VIRTUAL HEALTH CONNECT: A COMMUNITY-BASED IMMUNISATION SCHEDULER AND MANAGER

Keng Siang Ooi[1] and Yu-N Cheah[2]
[1]*Universiti Sains Malaysia, Malaysia, ooikengsiang@live.com*
[2]*Universiti Sains Malaysia, Malaysia, yncheah@cs.usm.my*

ABSTRACT. According to the World Health Organisation (WHO), there were 28,950 children in Malaysia who did not receive full immunisation, given by the Malaysian government for free, by the age of 7 in 2011 alone. Current manual or paper-based systems are no longer effective nor efficient in keeping track of the immunisation schedules, and in reminding parents regarding their children's immunisation schedules. Virtual Health Connect (VHC) is a community-based lightweight web-based solution that helps to manage children's immunisation schedules automatically and sends short message service (SMS) reminders to parents when their children's upcoming immunisation dates draw near. Healthcare personnel can also generate monthly reports on immunisation coverage and trace appointment defaulters easily, saving administrative time and effort.

Keywords: immunisation scheduler, immunisation management, immunisation reminder, short message service

INTRODUCTION

According to the World Health Organization (WHO), there were 28,950 children in Malaysia who did not receive full immunisation, given by the Malaysian government for free, by the age of 7 in 2011 alone (World Health Organization, 2012). Despite clear evidence that immunisation can help protect children from vaccine preventable diseases (Andre et al., 2008), parents still lack the awareness to bring their children for immunisation on time. Furthermore, a WHO report showed an increase in vaccine preventable diseases in Malaysia: 1,569 cases of measles, 248 cases of pertussis, and 374 cases of rubella were reported in the year 2011 compared to 73 cases of measles, 41 cases of pertussis, and 104 cases of rubella reported in the year 2010 (World Health Organization, 2012).

As the number of working parents increases, they tend to forget about their children's immunisation and health check-up schedules even though they are fully aware of their importance (Kharbanda et al., 2009). Based on a simple survey carried out at the Sungai Dua health clinic in Penang, Malaysia, we learnt that 50% of the 32 parents surveyed have been late at least once in bringing their children for immunisation. Many parents complained that they tend to forget the dates written on the immunisation cards while some parents misplace their children's immunisation and health record books. This means that traditional immunisation cards or health record books are no longer adequate in reminding parents.

With the current paper-based immunisation and health records, normal mail or phone call reminders are still commonly used to remind parents about their children's overdue immunisation appointments. Unfortunately, this causes extra burden on nurses to keep track of each defaulter and to call the parents one-by-one. In the same survey, the nurses

complained about the extra work incurred to call up the defaulters and even to make home visits just to remind them to take their children for immunisation. Obviously, reminders via phone calls and home visits are not cost-effective.

According to the Malaysian Communications and Multimedia Commission (MCMC), the cellular phone penetration rate in Malaysia reached up to 127.7% in 2011 (a penetration rate of over 100% can occur because of multiple subscriptions) (Malaysian Communications and Multimedia Commission, 2011). This means, parents potentially own at least one cellular phone that is capable of receiving short message service (SMS) notifications. Parents in the rural area (perhaps not including interior or remote areas) who do not lead a life dictated by schedules, can be reached through mobile phones and can potentially receive SMS messages. According to a separate online survey we had conducted and other related research findings, SMS reminders were well-accepted by parents (Kharbanda et al., 2009; 2011). Research projects in other countries showed that SMS reminders can help improve the immunisation coverage and ensure children receive their immunisation shots on time (Kaewkungwal et al., 2010; Kharbanda et al., 2011; Wakadha et al., 2013).

VIRTUAL HEALTH CONNECT

To address the issues of children missing their scheduled immunisation and inefficiencies caused by paper-based immunisation and health records, we propose a system called Virtual Health Connect (VHC). VHC is a community-based lightweight web-based solution that helps to record and keep track of children's immunisation schedules automatically. It also sends SMS reminders to parents to remind them to bring their children to the clinic for immunisation on time. VHC is a convenient and effective system that can save time, labour and cost of managing immunisation records, calling patients and health record keeping.

