

# A Review on Diabetes Patient Lifestyle Management Using Mobile Application

Md Abul Basar, Hassan Nomani Alvi, Gazi  
Nowrin Bokul, M Shahriar Khan

Department of Computer Science and Engineering  
Military Institute of Science & Technology  
Dhaka, Bangladesh

bashar7075@gmail.com, nomanalvi@gmail.com,  
shahriarkhan777@gmail.com, nowrinbokul@gmail.com

Farzana Anowar, Mohammad Nurul Huda, Khondaker  
Abdullah Al Mamun

Advanced Intelligent Multidisciplinary Systems Lab,  
Department of Computer Science and Engineering, United  
International University, Dhaka, Bangladesh  
farzana\_anowar@yahoo.com, mnh@cse.uui.ac.bd,  
mamun@cse.uui.ac.bd

**Abstract**— Diabetes is a silent-killer disease that highly demands proper patient care and sound self-management which is a major challenge for a patient. The advancement in ICT and the rapid increase of mobile phone users are showing that lifestyle management of a diabetes patient can be guided using mobile application. The objective of this review is to analyze the articles and the existing mobile apps that are currently available to support diabetes patient and based on the analysis to describe the opportunities for developing a mobile app integrating most of the common features required for the self-management of a diabetic patient. The review covers journal databases for articles and online markets for mobile app. Initially we found 273 articles from the journal databases and 1004 apps from the online markets out of which 29 articles and 43 apps satisfied our selection criteria. We successfully brought out five primary and seven secondary features which can efficiently handle the self-management system. The major features include blood glucose monitor, medication, diet plan, physical activity, automated transfer of blood glucose data, SMS based notification, weight management, communication etc. No app in our review is found satisfying all the features. Since all the primary and secondary features as a whole are very essential for an effective diabetes patient lifestyle management, but not available in a single app, so there is a potential scope to develop such an app integrating all the features very efficiently.

**Keywords**—diabetes; diabetes self-management; smartphone; information and communication technology

## I. INTRODUCTION

This Diabetes is a complex human body disorder which causes a number of critical and deadly diseases if left untreated [1,2]. Day by day the rate is alarmingly increasing [2]. Diabetes is a non-communicable but non-curable everlasting disease till death, but can be kept under control with the strict observance of a proper lifestyle management. The situation when the blood sugar called glucose of a person goes high either because of the inadequate production of insulin or because of the improper response of the body's cell to insulin or because of both is known as to be affected by diabetes mellitus, in short diabetes. We find mostly three types of diabetes (a) type 1 diabetes which is formed before the age of 40 years or even to a child, (b) type 2 diabetes which is the most common and formed due to multi-factors, (c) gestational diabetes which is formed during pregnancy [3]. Whatever may be the types, each highly

demand a proper patient care which includes medication, diet management, physical activity and exercises, sufficient knowledge on diabetes, social and individual awareness and strict discipline in lifestyle. Self-monitoring is the key to control this silent killer disease. But all these become a challenge for most of the people because it includes the radical changes in one's day-to-day habitual activities. And to the patient like illiterate, ignorant, incautious or unaware especially in the low and middle income countries it remains unnoticed and in the long run succumb to death very silently. So lifestyle management is the pivoting factor for healthiness of a diabetes patient which is the main challenge.

The number of diabetes patients is on the elevation due to the lack of discipline required for a healthy life. According to the statistics of World Health Organization (WHO), more than 387 million people worldwide have diabetes which is very likely to be more than doubled by the year 2030 [4]. At present, around 25.8 million people are suffering from diabetes only in USA [5]. In the developing and the least developed countries the rate is more frustrating. A global comparison conducted by WHO found that the increase rate would be observed highest in the South-East Asian Region (SEAR) and in Eastern Mediterranean Region (East-Med) [6]. More than 20% of the total diabetes patient in the world will be found only in SEAR [6]. At present there are more than 7 million cases of diabetes in Bangladesh while the rate is increasing by 5-6% every year [7]. The findings from several epidemiological investigations favor the hypothesis that Bangladeshi people are genetically more susceptible to be affected by diabetes and its complications than other SEAR countries [6]. Figure 1 shows a comparison of prevalence of diabetes between Bangladesh and the world which is, in fact, more or less common for almost all other developing and least developed countries [4]. Almost 8% of diabetes death occur in these countries [7]. Though these countries have higher rate of diabetes patient, there healthcare system lacks effective models for managing the disease including identification and treatment since the people are not much aware about the disease [4, 7].

