Building a Patient-Centered Blockchain Ecosystem for Caregivers: Diabetes Type II Case Study

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Abstract— **Diabetes is one of the fastest-growing health problems in the world, and is now reaching epidemic proportions in some countries. With the globally increasing numbers of diabetic patients and their need for professional care, it is difficult and time-consuming to share patient-care information among caregivers in a traditional way, which adds financial and psychological burden on home caregivers. Recent developments in advanced technologies and mobile health (mHealth) applications fail to equip them with the right ecosystem for patient-centered information sharing to allow for informed care decisions. Therefore, motivated by the need for home caregivers' empowerment to cope with the pressure, this paper studies the requirements for building an effective communication channel among caregivers and between them and their patients, and presents the potential benefits of mHealth applications and blockchain technology in achieving such requirements using a case study in Diabetes Type II patients in Saudi Arabia. Using interviews and questionnaires, this paper shows that there is the need for an ecosystem that supports diverse caregiving groups with multiple languages, distributes tasks between more than one caregiver to alleviate the burden on one caregiver, provides a treatment plan provision by a specialized care team to be viewed and followed by caregivers and patients, and alerts everyone in case of an emergency. Such requirements can be incorporated into an mHealth solution that builds a transparent blockchain-based patient-centered caregiving ecosystem.**

Keywords-Blockchain Technology; Diabetes Type II; mHealth; Patient-Centered care, Home caregiving.

I. INTRODUCTION

A caregiver, whether paid or unpaid, as a member of a person's social network helps patients with their daily-life activities [1]. Caregiving is most commonly used to address impairments related to people who are aging and/or with disabilities, diseases, conditions, injuries, or mental disorders. Supporting caregivers is one of the most important issues that has been neglected around the world while there is a growing demand for their help. According to recently published data, 25% of global population will be over 65 years old in the next 5 to 7 years [2]. Furthermore, there are no hospitals or nursing homes that can accommodate this huge and increasing number of patients. There are many difficulties related to communication between caregivers themselves and the caregivers within the care team regarding the accurate timestamped order in which to share informed decisions regarding the diabetic patient. Moreover, the care team faces many difficulties in order to manage and control the large number of patients. On the other hand, the patients themselves face a lot of difficulties, such as waiting times, and needing to see more than one doctor on the same day in order to receive the full treatment. Therefore, when they have disabilities, this process becomes very stressful for them. This project sheds light on diabetic patients of Type II, which occurs in patients over 40 years old and it is the most prevalent type of diabetes in Saudi Arabia [3]. The reason for selecting this type of category is the increasing number of diabetic patients in Saudi Arabia, which, according to previously published data, shows that 25% of Saudis are suffering from diabetes; this means that 4 million diabetic patients require 5.5 million consultations and follow-up visits each year [4]. Therefore, these numbers motivate us to do this project to help those people. Also, based on the interviews we conducted with diabetic patients [5] and diabetes caregivers [6], it is clear that there is a lack of Arabic speaking platforms that facilitate the caregiver's connectivity with diabetic patients.

A. Diabetes Statistics Globally Vs. Saudi Arabia

Diabetes is one of the fastest-growing health problems in the world and is now reaching epidemic proportions in some countries. It is mainly as a consequence of life-style behaviors, such as lack of exercise, unhealthy diet, obesity and being overweight. Over the past four decades, major changes have occurred in Saudi Arabia. Growth, prosperity and modern technology have brought pronounced changes in the lifestyle of people. In particular, eating habits are less healthy and the level of physical activity has declined. According to the International Diabetes Federation (IDS) 2019 report [7], there are currently 463 million people worldwide living with diabetes, and this is estimated to rise to 700 million by 2045. Additionally, the report reveals evidence that in 2019 the number of deaths resulting from diabetes and its complications is estimated to be 4.2 million, and health expenditure on diabetes has reached at least USD 750 billion, which represents 10% of total spending on adults [7].