We conducted a preliminary nationwide online survey to gauge parents' reaction towards the introduction of VHC. About 71.43% out of 56 respondents strongly agree that SMS reminders will help them to remember better and to avoid missing or forgetting the date of their children's immunisations. With the same sample size, 42.86% responded that they would be happy to subscribe to VHC while another 42.86% said that they would definitely consider subscribing to our service.

In this paper, the scope will be on introducing the features of the VHC system and the protocol involving the reminders for the children being immunised. These will make up the initial phase of a study to schedule and manage the immunisation of children (with reminders sent to their parents) with the hope of increasing the uptake and to widen the coverage of immunisation amongst children.

RELATED WORK

The effectiveness of SMS reminders has been previously studied for different kinds of immunisation, many with favourable results.

In urban areas of New York City, United States, a study on SMS reminders for human papillomavirus (HPV) immunisation was carried out as an opt-in system. Young adults or adolescents who have taken the first dose of HPV vaccine can participate and receive SMS reminders for their second and third HPV vaccine doses. The results showed a 13% to 16% increase in rates of return for the subsequent vaccine doses (Kharbanda et al., 2011).

On a larger scale, a study in the urban, low income population in New York City, United States, involving 7,574 adolescents who have yet to receive their influenza vaccine reported

that SMS reminders increased the rate of influenza immunization by 3.7% to 4.3%. However, the overall influenza immunisation rate in the area remains low (Stockwell et al., 2012).

In rural western Kenya, SMS reminders have also been studied in terms of their feasibility to improve immunisation coverage. Parents who opted-in the project received SMS reminders 3 days before the day of immunisation. Approximately USD2 was given as reward to parents if their children were vaccinated on time. The results showed that SMS reminders are capable to improve the immunisation coverage and timeliness despite moderate levels of mobile phone ownership among mothers in the area (Wakadha et al., 2013).

Smart phones have also been explored to deploy applications that can schedule appointments and update patient data remotely. One such application was specially designed for rural and remote areas in Thailand. SMS reminders were part of the system's feature to remind mothers regarding their appointments which include their children's immunisations. The results showed that SMS reminders helped double the rate of children receiving their immunisations on time (Kaewkungwal et al., 2010).

In another study, international travellers were the research focus because they often take the first dose of hepatitis A+B or hepatitis A vaccines and forget the second and third doses. The overall results show that SMS reminders can help increase the immunisation coverage by 5.8% to 23.5% and it is an effective tool for increasing compliance with the immunisation schedule (Vilella et al., 2004).

Similar researches on SMS reminders for immunisation were conducted in Malaysia. A simple program sent SMS reminders manually to parents two days before the immunisation appointment. The research survey shows that 45.2% of parents thought that the SMS reminders were very useful while 54.8% thought they were useful (Abbas, & Yusof, 2011).

In general, SMS reminders (or any form of reminder for that matter) would be useful in increasing coverage and timeliness of immunisation. However, from the related work surveyed, the studies were more on the effectiveness of the reminders. However, the challenge in a system for immunisation reminders stems more from the management and scheduling of the reminders. Some of the previous studies employ manual effort in sending out reminders which may not be practical or cost-effective on the long-term.

VHC SYSTEM OVERVIEW

VHC has the following features: (1) immunisation scheduler, (2) profile manager, (3) automatic SMS reminder, and (4) report builder. The design of the VHC system is focused on simplicity. This enables healthcare personnel (such as nurses) to use the system with ease, thus allowing them to complete their tasks much easier and faster.

The immunisation scheduler (see Figure 1) holds each child's immunisation record and automatically schedules their next immunisation appointment. The scheduler is aimed at replacing existing paper-based immunisation records.

