Functional Requirements of a Web-Based Solution to Engage Diabetic Patients

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Studies demonstrate a positive correlation between favorable health outcomes (i.e. patients achieving and sustaining good health) and patients who are engaged with managing their care plan. The advancement and adoption of IT solution in the health delivery setting has empowered providers to communicate health information with other providers and patients themselves. Patient portals have become the standard health information technology (HIT) tool for engaging patients with their care. As a Health Insurance Portability and Accountability Act (HIPAA) compliant tool, patient portals have allowed providers to share health information to patients without restraints. However, patient portals have many improvement opportunities in order to truly engage patient with their care. In a broad perspective, there is a need for bi-directional interaction between patients and providers. This paper identifies key issues that have contributed to the dissatisfactions associated with patient portals and requirements that would effectively address these issues. Moreover, this proposal will discuss how an alternate web-based solution can engage high-risk patient population, diabetics, through functions that will empower patients to manage their health, interact with multiple providers, and benefit from provider outreach efforts.

Health IT and Patient Engagement

Health information technology (HIT) is rapidly changing how health care providers communicate, exchange information, and interact with each other in an organization through the implementations of electronic health records (EHRs), clinical decision support systems (CDSS)

and computerized provider order entry (CPOE) (Agency for Health Research and Quality [AHRQ], 2011). A patient portal is a HIT tool used to engage patients within their care by granting them access to their own medical information and empowering them to communicate with their healthcare providers electronically (Ammensworth, Schnell-Inderst, & Hoerbst, 2012). These portals intend to support the workflow of care coordination between the patient and provider through a gateway that is convenient, accessible, multi-functional and HIPAA-compliant (Graffigna, Barello, & Riva, 2013). However, they have fallen short of market expectations (Ammensworth, Schnell-Inderst, & Hoerbst, 2012). The most frequently identified issues associated with patient portals are identified in *Table 1: Patient Portal Issues by Theme*. These issues are grouped by the way in which they negatively impact patient portals.

Synthesis of research indicates the requirements of a better health IT tool that will be measured by its ability to enhance patients' engagement of their personal care, improve the communication of clinical information between providers and patients, and encourage shared-decision making among patients and providers (Prey et al., 2013; Walch, Dube, & Anthony, 2007). This paper recommends an idea for the creation of a website, Empower, as a way to develop an ecosystem whose core themes are constant, reliable, provide patient-provider interaction, and encourage regular self-management.

Diabetic Patient Population

As of 2012, about 117 million people have one or more chronic health conditions, with seven of the top 10 causes of death in 2010 being chronic diseases (American Diabetes Association [ADA], 2014a; Centers for Disease Control and Prevention [CDC], 2014). Key findings from the National Diabetes Statistics Report, conclude that 29 million people in the United States (9.3%) currently have diabetes (Diabetes Latest, 2014). According to the ADA (2014a), diabetes was the seventh leading cause of death in 2010, where the patient population included people diagnosed with Type 1 and Type 2 diabetes, gestational diabetes, and pre-diabetes.

This paper proposes a web-based solution that is optimum for this particular population, because of the importance of self-care behaviors among diabetics, which can lead to improved outcomes and reduced effects of the disease. Four essential behaviors that positively correlate with satisfactory glycemic control, improvements in life quality, as well as reductions of

complications are: (a) healthy eating, (b) physical activity, (c) regular monitoring of blood sugar, and (d) compliancy with medications (ADA, 2014b).

A recent study evaluation of over 2,400 users, assessing the use and effectiveness of patient portals and diabetes management, reports that the diabetic patient population has better health outcomes with self-management tools (Agency for Healthcare Research and Quality [AHRQ], 2011). Federal studies conclude a significant decrease in diabetic distress among patients with better health outcomes for 62% of the patients (AHRQ). The same studies show evidence of an increase in improved diabetic care for patients who use patient portals for clinical diabetic monitoring. Currently, there is no evidence of an interactive web-based solution that features disease management tools, provides personal access to health metrics, enables provider monitoring, and incorporates an algorithmic alert system for preventative measures (Walch, Dube, & Anthony, 2007).

