ISSN (Print) : 0974-6846
Indian Journal of Science and Technology, *Vol 9 S(1), DOI: 10.17485/ijst/2016/v9iS(1)/106819 December 2016* ISSN (Online) : 0974-5645

Eliciting User Requirements to Design a Prediabetes Self-care Application: A Focus Group Study with Prediabetics and Diabetics

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Abstract

Objective: To explore the users' insights that contributes to behaviour change in prediabetics and the user requirements for a self-care application from the prediabetics' perspective. **Methods/Statistical Analysis:** We conducted Focus Group Discussions (FGD) on four distinct groups of diabetics and prediabetics at a Diabetes Resource Centre and among the public through advertisement. Open-ended questions were asked to stimulate the discussions. Transcripts of each discussion session were read several times, coded, categorised and analysed thoroughly by identifying the themes. The facial expressions during the discussion were also observed and taken into consideration. **Findings:** Results indicated that diabetes can be prevented through proper lifestyle changes, if and only if the person is willing to change his/her behaviour. The idea of a self-care application was well accepted by the participants and the components to be included were identified. The identified components are such as self-monitoring, diet, exercise, activity planning, goal setting, forum, social support and reminders. As for diabetics, taking medication has second highest priority where else it holds lesser priority among prediabetics. About 20% of the participants showed less interest in a self-care application either because they are not technology savvy or because of their advanced age status. **Application/Improvements:** A framework for designing prediabetes self-care application will be formulated, which integrates behavioural change theories.

Keywords: Behavioural Change, Blood Glucose, Diabetes Prevention, Mobile Application, Prediabetes, Web Technology

1. Introduction

Diabetes is a chronic disease, in which, the pancreas does not produce enough insulin or the body cannot use the insulin it produces effectively. This results in high levels of glucose in the blood. There are three types of diabetes, Type-1 diabetes, Type-2 diabetes and gestational diabetes. Type-1 diabetes is genetic and associated with children: it cannot be prevented. Gestational diabetes is temporary: it happens during pregnancy, which may or may not lead to Type-2 diabetes for both mother and child. Type-2 diabetes is the most common form of diabetes among adults: it is associated with a person's lifestyle. As such, Type-2 diabetes can be prevented, with proper lifestyle modification.

Recent statistics reveal that 3.5 million adults in Malaysia (17.5% of the adult population) already have diabetes. Tragically, more than half of them are not even aware that they have diabetes[1]. This is quite alarming as the World Health Organisation projected that Malaysia will

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have about 2.48 million people with diabetes by the year 2030[2-4]. However, even before reaching the year 2030, 3.5 million adults in the country already have diabetes. This noncommunicable disease can lead to death ultimately. Every six seconds, a life is lost because of it and one in 11 adults has diabetes, globally[5]. It is estimated that the Malaysian government is spending about RM2, 684.24 for each diabetes patient for treatment every year[6].

As such, efforts should be focussed on preventing diabetes instead of managing diabetes. A lot of effort and interventions are focussed on diabetes management, but the ultimate goal should be to prevent diabetes. Prediabetes is a condition whereby the blood glucose levels are higher than normal, but not high enough to be classified as diabetes. At this stage, prediabetes can be reversed with proper lifestyle changes. Otherwise, it can lead to Type-2 diabetes.

About 20% of Malaysians are known to be prediabetics. This condition can lead to other complications such as heart disease, stroke and kidney failure[7]. Managing diet and doing physical exercises are known to be important lifestyle changes in managing prediabetes on their own[6,8]. These self-care activities can help prediabetics to lead a healthy life by changing their behaviour and controlling their blood glucose levels[9].