Diabetes care or management is complex and requires many issues related with proper knowledge on it and habit of abiding those. The management plan should be formulated as such there exists a sound coordination among the patient, his/her family, the physician and the other members of a well-

organized health care team. The health care team may include the patient himself, his/her family members, the physicians (diabetes specialist, dentist, eye specialist etc.), the nurse, the diabetes educator, the dietician, the pharmacist, friends and well-wishers or counselors etc. Certain factors should be taken under consideration in formulating the management plan like the patient's physical condition, presence of diabetes complications, age, profession, habits, personality, social and cultural issues etc.

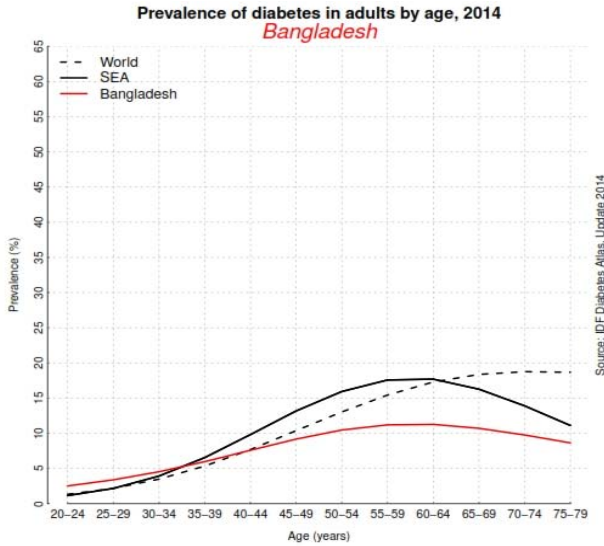


Fig. 1. Comparison of prevalence of diabetes between Bangladesh and the world [4].

In the present era, Information and Communication Technology (ICT) has emerged very significantly within a very short span of time [8]. World is now in the hand grip and can be moved with the finger touch due to the rapid evolution of ICT. More than 81% of the total population of the developed countries own a mobile phone, while the percentage is around 50% for the developing and least developed countries [9]. But if families are considered then it is found more than 89% families possess at least one mobile phone. Smartphone technology is the latest inclusion whose functionalities are like a computer but remain in the hand or inside pocket [10]. Smartphone facilitates advanced operating system enabling web browsing, social networking, data storage, internet access and many more [11]. In a recent survey in USA, more than 65% of the mobile phone users are found using Smartphones [10]. In many cases it eases up the complications of life. In healthcare, mobile phone technology has provided an enormous contribution [12, 13]. Mobile healthcare technology is marching fast and easing up patients' life by offering number of supports like self-management, self-monitoring, education, information, counseling etc. [2, 14].

Diabetes, where self-management demands the highest concern, can be a proper field of mobile healthcare technology since the mobile phone users normally always carry their mobile sets with them [1]. Thereby a mobile phone can be the best guide of a diabetes patient. Even when the patient sleeps,

he or she remains under the surveillance of his or her mobile phone. Based on the idea, day by day mobile applications (apps) for diabetes patient lifestyle management are being developed in different platforms like Android, Apple, Blackberry etc. [10]. Success of self-management on diabetes depends on the glycemic control by monitoring blood glucose in a proportionate rate [15]. So almost all the apps on diabetes self-management has the common feature of blood glucose monitoring. Few apps have dietary suggestion, few have data entry facilities or few have physical exercise plan [8, 12, 15]. But integration of most of the features in a single app is very rare.

