care field. The most common application of mHealth is the use of mobile phones and communication devices to educate consumers about preventive health care services. Because we believe in technologic advances could reduce the burden of self-monitoring and provide feedback to enhance adherence, mHealth is also has been widely used for disease surveillance, treatment support, epidemic outbreak tracking and chronic disease management.

In Asia, mHealth approach allows multiple care dimension of top chronic diseases such as Chronic Heart Disease, Diabetes Mellitus, Asthma, Hypertension and Obesity. Before mHealth technology has come, patient have to go to the hospital and waiting for a long time before proceeding with their regular medical check-up. With mHealth patient only have to use mobile phone that is able to self-monitor their current condition and send

all the medical record to doctors. This by means of mobile collection and monitoring the patient data and provision of personalized and customized feedback on a smartphone platform that enables real-time clinical interaction and feedback to patient also user.

II. DEVELOPING MONITORING CHRONIC DISEASES IN MHEALTH APPLICATIONS

Health monitoring is the continued oversight of the progression of a clinical trial. This is to ensure that it is conducted according to protocol as well as good clinical practice, regulatory requirements and standard operating procedures in health. The purpose of monitoring is to monitor patients to see whether a particular intended result or set of results has actually happened after a clinical process or substance has been applied and to provide ongoing oversight to the quality of care given.

This developed model build as a guideline to developers in mhealh monitoring system development. At the same time to provide public health officials with the tools that enhance their ability in communities they serve. Figure 1 shows the proposed model for monitoring chronic diseases in mHealth applications.

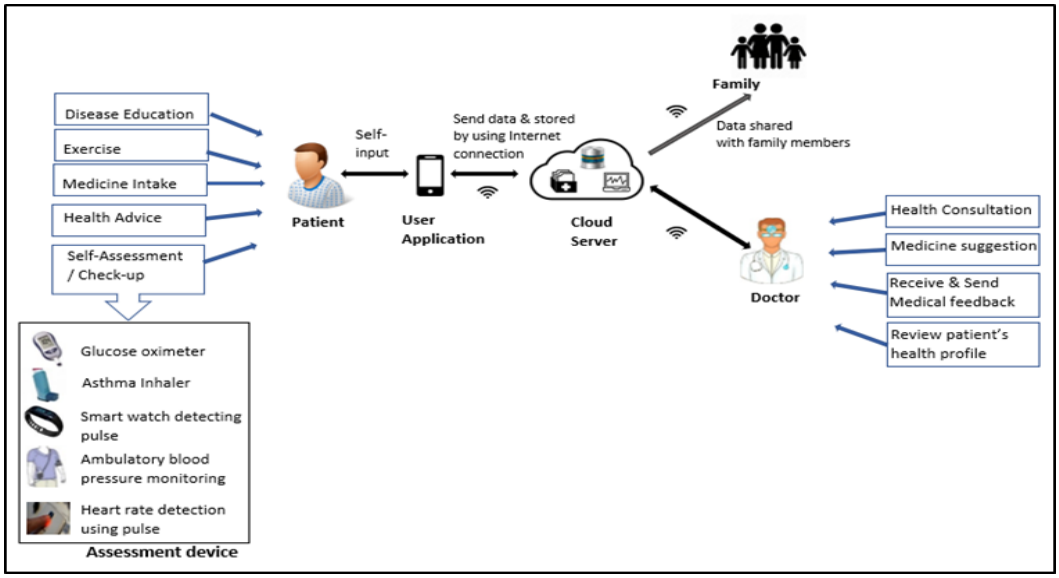


Figure 1: Model for Monitoring Chronic Diseases in mHealth applications

III. ELEMENTS IN MONITORING CHRONIC DISEASES IN MHEALTH APPLICATIONS MODEL

a. Patient

The first tier of this mobile application system is the patient's interface or patient's component which consists of Disease Education, Exercise, Medicine Intake and Self-Assessment/Check-up.