Advancement to the digital era in this 21st century enables the majority of the people to own personal computers, laptops and smart phones. This has helped to pave the way for implementations of web or mobile-based self-care applications to better manage an individual's health. These self-care applications enable the individuals to use them to fit into their own daily lifestyle patterns to manage their health conditions. Besides that, mobile health applications can save up to US$6 billion in yearly medical cost worldwide[10]. Example of applications that are targeted for diabetics include *DiabetesCoach*, *Glucose Buddy*, *myCompass* and *Diabetes Goal Tracker*[11-14]. *DiabetesCoach* is a patient-centric web-based application, which supports self-care among type-2 diabetics[11] and *Glucose Buddy* is another popular application that can be accessed via iPhone[12]. *myCompass* is a multi-platform intervention designed to improve mental well-being in young people with type-1 diabetes, which is said to be grounded in cognitive behaviour therapy[13]. The American Association of Diabetes Educators (AADE) have developed *Diabetes Goal Tracker* which focusses on the seven self-care behaviours: 1. healthy eating, 2. being active, 3. monitoring, 4. taking medication, 5. problem solving, 6. reducing risks, and 7. healthy coping in managing diabetes[14,15]. The integration of health behavioural change theories in development of diabetes prevention is vital and research efforts in this area can now be seen[16]. Recent research by Block et al. emphasises on a fully automated Diabetes Prevention Program, *Alive-PD*, which includes a six to twelve months of step-by-step individualized weekly guidance on increasing physical activity, improving eating habits, and weight loss[17].

Self-care applications impose greater responsibility on health-care consumers to manage their health. It is also true that it is not possible to treat or prevent diabetes without changing the individual's behaviour and habits[18]. This means that the health-care consumers must be able to use the self-care applications continuosly and the self-care applications should be a good assistant to the consumers to change their behaviour and habits.

However, many self-care applications do not meet the expectations of the users and do not support them to solve their health problems. The users feel that the applications are not customised to their needs. Some of the problems faced by the users are lack of feedback features, problems with navigation, lack of search functions, and the self-care advice insufficiently tailored to their personal needs[19]. For that reason, the users' insights and requirements need to be taken into consideration, instead of the healthcare professionals alone. Current applications are mostly designed to meet a single objective, such as weight management which is a far cry from a much needed comprehensive application. So, it is important that self-care applications are tailored to the users' requirements to ensure a continuous usage of the applications. Designing a self-care application for prediabetes is challenging as most prediabetics do not take their condition seriously.

The goal of this study is to obtain a clear understanding of the requirements for a prediabetes self-care application from the users' perspective. Hence, we conducted Focus Group Discussions (FGD) to explore the users' insights about their lifestyles that contributes to behaviour change via a prediabetes self-care application. In addition, we identified specific components that are to be incorporated in the application such as blood glucose tracking, diet tracking, goal setting, activity planning, calorie counter and online education.

This FGD technique was selected because it is an informal technique that can help to assess the user needs by bringing out the users' spontaneous reactions and ideas on a selected topic[20]. It also allows in-depth

discussions and to draw out subjective opinions of the participants[21,22]. This technique enabled us to gather the user requirements from the participants easily through the candid discussion among the peers.

This paper will discuss the findings of the FGD and is organised as follows. The first section describes the materials and methods that were used in conducting the data collection session. The subsequent section reports the results or findings of the FGD. The next section involves the discussion of the key findings and implications of the FGD. The conclusion section is inclusive of both summary and future work.

2. Materials and Methods

We conducted four FGD with 18 participants at a Diabetes Resource Centre and also among the public through advertisement, between the months of January and May 2016. Most of the participants are patients of a Diabetes Resource Centre and selected by the center management. Some of the participants are selected from public through advertisement. The selected participants are of various age groups, gender and ethnicities, who have either diabetes or are classified as being prediabetic.

Each FGD session lasted for 60 – 90 minutes and was facilitated by a moderator. There were two sessions for diabetics and two sessions for prediabetics. At the beginning of each FGD session, a consent form was distributed to each of the participant to sign. At the end of the discussion, a token of appreciation was given to the participants to thank them for their effort and participation.

As a warm-up and introductory session, the participants introduced themselves and briefed others on their history of diabetes or prediabetes. Open-ended questions were used to prompt the discussion. The role of the moderator was to ask the questions only to stimulate the discussion session and facilitate it. The participants were encouraged to give their own comments and opinions throughout the discussion.