Moreover, according to the IDS report, Saudi Arabia is ranked 9th in the top 10 countries with an estimated 2.5 thousand incidents (new cases) of Type I in children and adolescents in the age group 0-14 [7], while it is ranked 5th among the top 10 countries in terms of incidence rates (per 100,000 population per year) after Finland, Sweden, Kuwait, and Norway [7]. Therefore, Saudi Arabia is among the top 10 countries in the world with the highest prevalence of diabetes [7]. In Saudi Arabia, the national healthcare burden resulting

 ISBN: 978-1-61208-759-7

from diabetes is likely to exceed $0.87 billion [8], but this neglects the indirect costs associated with diabetes, such as absenteeism, loss of productivity from disease-related complications, unemployment due to disability and early mortality due to disease [8]. On the other hand, the social costs, such as pain and suffering and care provided by caregivers, as well as healthcare system administrative costs, cost of medications, clinician training programs, and research and infrastructure development are also omitted from this research study. Further studies are needed to confirm the present findings and to improve our understanding of the economic costs of diabetes and its related complications [8]. Diabetes should be treated under close collaboration between patients and caregivers in order to prevent long-term complications, and diabetics must have ongoing and accurate daily care to avoid early death.

B. Caregiving Ecosystem

In caregiving, some patients require modern homecare, which provides the patient with the correct and complete care. They are licensed, professional caregivers who devote all of their time attending to all of the patient's care needs [9]. mHealth is a general term for the use of mobile phones and other wireless technology in medical care [10]. It is also one of the most common applications for disease surveillance, treatment support, epidemic outbreak tracking and chronic disease management [10]. The scope of the patient-centered caregiving ecosystem for diabetic patients includes four aspects: diet monitored by a dietitian, physical training provided by a physical trainer, treatment plan implemented by a care team, and glucose level measured by the patient. Each and every aspect is managed by a specialist who collectively needs to collaborate for the implementation of patient-centric home caregiving. These aspects present the basic needs in diabetes caregiving ecosystems as illustrated in Figure 1 below.

Figure 1. Diabetes Caregiving Ecosystem

This paper aims to, first, study the requirements for building an effective communication channel among caregivers as well as between caregivers and their patients. Second, the paper presents the potential benefits of mHealth applications and blockchain technology in achieving such requirements using a case study in Diabetes Type II patients in Saudi Arabia. The remainder of this paper is organized as follows. Section II presents a review of the literature of all related work supporting home caregivers, while the methodology is explained in Section III. Section IV presents an analysis of the results, and Section V provides an overview of the proposed system design. The conclusions close the article in Section VI.

II. LITERATURE REVIEW

Although there are some applications available in the literature to support home caregivers, they have some limitations that mean that the key challenges cannot be addressed. *Thermo* [11] application helps take care of the family's health but it does not support diabetic patients. Furthermore, it is designed for management and maintains the record changes in temperature readings, displaying this in a timeline. However, it is only available in English, and does not provide services for Arabic-speaking caregivers. *Caring* [12] is designed for adding a person and making changes, adding notes and also sending reminders. This supports caregivers to connect, but there is a lack of necessary aspects relevant for a diabetic patient, such as setting an appropriate treatment plan for a diabetic patient and measuring blood sugar. *Medisafe* [13] solution could help in terms of remembering to take medication and it can select the shape and color of the pill for those who may not be able to read and it is also possible to invite a friend, but it is not permitted to add a caregiver. The mHealth application سكري [14] (i.e., Diabetes) is perfect to track blood sugar levels, meals and sports activities. It uses a medical doctor to monitor the patient's state remotely. However, it does not support home-caregivers and it is only available in the Arabic language. *Carely* [15] solution is a network connection between caregivers to share changes in caregiving and coordinate the responsibilities. However, it does not include important features, such as measuring blood sugar or sending an S.O.S alarm. Also, it is only available in the English language. *Saleem* [16] mHealth solution is mainly designed to connect patients with their medical doctors who can use it at their clinic to monitor vital signs remotely without the patient having to come to the clinic for each visit. It reduces the waiting time and therefore optimizes the hospital's resources. However, it does not connect home caregivers. *Fitbit* [17] solution is an American company that has products for activity tracking. It uses wireless and wearable devices such as watches, and it can measure data, such as the number of steps walked, heart rate, quality of sleep and steps climbed. This, however, does not measure sugar levels, support caregivers, or cater to Arabic language speakers. The above applications reviewed fall short of providing caregiving