- **Disease Education**

The first and foremost element that is heavily important and helpful for the patient is disease education. Patient should know and informed about the disease that they are suffer from. They should really understand the cause of the disease, the symptoms, what affect and effect of it, what should be done if they suffer from the disease, etc. The function of this element is to create awareness about the top chronic diseases in Malaysia which are Chronic Heart Disease, Diabetes Mellitus, Asthma, Hypertension and Obesity. Therefore, the disease education is not only for the patient itself, but also to all people and users. They will be provided with the graphics and images along with the brief summary and explanation about the diseases.

- **Exercise**

In this proposed application, exercise is a must in order to track patient's activity to keep them healthy. Doctor will suggest the doable and feasible exercise for patient through this application and it will keep the data and information of the exercise that has been done in their health record.

- **Medicine Intake**

The element of medicine intake from the patient's platform is for the patient to key-in their current medicine intake and dosage that is suggested by the doctor. Then it will export this data and information to the doctor's platform to be reviewed. This to ensure that the patient take every single medicine according to doctor's instruction.

- **Self-Assessment/Check-up**

This propose mobile application system has the ability to use with multiple sensors or medical devices that is wearable and can be used by patient to collect the medical and health information. This platform will transmit the real-time health data wired or wirelessly from the medical devices to the application system. The smartphone will then extract all the patient's data and information from the

wearable sensors and must be communicable via GRPS, 3G, 4G or Wi-Fi connection and networks. The medical devices that is going to be build-up with this application is Glucose oximeter to read the level of glucose in blood. The function of asthma inhaler is for the patient to inhale and exhale as hard as possible to the get the reading of oxygen that contain in patient's breath. Smart watch is commonly used in this worldwide area but to be used with this application, it must can detect the pulse on user's wrist and have the features of wired or wireless connection to transmit the data and information. Ambulatory Blood Pressure Monitoring is a medical device something that is wearable and wrapped around the upper arm to give the reading of blood pressure. The last medical device is the Heart Rate detector. It works by using the mobile flash camera and detect the pulse at patient's fingertip. It will then collect the data and transmit to the application to be shared on doctor's platform.

b. Doctor

Another tier on this mobile application platform is the doctor's component which consists of four elements which are Health Consultation, Medicine Suggestion, Receive & Send Medical Feedback and Review Patient's health Profile.

- **Health Consultation**

This element allows doctor to give health consultation based on the patient's current condition and health record. The consultation will be sent to patient through the application in message form.

- **Medicine Suggestion**

Medicine suggestion is an element where doctor will suggest the best medicine intake and dosage according to patient's current condition and health record as well as health consultation. Doctor have the right to change the medicine dosage and time intake and it will then send to patient via this mobile application.

- **Receive & Send Medical Feedback**

This application allow doctor to receive and send all the medical feedback whether it is the data and health information from the patient or vice versa from the doctor itself to the patient. Patient will view all the feedback and suggestions in the form of short messages.

- **Review Patient's Health Profile**

In order to make a detail feedback and consultation, doctor is allowed to view the profile, health record and medical history of the patient. The collected measurements, readings and health information that is uploaded to the health portal will be able to view by the doctor. This will allow fed back action to the patient along with the relevant health profile summaries and advice, depending on both current and historical data in the patient's medical record.

IV. CONCLUSION

The integration of public and private primary care sectors in Asia should be high on the agenda of policy change. Care for chronic conditions needs coordination and continuity across time and health care setting, and across sectors. Traditional boundaries among levels of the system of primary, secondary and tertiary care, as well as across public and private sectors must be minimised to allow better integration to occur. Asian country has a limited number of Family Medicine Specialists, but a large number of private general practitioners. Seamless integration and collaboration with the private primary care sector is crucial to optimise the use of available human capital to care for chronic conditions. We need top-down stewardship and strong commitment by national leaders, policy makers, health care organisations, community leaders, health care personnel, and patients and families, on quality primary health care that focus on prevention and control of chronic diseases. The solution lies in every person at all levels to become an agent of change by embracing a new way of thinking regarding chronic disease care and to take serious actions on each of the problems highlighted. Beside that implementation of mobile technology also have to critically study and implement in health area. Monitoring system using mobile apps one of the solution for patients to care themselves and also al good prevention plan for patients and all citizens.