In the low and middle income countries where the number of diabetes patient is more and at the same time lags awareness required for managing diabetes, needs more care for caring the patient. But unfortunately in this aspect also these people are lagging behind because either of their poverty or unawareness. Poverty cannot be eliminated over the night or the mass people will not be cautious within a moment. At the same time, people are becoming busy day by day because of the need of the present era. Under these circumstances technology can be a better guide to curb diabetes since ICT is emerging geometrically all over the world. A general statistics has shown that in a country like Bangladesh most of the common people are also possessing a smart phone. So diabetes patient lifestyle management through mobile app would be one of the best options. But so far no prominent or encouraging effort has been yet taken in the developing or the least developed countries including Bangladesh.

The objective of this review is to analyze the articles and the existing mobile apps that are currently available to support diabetes patient and based on the analysis to describe the opportunities for developing mobile apps giving special concern to the people of the developing and the least developed countries integrating most of the common features like blood glucose monitoring, data entry for various parameter, data storage and analysis, short message service (SMS) based service, communication with healthcare team, diet plan, nutrition information, exercise plan, medication suggestion etc. Our primary aim for the app user is to control blood glucose and the secondary aim is lifestyle management.

## II. METHODS

To implement the objective our goal is to review journal articles/conference papers as well as to study existing apps on diabetes self-management. Our sources of resources were journal/conference databases and online app stores. Our review on apps was covered both in literature and on online app market. Literature provides innovative ideas while the market shows the current trends.

### A. Search Methods

The keywords for searching articles were "Diabetes patient lifestyle management", "Diabetes self-management". And "Diabetes management", "Blood glucose monitor", "Diabetes", "Insulin", "Blood sugar" were the key words for searching apps.

## B. Selection Criteria

We put a selection criteria for articles and apps. Articles of only reputed journals/conference pertinent to the topic and latest inclusion on mobile healthcare technology for diabetes patient lifestyle management and apps only on the platform of iPhone, Android and Blackberry containing most of the common features were considered.

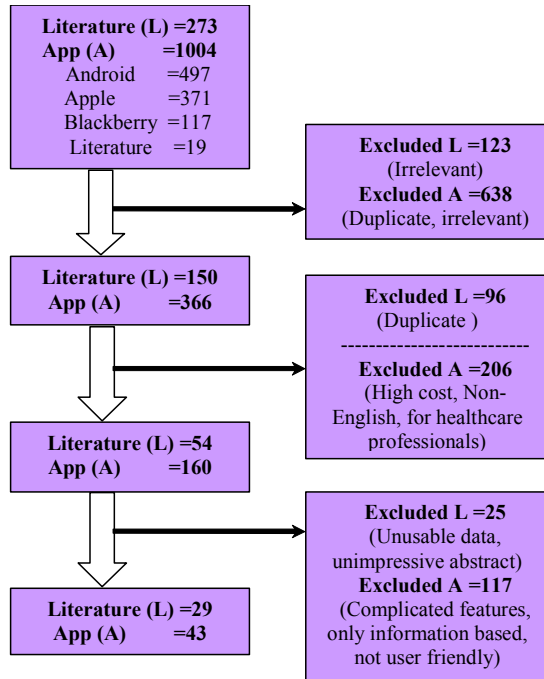


Fig. 2. Selection process for articles from journal databases and mobile apps from online app store showing the consolidated result.

1) We took into accounts of those articles only which are published not before the year 2000. We looked into both original research papers and review articles mainly from Google Scholar and Institute of Electrical and Electronics Engineers (IEEE) Xplore Digital Library. Out of numerous researches and reviews on the databases we targeted only those papers related to diabetes, type 1 diabetes, type 2 diabetes and endocrinology.