At the end of the discussion, a slip consisting of self-care application components was given to each participant to determine important components to be included into a prediabetes self-care application based on their opinion. The participants ranked the components with numbers at the space provided. The most important components were ranked as '1', followed by '2' and so on by the participants. Later, the rankings were assigned with specific values and the average value for each component was calculated. Finally, the percentage of each component was identified. The findings were divided into two separate sections: prediabetics and diabetics.

Each discussion was audio-recorded and transcribed later. The facial expressions during the discussion were also observed and taken into consideration. Notes from each focus group discussion were compared for accuracy with the audio-recordings. The transcripts of the FGD were read several times to highlight the themes, factors and diverse responses. The transcripts were coded, categorized, and analyzed by identifying the recurrent themes and assigning categorization codes. Each group was analysed individually and then compared with other groups. The conclusions were extracted independently by one researcher and verified by another research team member.

3. Results

Twelve participants were scheduled for the diabetes FGD, but only 11 participated. Eleven participants were selected; only seven participated in the prediabetes FGD. Characteristics of the participants are displayed in Table 1. The outcome of the FGD is divided into six themes – lifestyle and self-monitoring, education and awareness, motivation and commitment, attitude, social support and coaching, and technology. These themes emerged from the responses of the participants.

Table 1. Characteristics of the 18 participants

Category	No. (%)
Age (years):	
41-50	1 (5.6)
51-60	2 (11.1)
61-70	11 (61.1)
71-80	3 (16.7)
81-90	1 (5.6)
Gender:	
Male	14 (77.8)
Female	4 (22.2)
Ethnicity:	
Indian	16 (88.9)
Chinese	2 (11.1)
Patient Type:	
Prediabetic	7 (38.9)
Diabetic	11 (61.1)

3.1 Lifestyle and Self-Monitoring

All the participants mentioned that lifestyle needed to be changed in order to manage and prevent the disease. Proper diet and physical exercise need to be taken care of. One participant shared the reason he became diabetic: "*I used to go field work. Checking all the contract and cabling works. So when I'm on the field driving my car, thirsty, those days I don't take warm water in my bottle. So, I go to the mini market buy coke, sarsi or ice cream soda. That's how I got the sugar in my blood*". Another participant indicated that he became diabetic because he was not active in sports during his early age and always sat behind his desk, being in management level until he retired. Lack of physical exercise led him to diabetes.

All the participants were strongly in favour for proper diet and exercise to manage and prevent diabetes. They shared that they always were on the look-out and were alert on what they were eating. They changed their lifestyle by reducing sugary and carbohydrates food. Eight participants shared that they set their desired blood glucose level as their quarterly goal and worked towards it. It was also mentioned that everyone needed to find the type of food which best suited them to control their blood glucose level as each individual responds differently towards different foods. One participant mentioned: "*Not all the five fingers are the same. Everyone's lifestyle is different*".

Besides that, 11 out of the 18 participants exercise frequently. They either do brisk walking, yoga, jogging, breathing exercise or simple stretching, at least three times a week. The participants claimed that if they would have known earlier that they are going to be diabetic or prediabetic, they would have taken corrective measures at a younger age, especially on diet and physical exercise. Three of the participants said that medication alone does not help to manage the glucose level; physical exercise is the best method to stabilize the glucose level. A prediabetic participant shared that: "*I throw away my medicine and cut down my sugar, all my tea and everything became without sugar already. Then, exercise, I do a lot of walking. After that, every six months I check, 6.4, they said it's a good control. The doctor said I no need to take medicine*".

Seventeen participants claimed that their blood glucose level is well-controlled after changing their lifestyle. One of them shared that: "*I'll take my reading before exercise and after the exercise, wow… my reading will drop. Exercise is really good*". They also continued that a person can eat anything he or she wants but everything should be taken in the right proportion. They emphasized on maintaining proper body weight as well.

A prediabetic participant shared that she knows that she will progress to being diabetic, if she does not take care of herself. She further mentioned that she controls the amount food she consumes according to the amount of work she needs to do, because doing exercise is not easy for her. Another prediabetic participant shared that she has been following her daily controlled food regime for the past few years now.