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REFERENCES

[1] Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Patel, V. and Ustun, B. (2018). Depression, chronic diseases, and decrements in health: results from the World Health Surveys. [online] ScienceDirect. Available at: https://www.sciencedirect.com/science/article/pii/S0140673607614159 [Accessed 15 Feb. 2018].

[2] Beaglehole, R., Ebrahim, S., Reddy, S., Voûte, J. and Leeder, S. (2008). Prevention of chronic diseases: a call to action. [online] ScienceDirect. Available at: https://www.sciencedirect.com/science/article/pii/S0140673607617000 [Accessed 18 Feb. 2018].

[3] Kumar, S., Nilsen, W., Abernethy, A., Atienza, A., Patrick, K., Pavel, M., Riley, W., Shar, A., Spring, B., Spruijt-Metz, D., Hedeker, D., Honavar, V., Kravitz, R., Craig Lefebvre, R., Mohr, D., Murphy, S., Quinn, C., Shusterman, V. and Swendeman, D. (2018). Mobile Health Technology Evaluation: The mHealth Evidence Workshop. [online] NCBI. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3803146/ [Accessed 7 Apr. 2018].

[4] H. M. Mohamed, A., Tawfik, H., Al-Jumeily, D., & Norton, L. (2011). MoHTAM: A Technology Acceptance Model for Mobile Health Applications - IEEE Conference Publication. Retrieved from https://ieeexplore.ieee.org/document/6149947/

[5] Jahan, S., &MozammelHoque Chowdhury, M. (2014). mHealth: A Sustainable Healthcare Model for Developing World. Retrieved from http://pubs.sciepub.com/ajmo/2/3/2/

[6] Spies, C. (2015). Proposed model for evaluation of mHealth systems - IEEE Conference Publication. Retrieved from https://ieeexplore.ieee.org/document/7374199/

[7] Jake-Schoffman, D., Silfee, V., Waring, M., Boudreaux, E., Sadasivam, R., & Mullen, S. et al. (2017). Methods for Evaluating the Content, Usability, and Efficacy of Commercial Mobile Health Apps. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5748471/

[8] White, B., Burns, S., Giglia, R., & Scott, J. (2016). Designing Evaluation Plans for Health Promotion mHealth interventions: A Case Study of the Milk Man mobile app. Retrieved from https://onlinelibrary.wiley.com/doi/pdf/10.1071/HE16041

[9] Westmeath Examiner. (2018). Westmeath Examiner - Whelehans Pharmacy: High blood pressure can be a silent killer. [online] Available at: http://www.westmeathexaminer.ie/sponsorededitorial/roundup/articles/2018/02/27/4152733-whelehans-pharmacy-high-blood-pressure-can-be-a-silent-killer/ [Accessed 5 Mar. 2018]

[10] N., C., Costas, T. and A., P. (2018). The Clinical Problems of Hypertension Treatment in Hemodialysis P...: Ingenta Connect. [online] Ingentaconnect.com. Available at: http://www.ingentaconnect.com/contentone/ben/cvp/2018/00000016/00000001/art00011 [Accessed 11 Mar. 2018]

[11] Carey, R. and Whelton, P. (2018). Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Synopsis of the 2017 American College of Cardiology/American Heart Association Hypertension Guideline. [online] Annals of Internal Medicine. Available at: http://annals.org/aim/fullarticle/2670318 [Accessed 14 Mar. 2018]

[12] Stergiou, G., Palatini, P., Asmar, R., Bilo, G., de la Sierra, A., Head, G., Kario, K., Mihailidou, A., Wang, J., Mancia, G., O'Brien, E. and Parati, G. (2018). Blood pressure monitoring: theory and practice. European Society of Hypertension Working Group on Blood Pressure Monitoring and Cardiovascular Variability Teaching Course Proceedings. [online] Blood Pressure Monitoring. Available at: https://journals.lww.com/bpmonitoring/Abstract/2018/02000/Blood_pressure_monitoring___theory_and_practice_.1.aspx [Accessed 17 Apr. 2018]