 ISBN: 978-1-61208-759-7

requirements for diabetic patients in Saudi Arabia. For instance, when care is provided to the patient, the doctor must establish the treatment plans for the patient, while caregivers must confirm that the patient is following this treatment plan. According to the survey, the need for the measurement of blood sugar for the patient is the most important function.

III. METHODOLOGY

Using a pragmatic approach, this project implements a mixture of quantitative and qualitative methods. Initially, semi-structured interviews were conducted for primary data collection in order to identify challenges. Two interviews were conducted, the first with a consultant family physician [3] at the Ministry of Defense's Medical Services Directorate Medical Administration-MSD. The aim of this interview was to clarify the difference between the three different types of diabetes. The second interview was with a diabetes Type II patient [5] and his caregiver [6], who is also his wife. The aim of the interview was to clarify some points raised while analyzing the requirements. The question lists for each targeted interviewee are listed in Table 1 below.

TABLE I: INTERVIEWS WITH TARGETED INTERVIEWEE AND QUESTION LISTS.

Targeted Interviewees	Question Lists
Patients	• *Age:* • *Gender:* • *Type of diabetes:* • *Who are your caregivers?* • *Caregiver's age:* • *Caregiver's gender:* • *How difficult is maintaining your care?* • *Have you ever visited a doctor in an emergency situation?* • *If yes, can you explain your experience?* • *Have you ever forgotten to write down your blood glucose measurements and show them to your doctor?* • *"I often forget to take medicine on time." Do you agree with this sentence?* • *Do you agree to have more than one caregiver to obtain good care continuity?* • *Do you agree with the idea of gathering your caregivers via a system to provide good care continuity for you?* • *Do you prefer to have a daily blood glucose measurements recorder?* • *What are the diseases associated with diabetes in your opinion?* • *What is your favorite application?* • *May you talk about the beginning of your disease?* • *What was frustrating about that experience?*
Caregivers	• *Age:* • *Gender:* • *What is the type of patient diabetes?* • *Who is the patient who is being cared for?* • *Patient's age:* • *Patient's gender:* • *How difficult is maintaining your patient's care?* • *Have you ever had an emergency where you needed assistance on the spot?* • *If yes, can you describe that experience?* • *Have you ever thought about changing the way you help?* • *If yes, can you describe that experience?* • *Have you ever forgotten to write down the blood glucose measurements of your patient and show them to a doctor?* • *I often forget to give medicine to my patient on time." Do you agree with this sentence?* • *Do you agree to get help from other caregivers in order to provide good care continuity?* • *Do you agree that the idea of combining all caregivers in one system will save time and effort for communication?* • *What are the diseases associated with diabetes in your opinion?* • *What is your favorite application?* • *Can you talk about the beginning of your experience in caregiving?* • *What was frustrating about that experience?*

Furthermore, a questionnaire was designed to gather additional primary information regarding the proposed solution. The questionnaire targets caregivers and patients to reflect the opinion of a larger community of caregivers and patients for quantitative analysis. It was created using Google forms and classified into two categories, patient and caregiver. The patient's questionnaire has 15 questions and the first 6 questions provide an overview about the patient and his/her caregiver. The questions are diverse, consisting of multiple-choice questions, linear scale questions, true/false questions and open questions. Meanwhile, the caregiver category consists of 15 questions, and there were also Likert-type scale questions. Both questionnaires were distributed through social media and texting platforms, such as WhatsApp and Twitter.