Another participant shared that in his early years, he used to play football and he was eating well. But after he became diabetic, he started to control his food style.

Overall, the study indicated that engagement in self-management behaviours is the proximal outcome influencing the outcome of improved health status: managing a proper lifestyle and self-monitoring is essential in taking responsibility for one's own health.

3.2 Education and Awareness

The participants claimed that there was less awareness about diabetes and the factors that causes diabetes many years ago. Now, there is much awareness created about the disease and managing the lifestyle. Currently, there are also more talk and discussion sessions organised by many government and non-government organisations to educate the public. The participants said even the healthcare professionals nowadays are actively educating people. One of the participants said that: "*When you attend talks, it actually motivates you to stay in track. When you go out of track and you attend these talks, the fear is created in you, you feel you shouldn't be eating this and that*".

By attending all these talks, the participants are more aware of the food contents and the lifestyle changes. One of them shared that: "*Now we check and read food labels. I am from corporate level, but people don't talk about food to you. Dieticians here gave us the awareness to read the food labels*". Nevertheless, one prediabetic participant said there must be more awareness created among the younger generation. She mentioned: "*If we can get more information easily about diabetes and prediabetes, even from TV and all that, it will be good to create the awareness and realization, that we will be prone to diabetes*".

3.3 Motivation and Commitment

There are a number of factors that contribute towards the participants being motivated and staying committed to the lifestyle changes. They indicated that motivation is important to change their behaviours. Thoughts about family, awareness towards the disease, education on the proper lifestyle, fear of death, fear of leg amputation and support from others are the constraints that makes them to stay motivated to stabilize the blood glucose level. They also said that the interest to change must come from within themselves. Self-discipline is deemed as being very important. One of the participant shared that:

I feel that motivation is outside in, inside out. If you ask me, I feel more confident to manage my diabetes after coming to D'Centres. I will say this because when you are sick, you need someone to come to you and say hey you need to take this and that. To care for you. To motivate you, to keep you going. We have dietitians, cardiologist, people who come to give talk. When they give talk, they don't give prescriptions, we already have enough prescriptions. All that keep you motivated.

3.4 Attitude

Four participants who worked at corporate management level indicated that stress is the main cause that leads to all diseases. After they changed their attitude to be more relaxed and the perspective on how they viewed their life, they could manage their blood glucose level and blood pressure better. One of the participant shared that: "*Laughing is a good medicine. When I play with my grandchildren, I use to laugh*".

Apart from that, two participants emphasized on not getting angry and concentrating on spiritual meditation. One of the participants strongly stressed on having a positive attitude. He explained that: "*Positive attitude means always being aware. When you say always being aware, you must know this I cannot eat, this I can eat. And in front of people don't say this one I don't eat you know. You eat something, little bit you eat. Don't show that you are a diabetic. That's positive*".

3.5 Social Support and Coaching

Eleven of 18 participants shared that they need some kind of social support from either family, friends or a support group. Family is a institution whereby they stay together, so they needed support from their family, especially the wives. They usually will give timely reminders about diet. One of the participant said: "*When we have these kind of problems, our wives also should be very cooperative. My wife does*". A prediabetic participant also shared that: "*We really need support, maybe from support group, that we can contact and approach when we have any difficulties. When we are not sure of whether we are doing the right thing or not*".

Sixteen of the participants shared that they prefer to discuss things with others and listen to others' sharing. By this way, they learn a lot of people's success stories and get motivated. Moreover, all the participants would like to be connected with either their doctors or dietitians. They would like to get coached and supported by the dietitians continously.

3.6 Technology

When technology was mentioned, 14 participants gave postitive responses. About 72% of the participants own a smart phone. Some of them download health related apps from the playstore and use them daily. One participant shared how he uses his smartphone: "*I am using smart phone for my jogging. I can see how many calories I have burnt, how many kilometers I have walked. Sometimes, when I go shopping complex, I can count how many steps I have walked. After three hours, when I come back to my car, I will be very happy to see how much calories I have burnt. Very helpful*".