The profile manager handles the children's profiles. The profiles can be easily searched and managed through the VHC system instead of nurses having to manually search for the paper-based records.

Automatic SMS reminders are sent to the children's parents seven days before the immunisation date, and on the day of the immunisation. If the parents do not show up, the VHC system will continue to send SMS reminders every day for the next three days, and on the seventh day past the immunisation date. The list of children who are late (or defaulters)

will be shown by the VHC system. Figures 2 and 3 show the immunisation reminder protocol, as well as a sample SMS reminder sent by VHC respectively.

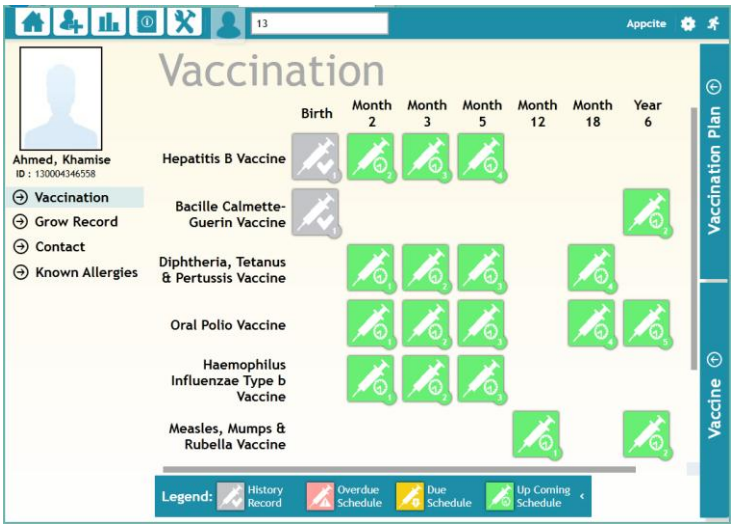

Figure 1. VHC's immunisation scheduler

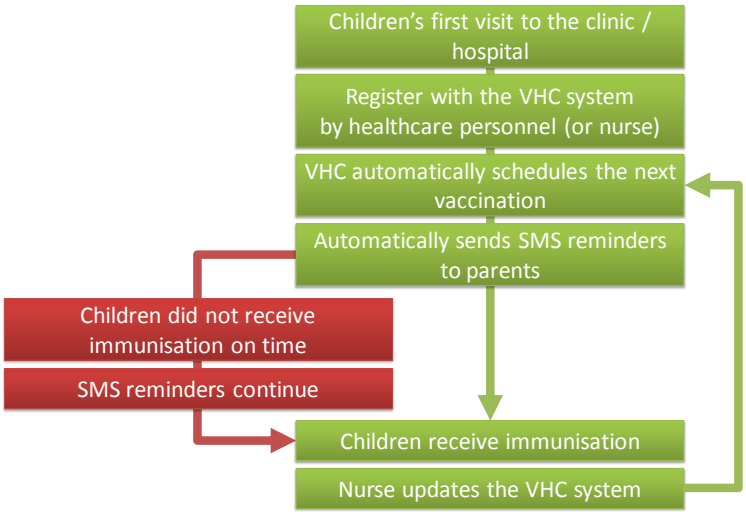

Figure 2. VHC protocol or system flow for immunisation reminders

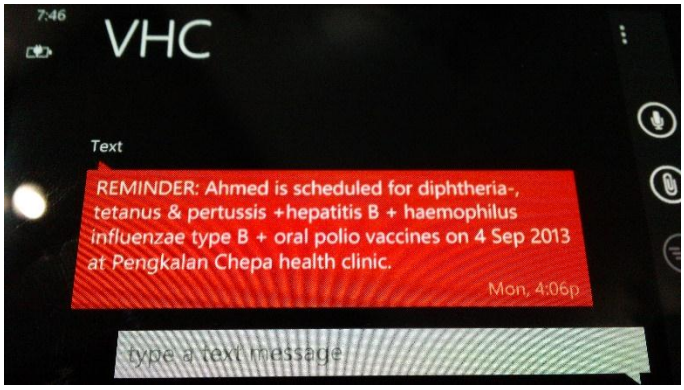

Figure 3. Sample SMS reminder sent by VHC

At any point in time, especially at the end of the month, the healthcare personnel can generate the necessary reports through the report builder as shown in Figure 4.