IV. SYSTEM ANALYSIS RESULTS

This section presents all of the results and findings as follows.

A. Qualitative Results

Results from the interviews show that each of the three types of diabetes has different causes and care needs. Diabetes Type I patients are normally diagnosed from an early age due to different factors, such as hereditary and

endocrine diseases. Type II, which is the most prevalent, usually occurs after the age of 40 [3], while Type III is related to pregnancy diabetes. Furthermore, the care team in general face many difficulties in tracking the blood glucose test for patients, since most of the patients have more than one caregiver and there may be a lack of communication, which might cause difficulties when the doctor needs to know when the last time the blood test was high or low in a timely manner in order to decide on the appropriate treatment plan. Regarding the information the care team needs to check before deciding the treatment plan, the team normally needs to have the overall assessment for patients, such as job, residence, sports, name, weight and height. Moreover, they need to keep track of medical records for the patient as well as the history related to the patient's family, such as allergies, social needs and medication. There are some emergencies that require immediate medical intervention for diabetic patients, and it is centered around two important aspects: the patient's blood sugar drops, causing unconsciousness or blood sugar rises which causes the patient to be very stressed and might cause problems in vision. Therefore, there is a frequent need to change the treatment plan depending on the changes in current medical conditions and the patient's diet, injections, medicine and sport activities. Finally, results reveal the need to improve communication between care team members and between the patient and the care team in the future.

In regards to the patient's needs, results reveal the patient's difficulties in remembering treatment times and coordinating between medicines and food. Moreover, patients require continuous follow-up with a diet that is suitable with the health status. Also, the patient must visit the doctor periodically every three months in order for certain medical examinations to be conducted, such as "Dilated" eye exam, blood pressure and kidney function tests. In addition, diabetic patients require observation and care continuity by at least one caregiver. This includes measuring blood sugar, type of food and the provision of psychological comfort. Finally, findings show that the most important needs of both patients and caregivers, are mainly related to recording changes, confirming treatments and maintaining contact with the care team.

B. Quantitative Results

The total number of questionnaire responses was 68 patients and 97 caregivers. Results show that 60.3% of patients were Type II, while 38.2% of the cases were Type I. Therefore, this study decided to target Type II. Furthermore, 70.1% of patients want to have a daily blood glucose measurements recorder, while only 28.4% expressed they did not want that. This indicates that there is a need for a measurements' recorder. Regarding the caregiver's communication, 44.3 % strongly agree on the need for one platform to connect all caregivers, while 17.5% neither agree nor disagree, and only 9.3% disagree. This represents the need to address the aim of this study. Furthermore, results show that, firstly, there are interruptions in continuity of care. This is because of communication challenges within the caring ecosystem. This indicates the need to optimise patients' quality of life in delivering the required care. Secondly, some caregivers needed to provide emergency assistance on the spot, and some stated that they were unable to provide such help due to unpreparedness, for example the lack of knowledge of first aid instructions. This highlights the need for an S.O.S alarm and some guidance when an emergency occurs.

C. System Requirements

The results above identify the fundamental system design requirements for building an ecosystem that coordinates tasks between all caregivers through the mHealth solution, rather than keeping the pressure on one caregiver. Furthermore, the proposed solution is a patient-centered one that involves the patient as a caregiver to engage in the decision-making process, increasing their satisfaction and ultimately improving health outcomes. The proposed system has three users: *Care Team Member*, *Caregiver,* and *Patient*. The functional requirements for each user are further explained below.