Proposed Functions' Overview

The proposed functions contribute to patient engagement through a collective workflow that allows patients to manage their data, interact with providers, and receive information tailored to their condition. The solution, Empower, takes on the most effective functionalities of existing patient portals (such as ones from Kaiser Permanente or Updox) and adds further enhancements that would encourage patients to take an active role in the maintenance of their health. Available via the web, Empower gives patients and providers (a) access to notification alerts that promote awareness; (b) allows for exchange of patient driven data; (c) generates resources through enterprise applications; and (d) integrates heterogeneous medical services, all contributing to the coordination of care and ultimately, the quality of care (Lau et al., 2014). The proposed functions overview workflow is summarized in *Diagram 1*.

Theme 1: Patient Self-Management focuses on the functional requirements for encouraging patients to become more involved with their health. These self-management opportunities aim to help patients improve the management of their condition in order to prevent potential future conditions such as stroke, heart disease, heart attack, infections, hypertension, mental health ailments, blindness and eye problems, kidney disease, amputations, and death (ADA, 2014a).

Theme 2: Patient-Provider Interaction focuses on the functional requirements for improving the direct communications between the patient and provider. Since engaging patients requires bi-directional communication, this solution provides a means of that interaction (Walch, Dube, Anthony, & 2007).

Theme 3: Provider Outreach describes how providers may use the tool to identify daily trends within patient populations, while directing patients to resources applicable to their condition.

Theme 1: Patient Self-Management

Since the delivery of health care services increasingly stresses the involvement of patients, patient self-management has become a value-added objective (Lyles et al., 2013). Patient portals allow users to access huge amounts of data; however, this data is rarely provided to patients in a useful manner (Lyles et al.). In order to educate patients about their conditions, help prevent serious health complications and ultimately improve quality of life, it is essential that patient data be analyzed and presented to the viewer in a comprehensive and comprehendible manner (Glasgow et al., 2011). Empower will provide diabetic patients with an automated reminder and tracking system, a self-appointment application, and a prescription refill arrangement without the assistance from a provider or delivery staff.

A major concern for delivering longitudinal care is the lack of adherence to treatment regimen and it is also one of the leading causes of poor patient outcomes (Kocurek, 2009). According to Kocurek, adherence rates vary from 31 to 87% in retrospective studies and from 53 to 98% in prospective studies. This study also indicates a need for user-friendly reminders that will help patients adhere to their treatment regimen, a feature that is incorporated into Empower's functionality.

This paper's proposed solution also offers a tracking system for when the prescription of a patient is about to end, sending an alert to the patient 48 hours before the due date to get a new prescription from the doctor. Such a function helps minimize the effects of non-adherence behaviors such as poor blood glucose control, which can lead to diabetes-related complications, reduced functioning, and eventual premature death (ADA, 2014a; Lau et al., 2014).

Currently, one of the most useful features of diabetic patient portals is its ability to allow the patient to record his or her blood sugar reading (Graffigna, Barello, & Riva, 2013). Empower takes into account this feature, but additionally enhances it for a more user-friendly experience

by presenting the data in the form of graphs that allow patients to visualize their progress over days, months or years, thus identifying trends. With such information, patients and providers can compare data to ideal levels of health for an individualized assessment. In terms of prevention, daily entry of blood glucose levels allows patients to regularly keep track of their health, which may lead to improved control of A1C (blood test that provides information about a person's average levels of blood glucose), systolic blood pressure, lipids, and diabetes-related distress (Lau et al., 2014). This feature also allows patients and providers to quickly distinguish any major fluctuations, leading to early detection of potential hazardous conditions such as hyperglycemia or hypoglycemia. In addition, providers can utilize this data to monitor the levels of patients and assess how changes in medication types or doses affect blood glucose levels, thus allowing them to use the information on this proposed website for treatment purposes.

Weight management for diabetics is incredibly important and may require patients to forfeit the intake of medications, including insulin, because of significant reduction in blood sugar levels (Hamman et al., 2006). The functionality of this website encourages patients to record their weight daily, which may lead to improved overall health (Urowitz et al., 2012).

According to Comstock (2014), a survey done by PricewaterhouseCoopers states that one in five Americans owns a wearable device that measures important biometrics such as heart rate, respiration rate, blood oxygen levels, blood pressure and many other health indicators (Graffigna, Barello, & Riva, 2013). Empower provides patients the ability to enter these measurements into the system and analyze the fluctuations in these metrics over a period of time. This allows the health care team to identify risk factors that are associated with diabetes (Glasgow et al., 2011).