2) Since our prime focus is on the developing and the least developed countries, so our investigation swept only on those apps which are obtainable at a free cost or low cost from online stores. Our searching operation covered Apple iTunes Store for iPhone, Google Play Store for android and Blackberry App World for blackberry.

We put a filtering process on the characteristics of the apps to be considered in the review which can be summarized as:

- 1) The app must have the feature for monitoring blood glucose.
- 2) Integration of as many as of the common features for diabetes self-management.
- 3) Since it is for self-management, the patients are considered as the primary users.

4) The language of the app must be English.

5) The app can be downloaded at a free cost or low cost.

6) The app should be dynamic i.e. only informative or educative apps are excluded.

7) Duplicate applications (more than 70%) have been excluded.

8) Since we are more concern about the people of the developing and the least developed countries where most of them are less educated, the app should be very user friendly.

## III. RESULTS

Figure 2 summarizes the search process and results. The breakdown illustrates the whole process of selecting articles from journal databases and apps from different online stores.

### A. Journal Articles/Conference Papers Search Results

We found 273 articles from the journal databases. Though our search was based on the keywords comprising the title and brief abstract, many irrelevant articles were yielded. Beside this, most of the articles that matched the search criteria had to be rejected because of the unusable data and duplicity. At last, 29 articles have been chosen for our review.

### B. Google Play Store (for Android) Search Results

A total of 497 apps on android had been selected by the key words. But we found only 24 of them worthy for our review after the filtering process. Information pertaining to download frequency, user rating and release dates helped to short list the apps, as well.

### C. Apple iTune Store (for iPhone) Search Results

Searching by the designated key words found nearly 371 apps. But 40% of them were costly, 26% of them were duplicate in nature and features, 23% of them were irrelevant and 7% of the apps' language were not English. Finally we could select 11 apps on iOS.

### D. Blackberry App World (for blackberry) Search Results

Out of 117 apps, we had to eliminate 113 because of our selection criteria. At the end, we got 5 apps for our purpose.

### E. Apps on Literature Search Results

Since literature is the source to find innovative ideas and new trends, our search operation also stepped here. We found 3 apps suitable from literature for examining where few additional self-monitoring features have been explored like self-management on education, communication, diet information, weight controlling, blood pressure monitoring etc. [2,14,15,16].

### F. Features Obtained from the Reviewed Apps

After carrying out the systematic review the primary features of the apps can be summarized as:

- 1) Blood glucose monitor

- 2) Medication suggestion
- 3) Diet plan
- 4) Physical activity/exercise plan
- 5) Automated transfer of blood glucose data

The secondary features may include:

- 1) SMS based service/notification
- 2) Data entry and record (blood glucose/sugar, blood pressure, HBA1c, cholesterol, weight etc.)
- 3) Nutrition information
- 4) Communication with healthcare team
- 5) Education
- 6) Weight management
- 7) Blood pressure monitoring

Table 1 shows the characteristic comparison of the features from the reviewed apps. Out of 43 apps, 32 are free of cost and the rest have a mean purchase price of \$2.86 where the highest cost is \$9.99. The free apps did not differ significantly from the purchased apps in terms of features and functionality.

Finally, we could successfully brought out 5 primary and 7 secondary features that can efficiently and perfectly handle the self-management system.

*Automated Data Transfer:* Manual data input of blood glucose, blood pressure etc. always remains as an additional task. Moreover children with type 1 diabetes and also their parents have to undergo tremendous problems in monitoring blood glucose [12]. Also some of the elder or less-technical or non-technical users might face difficulty [16]. Automated data input system eradicates such hazards. It also simplifies the user operation and thereby can increase user's satisfaction [16]. Wireless system like Bluetooth technology, bracelet capable of transmitting data reading from human body to app may be integrated in that case [12, 16]. Out of 43 apps only 17% have the option of automated data transfer but with a limited scale.