1. *Caregiver*
    1. A Caregiver shall be able to register onto the system.
    2. A Caregiver shall be able to log in to the system.
    3. A Caregiver shall be able to view the patient's demographic information (caregiving history, work location and home location).
    4. A Caregiver shall be able to view a treatment plan.
    5. A Caregiver shall be able to create reminders to inform him/her when the time of treatment is.
    6. A Caregiver shall be able to record care changes about patient status.
    7. A Caregiver shall be able to add comments about the changes in the care timeline.
    8. A Caregiver shall receive an alarm to inform him/her of the time of treatment or patient's appointments.
    9. A Caregiver shall be able to confirm treatment.
    10. A Caregiver shall receive a notification to inform him/her that the treatment is confirmed from another caregiver/patient (or a Caregiver shall be able to view the confirmed treatment).
    11. A Caregiver shall be able to send an S.O.S alarm.
    12. A Caregiver shall receive an S.O.S alarm.
    13. A Caregiver shall be able to record measurements of blood sugar.
    14. A Caregiver shall be able to record care timeline.
    15. A Caregiver shall be able to view care timeline history.
2. *Patient*
    1. A Patient shall be able to register onto the system.
    2. A Patient shall be able to log in to the system.

 ISBN: 978-1-61208-759-7

3. A Patient shall be able to view the demographic information (personal information, caregiving history, work location and home location).
4. A Patient shall be able to add a new caregiver.
5. A Patient shall be able to view a treatment plan.
6. A Patient shall be able to create reminders to inform him/her of the time of treatment.
7. A Patient shall be able to record care changes about his/her status.
8. A Patient shall be able to add comments about changes in the care timeline.
9. A Patient shall receive an alarm to inform him/her of the time of treatment or appointments.
10. A Patient shall be able to confirm treatment.
11. A Patient shall be able to send an S.O.S alarm.
12. A Patient shall be able to record measurements of blood sugar.
13. A Caregiver shall be able to record care timeline.
14. A Patient shall be able to view care timeline history.

3. *Care Team Member*
   1. A Patient shall be able to register onto the system.
   2. A Patient shall be able to log in to the system.
   3. A Care Team member shall be able to view the patient's demographic information (caregiving history, work location and home location).
   4. A Care Team member shall be able to add a treatment plan.
   5. A Care Team member shall receive an alarm when an emergency occurs to the patient.
   6. A Care Team member should be able to view current location when an SOS alarm is pressed.
4. *System*
   1. The System shall be able to send an alarm to inform all caregivers of the time of treatment.
   2. The System shall be able to send notification after recording a change in care.

D. Blockchain-Based Distributed Medical Record

Interoperability of healthcare systems for data exchange has been a global issue for decades. This has been traditionally addressed using interoperability standardization [18]. The Fast Health Interoperability Resources (FHIR) has been one of the most recently and widely adopted interoperability standards in the healthcare sector, mainly due to its cost effectiveness [18]. However, with the first introduction of blockchain technology in the last decade, and after its recent developments beyond financial services and cryptocurrency applications, interoperability has been revolutionized with the applications of blockchain technology, which makes interoperability one of its mostly used use case applications of this new technology in most sectors even beyond healthcare [18][19]. Blockchain technology is considered a data structure that stores transactional records efficiently by supporting key features. Ultimately, this makes blockchain more capable in terms of solving existing healthcare interoperability problems more effectively, quickly and simply than traditional interoperability standardizations [18].

This project utilizes blockchain technology to provide effective support; this is because it is a digital ledger that allows caregivers to securely connect with each other, without the need for third-party middlemen [19]. Furthermore, blockchain technology creates an immutable, timestamped, trusted chain of components (changes in care continuity) that are distributed in a ledger among the network of caregivers and each caregiver has the same ledger [19]. There are four classes of accessibility and visibility in blockchain [20]: *Permissionless private* that provides access so that only specific people can visit, *permissionless public* that is accessible and visible to everyone, *permission private* is such that a specific person can access and visit and *permission public* provides visibility to anyone but only a specific person can access.