A unique feature of the proposed website is an alert system. Algorithms integrated within the system analyze the biometric data entered by the patient and send the patient as well as the providers alerts when the patient's blood glucose levels increase above the normal limit or if he or she gains/losses significant weight within a month or year. For example, if a patient enters blood glucose levels of 70 mg/dL or less, the system automatically registers that number as being associated with hypoglycemia and notifies the patient of the condition and symptoms immediately. Since these alerts will also be received by the provider, he or she will be able to send email alerts to the patient to come in for a check-up or further tests, aligning with the Empower's goal of preventive care.

Theme 2: Patient-Provider Interaction

A vital aspect of the solution is the ability of physicians to communicate with their patients through a secure email system. A study, particularly for diabetic patients, reports that patient engagement through a confidential messaging system is linked with progress in health outcomes such as glycemic control (Lau et al., 2014). The email system will allow for a two-way interaction where either the physicians or the patients can voice questions, concerns, or sudden emergencies in need of being addressed. According to Urowitz et al. (2012), it has been noted that involving physicians in aspects of a patient portal has resulted in enhanced adoption and greater adherence as well.

Theme 3: Provider Outreach

Provider outreach, essential for patient-centered care, encourages accountability among patients regarding their medical conditions through communication initiated by the provider (Centers for Medicare & Medicaid Services, 2014). This requires the provider to have sufficient data on interests of patient populations that share similar characteristics. However, even with access to the patient population, it remains a challenge for providers to deliver patient-centered care without understanding patients' interests and goals for their health (Cole & Charlton, 2013). Therefore, providers need data that will indicate patients' interests regarding their health condition (Glasgow et al., 2011). Barriers associated with provider outreach resulting in inadequate patient engagement include the timeliness and connotation of outreach efforts (Lau et al., 2014). Therefore, timeliness is essential to outreach efforts as there is a strong correlation between patient retention and provider responsiveness (Lau et al., 2014). In addition to timeliness, effectively communicating the connection between the clinical need and the patient's desire to improve their health statuses is essential for successful engagement. Thus, these barriers indicate the ideal workflows for provider outreach would require an approach that (a) leverages timely information, and (b) aligns patients' interests with their clinical needs, both of which the proposed solution addresses in the form of discussion boards and newsfeeds.

Open channels of communication, such as discussion boards, are an apt option for user engagement because they empower users to openly express concerns they would usually not express in physical environments (Lyles et al., 2013). Cultivating patient comfort is a critical component for patient engagement and may be attained through discussion boards as many

people seek medical advice from their peers (Nijland, Gemert-Pijnen, Kelders, Brandenburg, & Seydel, 2011). Since the proposed solution does not display any individually identifiable information, patients may communicate with each other without violating any security concerns (Collmann & Cooper, 2007). As a complementary workflow, newsfeeds identify related data driven by the user to suggest information related to the users' interest. For example, a patient with Type 2 diabetes participating in the Type 2 Diabetes discussion board would receive credible news posts regarding Type 2 diabetes in their newsfeed (ADA, 2014b).

Being able to use the proposed website to discuss their medical issues within a controlled and safe community would allow patients to become more comfortable with their condition and will drive online activity, encouraging patients to engage with their health. As a result of the online activity, providers would be notified of discussion boardrooms demonstrating the most activity. This volume of boardroom activity (i.e. discussions with more than 30 people) would indicate the need for a provider to join the discussion. To ensure the appropriate provider is engaging with the discussion of interest, a lower tiered clinician (i.e. registered nurse, licensed practical nurse, etc.) would connect the patient with the most suitable provider. The ultimate goal of these two workflows is to ensure that information presented to the patient is driven by patients' medical concerns and delivered to the patient through multiple channels of communication (i.e. peer discussions, news, credible resources posted by members in the newsfeed) with provider validation.

Storyboard

A storyboard has been developed for this study to demonstrate how the functional requirements would work to improve patient outcome and involvement according to the themes discussed above. *Figure 2: Storyboard* depicts how a diabetic patient would use the web-based solution, Empower, to regulate and stay informed about his or her health. It also shows how the patient's primary care physician uses Empower to establish an interactive patient-provider environment.

Research & Development Methods

The development of this solution underwent the following activities in the order as follows: (a) Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis; (b)

requirements prioritization; (c) peer-reviewed research for solution development; (d) third-party comment; (e) solution refinement; and (f) supplemental information development.

For the SWOT analysis, data primarily from the Journal of the American Medical Informatics Association (JAMIA) and the Centers of Medicare and Medicaid (CMS) determined identification of objectives, expectations, benefits, and issues of patient portals. These sources provided both academic and market research data. Common findings (themes) across the research data allowed issues related to each other to be grouped together.