*SMS Based Service/Notification:* A recent feasibility test was carried out on automated SMS generating system for educating the users [12]. Communication with the patient's healthcare team is mainly through email even which is also less in number (37% out of 43 apps). Our SMS based notification would act as an alarm system to the guardians of the child patient. The app will have automated data transfer from patient's body and if it crosses the safe level or the reading goes high then it notifies the parents or the healthcare team.

*Weight Management:* Weight management is another vital factor for a diabetes patient. Integrating Body Mass Index (BMI) management system in the app will bring dynamism in maintaining body weight of a patient. Beside a simple calorie

calculator in the app will help to suggest daily food calorie consumption and to maintain proper body weight. Less than 47% apps have been found with weight management facilities.

*Physical Activity:* Automated data transfer can also be integrated to keep physical record by a step counter kept with the patient [12, 14]. The data will be saved in the log book and help the patient to understand the necessity of increasing or decreasing the intensity of physical exercises. The step counter can be automated to count or can be manual by pressing the counter push button.

*Education:* Since awareness and proper knowledge is a must for a diabetes patient for self-management, educating themselves is a necessity [16]. Four apps and three research articles [12, 14, 16] have been found with this feature. But we intend to integrate SMS based educational facility as well in our app which will have a positive and pro-active endeavor in self-management.

*Log Book :* A detailed log book or diary relating to keeping records of the blood glucose data from automated data transfer, blood pressure, cholesterol, weight, physical activity, daily food consumption etc. data through manual input will definitely benefit the user. Showing the records graphically will ease up the understanding. We found 34 apps having data record facility of which 8 apps have been found mostly based on diabetes diary.

#### IV. DISCUSSION

It has been already mentioned that several statistics carried out in different parts of the world found more than 80% of the population in the developed countries are mobile phone users while it is approximately 60% for the developing countries and 50% for the least developed countries[9][17][18]. If one person from each family is considered then about 90% of the total families in the world found having at least a mobile phone per family [9]. Prediction by the researchers says that very recently the percentage of mobile phone users will cross 90 [17]. Though the number of Smartphone users are little less than that of mobile phone users of any kind, within next 5-10 years it will estimate 80-90% [17]. So diabetes patient lifestyle management using mobile app might bring a revolution in managing the disease. Since we intend to facilitate primarily the people of the least developed countries by our app, the features and functionalities of the app will be more tuned considering the interest of such people.

From our review we found that the number of apps in Android and iOS are almost close to each other, but Android is more user friendly, less costly and available in various types of devices like phones, tablets etc. [9, 11, 18]. It is also found from the online app stores that Android is more popular than other platforms specially in the developing and the least developed countries because of its many user friendly functionalities.

The features and user ratings do not differ significantly between free apps and paid apps [13]. But the tendency of

using more free apps may lack the quality of features and usability. At the same time, the cost of apps will discourage the