Private permission is suitable for this project so that a specific care team can write and read, and only caregivers that the patient knows can access and view information about him/her. Therefore, this study builds a private permissioned blockchain solution to address connectivity and patient homecare continuity issues. This is achieved by designing a blockchain-based social network for a patient-centered family caregivers' support system that can connect the patient's families, friends and neighbors to build an ecosystem of stakeholders to make shared, informed care decisions. Connected caregivers can exchange information about a patient, including, but not limited to, a patient's treatment, changes in vital signs readings, time of sleep, who is the last to care for the patient to ensure care continuity and they can also confirm taking treatments at specified times. In addition, the caregivers and the patient can add comments which increases the power of interaction and contact between the members of this system. Therefore, the blockchain ledger can be shared among all caregivers in this distributed network, and they will know who made the changes or added information in relation to patient care. Blockchain allows having multiple participants who need to view common information, or multiple participants' actions must be recorded or verified so other participants can trust the validity of the noted actions. Blockchain has strong potential in providing a solution [18][21]. Since these mentioned conditions meet our project aims, blockchain is the best platform solution.

V. SYSTEM DESIGN

In this section the system design is fully presented as follows.

A. Data Design

The system has the following users:

- ***Care Team Member*** includes medical doctors/healthcare practitioners who specialize in managing diabetes

 ISBN: 978-1-61208-759-7

patients. One of the specialist medical practitioners required by diabetic patients is an ophthalmologist who should check the retina annually, record when complications occur, and it is possible that the patient will require kidney and gangrene medical practitioners. Specialists, who could help the doctors in their job but are not certified as medical doctors, can provide the patient with the dietitian's plan at the beginning of the disease, and it may be the case that the disease is advanced and the patient was unaware. There is also a diabetes educator or health educator who follows-up with the patient's status at frequent intervals, measuring glucose, and providing instructions when there is low or high glucose.

- ***Caregiver*** includes family, friends or neighbors who help to take care of their patients.
- ***Patient*** is the person who needs to receive care.

The proposed system use case diagram is illustrated in Figure 2 below.

Figure 2. Proposed System Use Case Diagram.

The designed system builds a network that connects more than one caregiver and their patient. Patients may be able to care for themselves so when we refer to a caregiver, this might indicate the normal caregiver or the patient. In this system, there are features (illustrated in Figure 2) that help to provide good care, namely, the ability to view a treatment plan, create reminders, add comments about changes in the care timeline, confirm treatment, send an S.O.S alarm and record measurements of blood sugar; all these features are available to a caregiver. Also, the patient can add a new caregiver. Furthermore, a care team member shall be able to add a treatment plan that would be seen by caregivers. Three of the key proposed system use cases in Figure 2 including, *Add a New Caregiver/Care Team Member, Measuring Blood Sugar,* and *Performed Treatment* are further explained in use case activity diagrams below and illustrated in Figures 3-5, respectively.

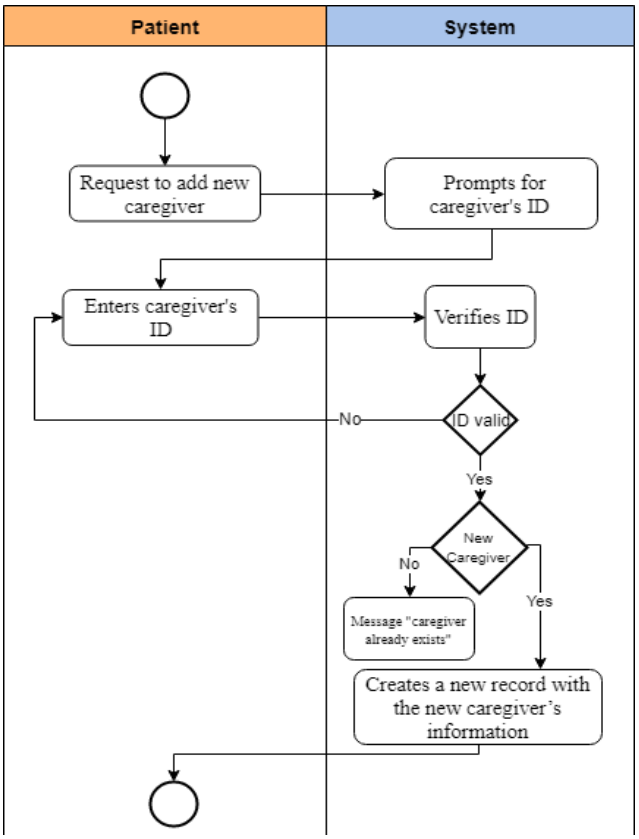

Figure 3. Add a New Caregive/ Care Team Member Activity Diagram.