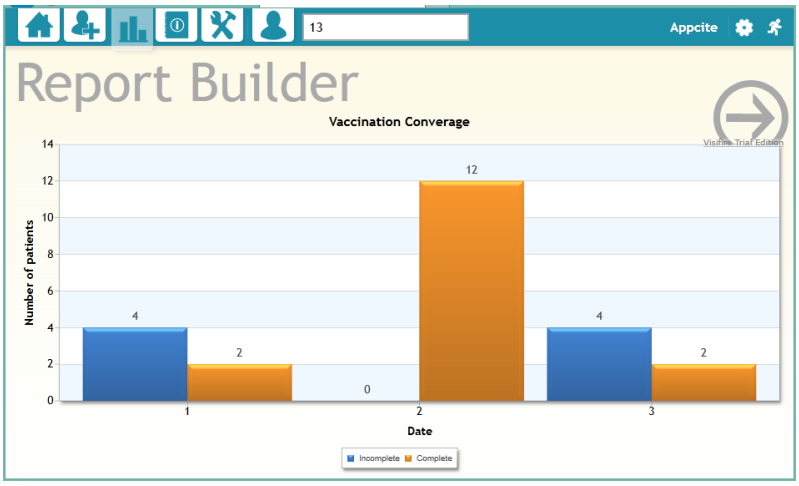

Figure 4. VHC's report builder

DISCUSSION AND FUTURE WORK

VHC is unlike existing immunisation reminder system (Vilella et al., 2004; Kharbanda et al., 2011; Abbas & Yusof, 2011; Stockwell et al., 2012) because it incorporates an automatic immunisation scheduler and manager that is integrated with the children's immunisation records. In the local context, the system does not only focus on the free immunisation plan provided by the Malaysian government, but can be tailored to include any additional immunisations. All appointments for immunisation are automatically scheduled and the SMS reminders are sent according to the schedule in the immunisation records.

The rationale for the project is convenience and cost. In terms of convenience, the system is designed with a touch-screen kiosk in mind. Hence, not only does the VHC system facilitate the management of the immunisation records, it also makes access to the various features or functions much easier. In terms of cost, the VHC project translates computer database, and SMS technologies into a practical, simple, but yet effective way to increase immunisation uptake and to widen its coverage. This leads not only to a better quality of health for the community, especially for infants and young children, but also a reduction in the cost of healthcare to treat diseases.

Research on the VHC system is on-going. In the next phase, we plan to carry out a pilot study at selected health clinics for six months to allow parents to receive reminders for the immunisations of their children, especially in the case of infants below the age of one year who would be receiving immunisation every month or every other month.

From the pilot study, we hope to evaluate the effectiveness of the SMS reminders to increase immunisation uptake, coverage and response (timeliness), as well as to study the acceptance and usability of the VHC system by healthcare personnel.

CONCLUSION

In this paper, we presented the features of the VHC system that facilitates the scheduling and management of immunisation, as well as to send reminders to parents regarding their children's immunisations. Moving forward, we hope that the VHC system will be able to help improve the overall immunisation coverage and response in the pilot study area. Since we had

received positive response from both parents and nurses from the surveys conducted earlier, we strongly believe that the response of the pilot study will also be favourable.

This research on SMS reminders for immunisation could be extended further to other domains that require frequent reminders, e.g. in finance and banking for loan repayments. This again would contribute towards building a smart community, i.e. a community that leverages on technology to be more effective and efficient.

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