TABLE I. SUMMARY OF THE FEATURES OF THE APPS

Name	Glucose Monitor	Medication	Diet Plan	Exercise	Auto Data Input	Blood Pressure Monitor	Weight	Communication	Detail Log Book	Education	Differentiate between types of Diabetes
Diabetes Tracker	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Sugar Sense	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Diabetes: M	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No
Diabetes PA	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes
on Track	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No
Blood Glucose Tracker	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	No
Glucose Buddy	Yes	Yes	No	No	No	Yes	Yes	No	Yes	No	Yes
Blood Sugar Manager	Yes	No	No	No	No	No	No	No	No	No	No
iHealth Gluco Smart	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	Yes
BG Monitor Diabetes	Yes	No	No	No	No	No	No	Yes	Yes	No	No
Diabetes Glucose Diary	Yes	No	No	No	No	No	No	No	No	No	No
Diabetes Plus	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	No
Diabetes Recorder	Yes	No	No	No	No	Yes	Yes	Yes	No	No	No
Sugar Log	Yes	Yes	No	No	No	No	No	No	Yes	No	No
My Glycemia: Diabetes Tracker	Yes	No	No	No	No	No	No	No	Yes	No	No
Diabetes Diary Glucose Tracker	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No	No
Diabetes Connect	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Diabetes Tracker Mobiscreen	Yes	Yes	No	No	No	No	No	No	Yes	No	No
Smart e-smbg Diabetes Lifelog	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
dbees.com Diabetes Management	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No
Diabetes Journal	Yes	No	No	Yes	No	No	No	Yes	No	No	No
Glucool Diabetes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	No
Lifespan Measure	Yes	No	Yes	No	No	Yes	No	Yes	Yes	No	No
SiDiary Diabetes Management	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	No
Diabetes UK Tracker	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No	No
Diabetes Diary	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	No
Sweet Log	Yes	No	No	No	No	No	No	No	No	No	Yes
Gmate	Yes	No	No	No	No	No	No	Yes	No	No	No
Glucose	Yes	No	No	Yes	No	No	No	Yes	No	No	No
Mysugar Diabetes Log Book	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	No	Yes
Diabetes in Check	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Glucose Wiz	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No
Diabetes Pedometer	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No
Diabetes Pal App	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Glucose Companion	Yes	No	No	No	No	No	Yes	Yes	Yes	No	Yes
Diabetes Kit Blood Glucose Logbook	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Easy Diabetes	Yes	No	No	No	No	No	No	No	Yes	No	No
Diabetik	Yes	Yes	No	Yes	No	No	No	Yes	Yes	No	No
Glooko	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Diabetes in Check	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Glicontrol	Yes	No	Yes	No	No	No	No	Yes	No	No	No
Diaguard	Yes	No	No	Yes	No	No	Yes	No	Yes	No	No
Diabetes App Blood Glucose Tracker	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No

poor and the middle income people. Since there is acute shortage of apps on diabetes patient lifestyle management concerning the mass people of the developing and the least developed countries, our app should be cost free.

The bulk of the diabetes patients are of ages more than 45. So the tendency of becoming a diabetes patient rises with the increase of age of an individual. So the usability and usefulness of an app draws an attraction for giving an extra care for those people [19]. At the same time, the subject concerning the children affected with type 1 diabetes has to be taken under consideration like the older people. Again women may have gestational diabetes during pregnancy or they may have normal

type 2 diabetes where these two categories require separate type of care [20]. The BMI and the tendency of becoming overweight or obese in case of a woman is different from man. So while designing and developing the app, the features like SMS based notification, communication with the healthcare team, categorized diet plan and physical activity plan should be considered for women, children and older people.

There are several limitations in our study. Based on our selection criteria we have chosen the apps and articles for our review where we might miss apps or articles which are better and more resourceful than what we selected. Moreover all the reviewed apps could not be tested or evaluated at user level. So for those apps, we had to take decisions based on the features, cost, availability and usability of the apps. Again few apps could not be installed. In that case, we had to depend on the feature description from the sites or from the articles.

We did not have enough background information to know the details of each app's development or what usability test (if any) was done before it was commenced. So there may be few apps which may not be appropriate or useful in terms of usability outcomes. Again from the comparison, we have selected Android platform for our app which may not be liked by many of the users since different people have different choices.

We found from the review that Bluetooth technology is mostly being used for automated data transfer by glucometer or pace counter for blood glucose reading or physical activity record respectively from human body to mobile app. But we have intended to include bracelet having data transmitting capability where little confusion arises about its success since the device is not yet commonly in use. But automated data transfer is not a problem since we have the alternatives of using glucometer for this purpose. Again some may find the pace counters little big or may feel uncomfortable to use an extra device with the app.

There are many mobile applications and web-based solutions to enhance diabetes management. But automation does not exist everywhere in the poor or middle income countries. So patient may be automated in disease management, but doctor may lag behind or vice-versa. But yet this is a starting endeavor in the mobile health technology which surely going to prevail everywhere and to everyone. A work finally shines firstly by searching limitations and then by overcoming those. We are to develop an app aiding the diabetes patient specially from the least developed countries in

managing their lifestyle. To accomplish the assignment we have sorted out the features of the app which already have been described and identified the limitations of the project so that those can be handled and dealt to get a finer and acceptable subjected mobile app.