Ten participants browse health related websites and use the search engine *Google* to find information on food, especially on those which are good for diabetes. One participant who has a *Facebook* account follows the articles shared by his doctor on house work and the number of calories burnt by each activity. Since then, he started mopping his house to burn calories.

Seven participants claimed that they get the information they need very fast from the Internet and through *Whatsapp*. Upon reading them, they feel motivated and share it with others. A participant shared her viewpoint: "*Nowadays, we don't read. Maybe in the phone, because most of us got smart phones. So, if we can get information easily, it will be better*".

The participants said that usage of smart phones and Internet often helps them in many ways. They said a self-care application will be a good assistant to monitor their health. A prediabetic participant shared her concern that the self-care application should be multi-lingual so that many could use it. In addition, some of them also mentioned that it would be good if the self-care application can give them reminders at a specified time.

Components of the Proposed Self-care Application: The participants highlighted the important components they wanted in a self-care application by ranking the components. The priorities of the self-care application components have been divided: prediabetics and diabetics. Priorities here means the most important to least important components from the participants' viewpoints. Table 2 shows the percentage of prediabetics and diabetics who have chosen each component. Figure 1 illustrates the comparison between the prediabetics and diabetics on their priorities.

Table 2. Priorities of prediabetics and diabetics on self-care application components

Components of Self-care Application	Prediabetics (%)	Diabetics (%)
Self-monitoring	100	93.18
Diet	92.85	84.1
Exercise	92.85	81.83
Personal Data	92.85	77.28
Activity Planning	85.73	65.9
Blood Glucose	85.73	88.63
Goal Setting	82.15	63.63
Online education	78.575	56.83
Forum	75	38.63
Social Support	75	40.9
Alerts/Reminders	71.43	54.55
Coaching	71.43	61.38
Medication	71.43	90.9
SMS/In-app Message	67.85	43.18
E-mail	64.28	36.38
Reward System	57.15	27.28

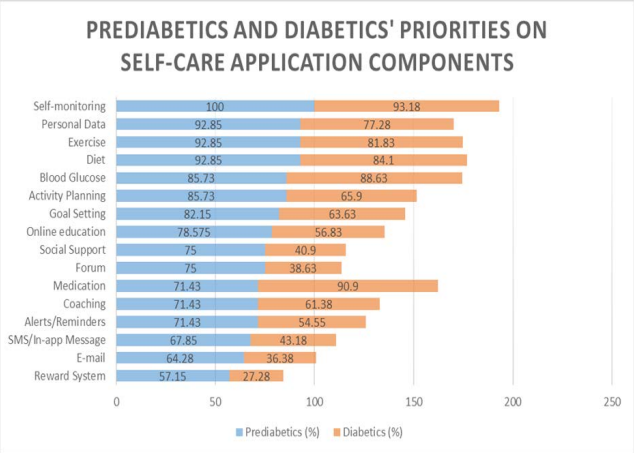

Figure 1. Comparison between prediabetics and diabetics priorities on self-care application components.

Based on the participants' choices, self-monitoring stays as the top priority for both groups. This followed personal data, exercise, diet, blood glocose, activity planning, goal setting, online education, social support, forum, medication, coaching, alerts/reminders, SMS/In-app message, e-mail and reward system for prediabetics. Meanwhile, for diabetics, self-monitoring is followed by medication, blood glucose, diet, exercise, personal data, activity planning, goal setting, coaching, online education, alerts/reminders, SMS/In-app message, social support, forum, e-mail and reward system. It is interesting to note that medication is not being considered as one of the top priority for prediabetics compared to diabetics. Prediabetics have chosen personal data, diet and exercise as their top priorities because they would like to have a self-care application which is personalised to them and keep track of their diet and exercise to monitor their blood glucose level. Prediabetics are not on medication, except for one participant who took the medication for two months only.

The reward system is the least priority for both the groups. They mentioned that they should be self-motivated through the thought about their own health and not through any reward system. Besides that, online education, social support and forum are in higher priority for prediabetics than diabetics. It is also seen that alerts/reminders are in lower ranking for prediabetics, compared to diabetics.