Figure 3 shows the interaction between *Patient* and *System* (i.e., the proposed one) when a new *Caregiver* joins the patient's care team and so needs to be added to *System* to grant him/her all the needed rights. Therefore, only the *Patient* has the right to initiate this use case by requesting it from the *System,* which prompts for the new *Caregiver* details. Such information details can only be recorded by the *Patient*. Then *System* validates the details in terms of

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completeness and accuracy for quality assurance purposes before it creates a new record for the new *Caregiver*.

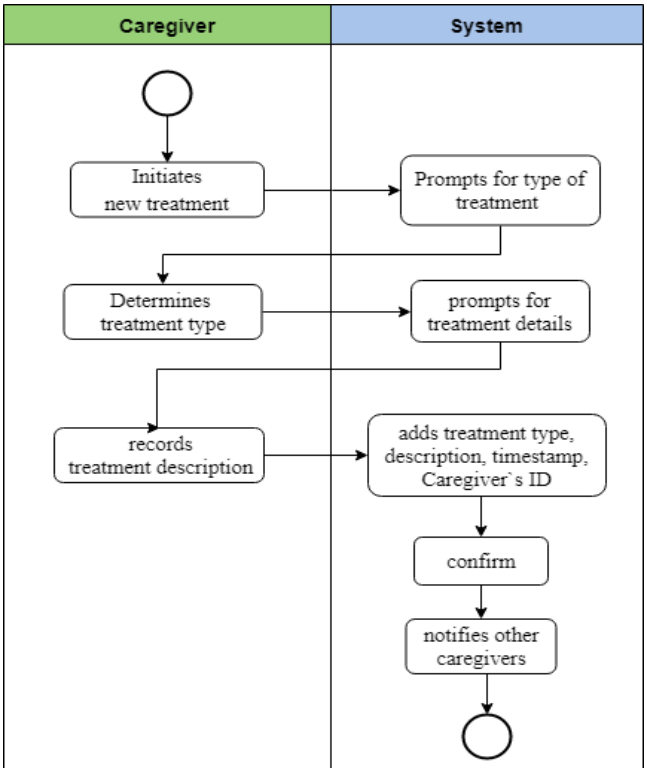

Figure 4. Performed Treatment Activity Diagram

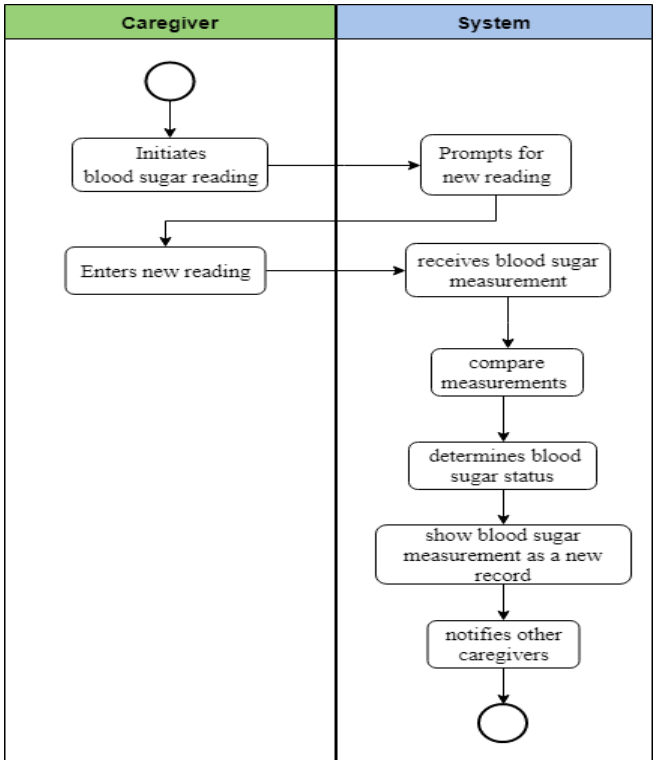

Figure 5. Measuring Blood Sugar Activity Diagram

Furthermore, once the *Patient* undergoes any kind of treatment or have a new blood sugar measurement reading, the *Caregiver* must record it to be shared with the rest of the care team as a change in care. Such change in care is shown in both *Performed Treatment* activity diagram (see Figure 4), and *Measuring Blood Sugar* activity diagram (see Figure 5), respectively. As for new treatments, the *System* prompts for details including, the treatment type, description, even the time it was performed, and the Caregiver's ID for authenticity. While in every new blood sugar measurement reading taken by a *Caregiver*, the *System* compares the latest reading with the previously recorded one to determine the blood sugar state. Finally, once the details are successfully recorded, for a new treatment or blood sugar measurement reading, the *System* notifies all registered *Caregivers* in the system earlier by the *Patient.* and notify the rest of the team about any changes in *Patient's* care.

VI. CONCLUSION

Caregiving is most commonly used to address impairments related to people who are aging and/or with disabilities, diseases, conditions, injuries, or mental disorders. Supporting caregivers is one of the most important issues that has been neglected around the world while there is a growing demand for their help. Moreover, diabetic patients, in particular, require home caregiving since there are no hospitals or nursing homes that can accommodate the huge and increasing numbers. Also, most of these diabetes patients are aged over 45 years according to the questionnaire, which means that these diabetic patients present with Type II and therefore require special care. Therefore, this study aims to address key challenges home caregivers face to support their loved ones. Moreover, the increasing number of diabetic patients motivates us to develop this application to serve or help those people. Besides, there are many difficulties related to communication