## V. RECOMMENDATION

Illiteracy, unconsciousness, poverty are the basic drawbacks for the poor countries. Most of the people are deprived of sound health facilities and other citizen charters. But the effect and outcomes of the disease is same for all the people of the world be it a developed, developing or least developed countries. So considering all issues we recommend the following features as the important variables for diabetes self-management: Blood glucose monitor, Medication, Diet management, Weight management, Physical activity, Education, Automated data transfer of various record specially blood sugar, blood pressure monitor, SMS based notification, Communication with the healthcare team, Nutrition information, Diabetes log book or diary.

## VI. CONCLUSION

The potential use of the technology encourages a wide variety of apps in mobile health technology. All the diseases do not require monitoring or self-management. Diabetes is such a disease which demands highest motivation and awareness since it is a silent killer everlasting disease. Achieving glycemic control, continuous surveillance to the patient specially the child or old and timely notification are major challenges in diabetes self-management. The main outcome of this review is to formulate a well-balanced, coordinated and suitable set of features for diabetes self-management to design an app giving extra importance to the people of the less developed countries. Beside this, all the features that we have deduced in this paper were not found altogether in any single app. So our formulated app would be unique in design and functionality. Few further works will be needed to carry it much ahead like proving the worthiness of the app, development of the app eliminating the limitations and collaboration between patient and doctor in the field of health technology.

## REFERENCES

- [1] C. Free, G. Phillips, L. Galli, L. Watson, L. Felix, P. Edwards, V. Patel, and A. Haines, "The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review," *PLoS Med.*, vol. 10, no. 1, 2013.
- [2] H. Holmen, A. Torbjørnsen, A. K. Wahl, A. K. Jenum, M. C. Småstuen, E. Årsand, and L. Ribu, "A Mobile Health Intervention for Self-Management and Lifestyle Change for Persons With Type 2 Diabetes, Part 2: One-Year Results From the Norwegian Randomized Controlled Trial RENEWING HEALTH," *JMIR mHealth uHealth*, vol. 2, no. 4, p. e57, 2014.
- [3] S. Goyal and J. a. Cafazzo, "Mobile phone health apps for diabetes management: Current evidence and future developments," *Qjm*, vol. 106, no. 12, pp. 1067–1069, 2013.
- [4] "Diabetic Association of Bangladesh International Diabetes Federation."