[13] Ioannidis, J. (2018). Diagnosis and Treatment of Hypertension in the 2017 ACC/AHA Guidelines and in the Real World. [online] JAMA Network. Available at: https://jamanetwork.com/journals/jama/article-abstract/2666624?redirect=true [Accessed 24 Apr. 2018]

[14] Galiè, N., Humbert, M., Vachiery, J., Gibbs, S., Lang, I., Torbicki, A., Simonneau, G., Peacock, A., VonkNoordegraaf, A., Beghetti, M., Ghofrani, A., Gomez Sanchez, M., Hansmann, G., Klepetko, W., Lancellotti, P., Matucci, M., McDonagh, T., Pierard, L., Trindade, P., Zompatori, M. and Hoeper, M. (2015). 2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. [online] Oxford Academic. Available at: https://academic.oup.com/eurheartj/article/37/1/67/2887599 [Accessed 19 Apr. 2018]

[15] Psychiatry.org. (2018). App Evaluation Model. [online] Available at: https://www.psychiatry.org/psychiatrists/practice/mental-health-apps/app-evaluation-model [Accessed 2018]

[16] Slovensky, D., Malvey, D., &Neigel, A. (2017). A model for mHealth skills training for clinicians: meeting the future now. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5505927/ [Accessed 5 May 2019]

[17] H. M. Mohamed, A., Tawfik, H., Al-Jumeily, D., & Norton, L. (2011). MoHTAM: A Technology Acceptance Model for Mobile Health Applications - IEEE Conference Publication. Retrieved from https://ieeexplore.ieee.org/document/6149947/

[18] Jahan, S., &MozammelHoque Chowdhury, M. (2014). mHealth: A Sustainable Healthcare Model for Developing World. Retrieved from http://pubs.sciepub.com/ajmo/2/3/2/ [Accessed 29 Apr. 2019]

[19] Jake-Schoffman, D., Silfee, V., Waring, M., Boudreaux, E., Sadasivam, R., & Mullen, S. et al. (2017). Methods for Evaluating the Content, Usability, and Efficacy of Commercial Mobile Health Apps. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5748471 [Accessed 19 Apr. 2019]

[20] Chin M. H, Cook S, Drum M. L, Jin L, Guillen M, Humikowski C. A, Schaefer C. T. Improving diabetes care in midwest community health centers with the health disparities collaborative. Diabetes Care. 2004;27(1):2–8. http://dx.doi.org/10.2337/diacare.27.1.2 . [PubMed] [Google Scholar]

[21] Ciccone M. M, Aquilino A, Cortese F, Scicchitano P, Sassara M, Mola E, Bux F. Feasibility and effectiveness of a disease and care management model in the primary health care system for patients with heart failure and diabetes (Project Leonardo) Vascular health and risk management. 2010;6:297. http://dx.doi.org/10.2147/VHRM.S9252 . [PMC free article] [PubMed] [Google Scholar]

[22] Ezzati M, Lopez A. D, Rodgers A, Murray C. J. L. Geneva: World Health Organization; 2005. Comparative quantification of health risks: global and regional burden of diseases attributable to selected major risk factors. [Google Scholar]

[23] Franks P, Chapman B, Duberstein P, Jerant A. Five factor model personality factors moderated the effects of an intervention to enhance chronic disease management self-efficacy. British journal of health psychology. 2009;14(3):473–487. http://dx.doi.org/10.1348/135910708X360700 . [PMC free article] [PubMed] [Google Scholar]

[24] Piatt G. A, Orchard T. J, Emerson S, Simmons D, Songer T. J, Brooks M. M, Zgibor J. C. Translating the Chronic Care Model Into the Community Results from a randomized controlled trial of a multifaceted diabetes care intervention. Diabetes care. 2006;29(4):811–817.

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