between caregivers themselves as well as between the caregivers and the care team in terms of providing an accurate, timestamped order to share informed decisions regarding diabetic patients. On the other hand, the patients themselves face significant difficulties, such as waiting times and needing to see more than one doctor on the same day to receive the full treatment. Therefore, when they have disabilities, this process becomes very stressful for them. Also, there is a lack of Arabic speaking platforms that help with caregivers' connectivity for diabetic patients.

This paper sheds light on the challenges faced by patients and caregivers. It identifies the requirements for building a blockchain-based social network ecosystem to facilitate patient-centered family caregiving to empower and connect those patients' families, friends and neighbors to share patient-centered information with each other and make shared, informed care decisions. The proposed ecosystem design achieves this by allowing caregivers to track and record their patients' care management changes, health status and psychological status on a 24/7 basis. It also provides the caregivers with the treatment plan for diabetes and associated

 ISBN: 978-1-61208-759-7

diseases for comorbid diabetic patients which are decided by the care team member. This would facilitate the process of increasing the caregiver's connectivity in order to provide professional, timestamped care continuity for diabetic patients with Diabetes Type II in Saudi Arabia.

Scalability should be considered for future work related to the application to include more languages, involving communities from Arab countries and the rest of the world, as well as other types of diabetes, including Diabetes Type I and III and other chronic diseases. Also, consideration should be given to incorporating more IoT devices and wearables to connect with caregivers' and patients' smart devices. The proposed system design has great impact on the caregiving process for diabetic patients by allowing the patient's family to have continuous patient-centered care to help them provide the best care while reducing the burden of caregiving. Furthermore, it has a significant impact on the field of Computer Science by allowing analysists, developers, and engineers to interact with health care professionals in order to provide a solution that serves the diabetic patients of Type II along with their caregivers. This is to provide full treatment plan for diabetic patients suffering from different types of diseases and conditions associated with diabetes. Finally, this solution has an ethical and legal impact on our society as it provides transparency among all caregivers.

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 ISBN: 978-1-61208-759-7