- [5] M. Cable, "Mobile Diabetes Management Tools," no. November, pp. 24–26, 2011.
- [6] M. H, "Global epidemic of type-2 diabetes: Bangladesh perspectives." .
- [7] "International Diabetes Federation," *The Lancet*, vol. 266, no. 6881, pp. 134–137, 1955.
- [8] T. Chomutare, L. Fernandez-Luque, E. Arsand, and G. Hartvigsen, "Features of mobile diabetes applications: Review of the literature and analysis of current applications compared against evidence-based guidelines," *J. Med. Internet Res.*, vol. 13, no. 3, pp. 1–16, 2011.
- [9] M. Donna S Eng, MD and Joyce M. Lee, MD, "Mobile Health Applications for Diabetes and Endocrinology: Promise and Peril?," *Changes*, vol. 29, no. 6, pp. 997–1003, 2013.
- [10] C. Kratzke and C. Cox, "Smartphone Technology and Apps: Rapidly Changing Health Promotion," *Int. Electron. J. Health Educ.*, vol. 15, pp. 72–82, 2012.
- [11] a. P. Demidowich, K. Lu, R. Tamler, and Z. Bloomgarden, "An evaluation of diabetes self-management applications for Android smartphones," *J. Telemed. Telecare*, vol. 18, no. 4, pp. 235–238, 2012.
- [12] E. Årsand, D. H. Frøisland, S. O. Skrovseth, T. Chomutare, N. Tatara, G. Hartvigsen, and J. T. Tufano, "Mobile health applications to assist patients with diabetes: lessons learned and design implications," *J. Diabetes Sci. Technol.*, vol. 6, no. 5, pp. 1197–206, 2012.
- [13] C. A. Caburnay, K. Graff, J. K. Harris, A. Mcqueen, M. Smith, M. Fairchild, M. W. Kreuter, H. Jk, A. Mcqueen, M. Smith, and M. Fairchild, "Evaluating Diabetes Mobile Applications for Health Literate Designs and Functionality," pp. 1–13, 2014.
- [14] E. Arsand, N. Tatara, G. Østengen, and G. Hartvigsen, "Mobile phone-based self-management tools for type 2 diabetes: the few touch application," *J. diabetes Sci. Technol.*, vol. 4, no. 2, pp. 328–336, 2010.
- [15] J. Tran, R. Tran, and J. R. White, "Smartphone-based glucose monitors and applications in the management of diabetes: An overview of 10 salient 'apps' and a novel smartphone-connected blood glucose monitor," *Clin. Diabetes*, vol. 30, no. 4, pp. 173–178, 2012.
- [16] O. El-Gayar, P. Timsina, N. Nawar, and W. Eid, "Mobile applications for diabetes self-management: status and potential," *J. Diabetes Sci. Technol.*, vol. 7, no. 1, pp. 247–62, 2013.
- [17] M. N. K. Boulos, S. Wheeler, C. Tavares, and R. Jones, "How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from eCAALYX," *Biomed. Eng. Online*, vol. 10, no. 1, p. 24, 2011.
- [18] D. S. Eng and J. M. Lee, "The promise and peril of mobile health applications for diabetes and endocrinology," *Pediatr. Diabetes*, vol. 14, no. 4, pp. 231–238, 2013.
- [19] H. Blake, "Innovation in practice: mobile phone technology in patient care," *Br. J. Community Nurs.*, vol. 13, no. 4, pp. 160, 162–165, 2008.
- [20] M. J. S. et al Frank.B.Hu, Joann.E.Manson, "Diet,Lifestyle, And The Risk of Type 2 Diabetes Mellitus in Women," vol. 345, no. 11, pp. 790–797, 2012.
- [21] A.Rao, P.Hou, T.Golnik et al, " Evolution of Data Management Tools for Managing Self-Monitoring of Blood Glucose Results: A Survey of iPhone Applications" vol.4, no. 4, pp. 949-957, 2010.
- [22] E.Arsand,J.Tufano,J.Ralston, "Designing mobile dietary management support technologies for people with diabetes," vol. 14, no. 7, pp. 329-332, 2008.
- [23] A.Recupero,B.Mahnke,J.E.Pinsker, "Emerging Technology in Diabetes Care: The Real-Time Diabetes Monitoring System" vol. 178, no. 2, pp. 218-221, 2008.
- [24] A.Nes,S.V.Dulmen,E.Eide et al," The development and feasibility of a web-based intervention with diaries and situational feedback via smartphone to support self-management in patients with diabetes type 2" vol. 97, no. 3, pp. 385-393, 2012.
- [25] E.Garcia,C.Martin, A.Garcia, "Systematic analysis of mobile diabetes management applications on different platforms"
- [26] Tanya D,Thomas R, S.K.Kumanyika et al," A randomized controlled trial weight reduction management in older African-American Subjects" vol. 20, no. 10, pp. 1503-1511, 1997.
- [27] A.J.Pulman,J.Taylor,K.Galvin et al," Designing Mobile Applications to support type 1 diabetes education", 2012.
- [28] E.Årsand,R.Varmedal,G.Hartvigsen," Usability of a mobile self-help tool for people with diabetes: The easy health diary", pp. 863-868, 2007.
- [29] E.Ciemins, P.Coon,C.Sorli, "An analysis of data management tools for diabetes self-management: can smart phone technology keep up?" vol. 4, no. 4, pp. 958-960, 2010.