Following the SWOT analysis, the research/analysis requirements listed for American Medical Informatics Association (AMIA) 2014 Student Development Challenge (SDC) determined prioritization of themes. Analysis requirements included: (a) successfully portraying the information to patients that is easy to understand using visualization techniques, (b) improving the communication methods between patients and their providers, and (c) establishing the most applicable information to display to patients.

Requirements were prioritized as follows: (a) SDC analysis requirements that we indicated as essential for the competition; (b) non-essential SDC analysis requirements that overlapped with data source issues identified; and (c) the practicality of researching solutions for the identified issue(s). Other issues that were found from the research data were discarded after the prioritization process. Based on this process, three themes or groups of issues were identified: introduction patient self-management, patient-provider interaction and provider outreach. A theme was evaluated using peer-reviewed journals, most commonly JAMIA, to identify approaches for resolving issues associated with that theme and synthesized solutions for their assigned theme. A proposal was drafted by evaluating each theme narrative based on the scope of the initial requirements.

Proceeding the proposal draft, a health IT professional was recruited to provide comments on the proposal. The comments provided were then evaluated by the two external reviewers to refine the proposal accordingly. After refining the proposal, supplemental information was determined from developing the proposal's introduction narrative, Table 1, Diagram 1, and the Story Board.

Summary

Studies show that patient portals have not met market expectations, but have met the anticipated functional requirements (AHRQ, 2011). Contributors to this problem of poor patient engagement lie within the user-interface and aggregation of data (Urowitz et al., 2012). Therefore, in order to engage patients, a solution to this dilemma must be intuitive and attractive to the patient. The workflow in this proposal is a combination of engagement approaches utilized in the social media market. By leveraging techniques such as an alert or email system, and discussion boards in healthcare delivery, providers can shorten the learning curve and eliminate the barrier between the patients and providers.

The three themes identified in this study, patient self-management, patient-provider interaction and provider outreach, summarize the overarching key challenges associated with engaging patients through patient portals. Thus, by improving the communication mechanism between the patient and the provider, the proposed solution offers a suite of functional requirements to enhance patient engagement. Also, by providing more autonomy, the proposed solution allows patients to make informed decisions about their care with minimal effort and reduced time. Most compressively, establishing a channel of communication quickly between patients and providers with the least amount of exertion allows for patient-centered care.

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Tables and Figures

Table 1: Patient Portal Issues by Theme

Issue ID	Patient Portal Issues	Theme
1.1	Lack of user-friendly/intuitive interface (Urowitz et al., 2012)	Patient Self-Management
1.2	Lack of patient involvement with care (Prey et al., 2013)	
1.3	Lack of provider alerts for preventative care (Prey et al.)	
1.4	Lack of patient notification reminders (Prey et al.)	
2.1	Limited patient communication specific to need/not patient-centered (Graffigna, Barello, & Riva, 2013)	Patient-Provider Interaction
2.2	Limited provider access to patient generated health data (Lau, Campbell, Tang, Thompson, & Elliott, 2014)	
2.3	Limited provider access to population data (Graffigna, Barello, & Riva, 2013)	
2.4	Limited provider consultation (Graffigna, Barello, & Riva)	
3.1	Inability for patient to consult multiple providers (Urowitz et al., 2012)	Provider Outreach
3.2	Inability for provider to target population activity (Urowitz et al.)	
3.3	Inability for provider to support care through patient data (Hamman et al., 2006)	