4. Discussion

These FGD results highlight that majority of the participants would like to use technology as their aid in managing their lifestyle to prevent diabetes. All the participants take self-responsibility towards their healthcare. They prefer the idea of a self-care application which can be a 'one-stop center' for all their needs as it can save time and cost.

Most of the diabetics are not aware of prediabetes and its reversal possibility stage. During our selection session for prediabetics, we found that most people are not aware that they are in prediabetes zone and those who are already diagnosed with prediabetes are not willing to admit that they are prediabetics. Some are not willing to let others know that they are prediabetics and are scared to come forward to seek help. For these reasons, we strongly feel that a prediabetes self-care application will be a good tool

to prevent diabetes, as the application will be personalised to each individual with their own personal data and to monitor their own lifestyle without letting others know. They still can get support and coaching online without meeting face-to-face with people. If and when they have any queries, they can post the questions virtually and discuss with other members who are online.

Online education will be helpful in creating awareness and as a source of knowledge to the prediabetics to gather more knowledge. Prediabetes can be managed, if and only if, the prediabetics are willing to change their lifestyle and behaviour. In order to this, they need knowledge and awareness about food, its contents and benefits. The majority of prediabetics mentioned that they normally use Google to find out about food, to identify the type of food which can help them to cure. The food which is deemed suitable varies among individuals. So, they suggested everyone should do their own research and find the food which helps them. They measure their blood glucose level before and after taking a new type of food to find out whether it suits their body or not. In this case, a component in the self-care application to record multiple entries of blood glucose level will be very useful. The participants are also interested in knowing the number of calories they are consuming and burning with every type of food and activity. So, adding a calorie calculator to count the calories in food they are consuming and recommended activities to burn those calories will be seen as being important.

Since most of the participants agreed that they need family support to better manage their health, we should strive to include their families, friends and support group. For example, an alert email or message can be sent to a family member or support group, who can encourage them to exercise and eat proper diet and find the reasons for not doing them. Forums will be useful too, as the participants said that they want a platform where they can communicate with others who are facing the same issue with them. They want to discuss what worked and what did not work with them and others. They also mentioned that they would appreciate direct coaching sessions with their doctors, so that they can discuss with their doctors about medication or any health related issues they are facing in their daily life.

Goal setting and activity planning also play a vital role in self-care applications. This is because in the process of managing their blood glucose level, the prediabetics set their own target blood glucose reading to achieve in a period of time, for instance three months. To achieve their target reading, they plan their schedule to perform physical exercises and to follow proper diet. Adding these features will help them to keep track of their goals and manage them more effectively.

As for the idea of adding reward system into the self-care application, they did not show much interest as they said that the idea to change should come from within. If a person is not interested, then nobody can change him or her. Despite getting positive feedbacks on the idea of developing a self-care application for prediabetes, about 20% of the participants showed less interest in a self-care application either because they are not technology savvy and do not own a smart phone or because of their advanced age status.

5. Conclusion and Future Work

Getting the users' feedback on the idea of developing a self-care application for prediabetes and their requirements for the application is essential to understand the needs and expectations of the target users so that a good self-care application can be designed for them to manage their health independently. Even though our FGD study is based upon a small sample size, it provides us valuable insight into the participants' lifestyle, awareness on prediabetes, and how they get motivated to change their behaviour. These insights help greatly to determine their expectations towards the currently available web technologies to take care of their health.

The FGD results support our hypothesis that a self-care application is a suitable tool in assisting the prediabetics to prevent diabetes. Our study also indicates that usage of technology is low among older people but not all older people. Some from the same age group are technology savvy. The outcome of the FGD will be used to develop a framework which integrates behavioural change theories to design a self-care application for prediabetes.

6. Acknowledgment

This study is funded by the Malaysian Ministry of Higher Education (MoHE) under the Fundamental Research Grant Scheme (FRGS). We acknowledge the contibution of D'centers, the Diabetes Resource Centre. We thank the participants for their time and willingness to share their viewpoints with us.

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