Figure 1: Proposed Functions' Overview Workflow
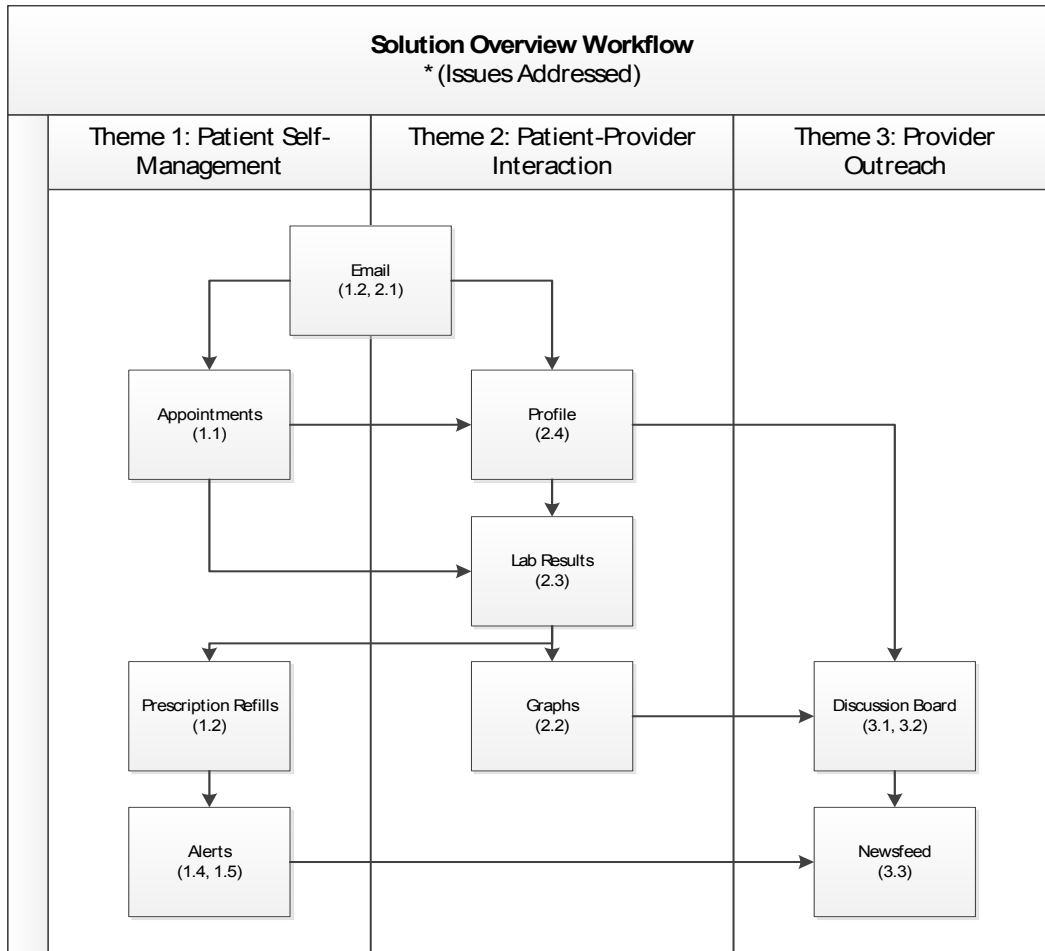
*The themes are the three core issues that the paper addresses. The ID's (i.e. 1.2, 2.1, etc.) are outlined in Table 1.
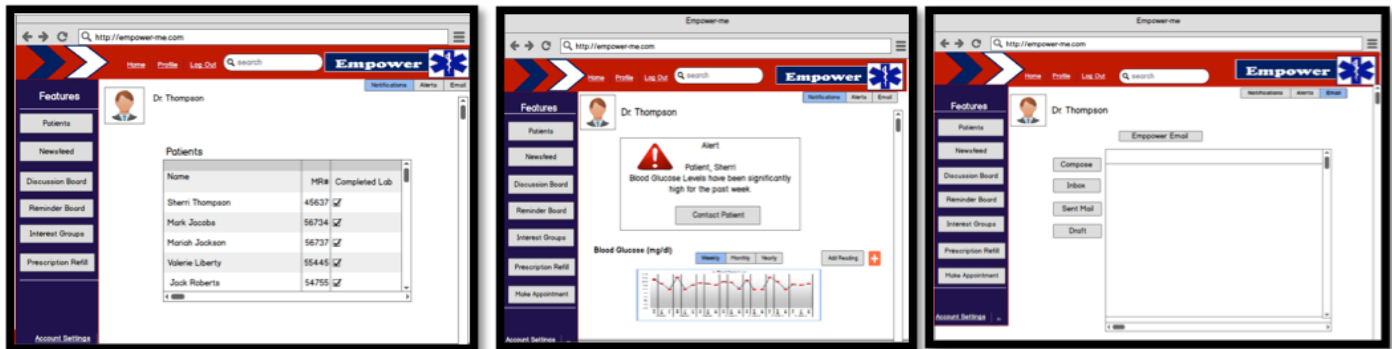
Figure 2: Storyboard

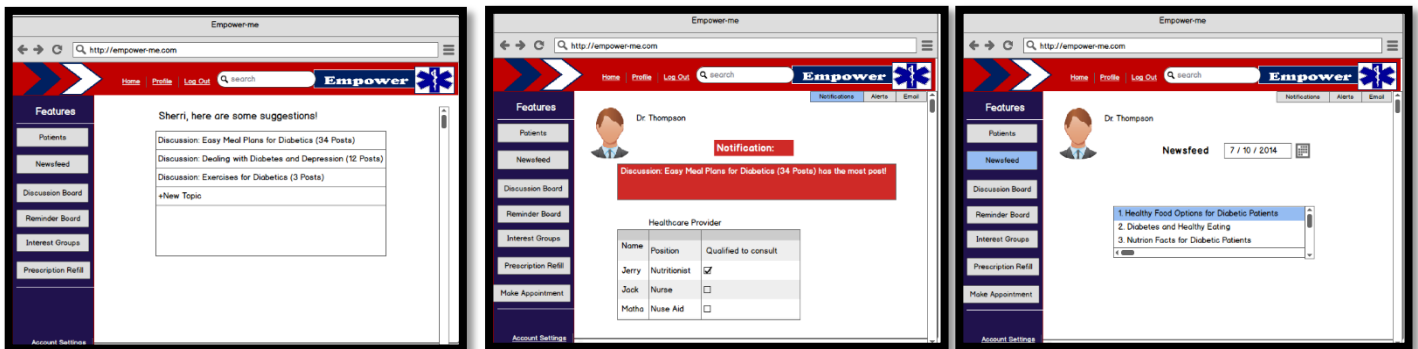| Theme 1: Patient Log-In	Theme 1: Patient Homepage	Theme 1: Adding a Reading
Sequence Number: 1	Sequence Number: 2	Sequence Number: 3
Description: After entering the URL, the users, patients, are taken into the login screen for the website (Empower). Patients are required to enter unique Username and Password. If the patient is not a new user, he/she can click on "sign in" to get into the website.	**Description:** Patients are taken to the homepage where they can view their blood glucose levels, weight, insulin injection chart etc. These graphs will allow the patients to see the progress over days, months or years and compare it to what the ideal levels should be in the form of markers on the graph.	**Description:** Every time patients take their blood glucose or weight readings, they can add the number to this website via the "Add Reading" button. That'll give her a pop-up where she can enter the appropriate information.

Theme 1: Patient Alert	Theme 2: Provider Log-in	Theme 2: Provider Selection
Sequence Number: 4	Sequence Number: 5	Sequence Number: 6
Description: If the patients' glucose levels are high, they get an alert from the website declaring that their glucose levels are high and that they should contact a physician immediately for a check-up. This alert was generated through algorithms incorporated within the system that send alerts when a significant change is detected.	**Description:** The user, physician, goes into the login screen for Empower. The physician is required to enter his/her unique Username and Password. If the provider is not a new user, he/she can click on "sign in" to get into the website.	**Description:** From the home screen, the physician, selects the "patient" tab.

Figure 2: Storyboard (Continued):

Theme 2: Provider's Lab Review	Theme 2: Provider Alter	Theme 2: Provider Email
Sequence Number: 7	Sequence Number: 8	Sequence Number: 9
Description: The physician is able to see a list of his/her patients that recently completed their labs. The provider then clicks on specific patients' name and review their lab results.	**Description:** The provider then selects a patient's lab information. When selected, the physician finds out that patient's blood glucose level have been significantly high for the past week. In addition, through the graphs presented, the physician will be able to see trends overtime for each patient and help prevent further chronic conditions.	**Description:** The provider then selects "email" in order to communicate with his patient through a secure email system if he has questions or concerns regarding lab results and graphical images.

Theme 3: Patient Discussion Boards	Theme 3: Provider Outreach	Theme 3: Patient Newsfeed
Sequence Number: 10	Sequence Number: 11	Sequence Number: 12
Description: In the Discussion board, patients can search for ideas that will help improve their diet and their medical condition; The "Discussion Board" widget displays topics that other publically non-identifiable diabetic patients are engaging in.	**Description:** Since the number of responses regarding this discussion is significantly greater than other discussion board topics, the provider is notified of its high activity. Completion of an electronic checklist displayed on the provider's portal view determines whether the clinician needs to consult a higher tiered clinician or engage in the discussion post.	**Description:** Providers are able to leverage information related to the patients' condition(s) and internet searches to deliver helpful information provided by trusted searches in the Newsfeed tab. The Newsfeed will include incredible sources with information regarding meal plans for diabetic patients. Providers will be able to assist patients to customize their personal health plans through information generated within the newsfeed.