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Design for a Virtual Peer-to-Peer Knowledge to Action Platform for Type 2 Diabetes

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Abstract. Many patients with Type 2 Diabetes (T2D) have difficulty in controlling their disease despite wide-spread availability of high-quality guidelines, T2D education programs and primary care follow-up programs. Current diabetes education and treatment programs translate knowledge from bench to bedside well, but underperform on the 'last-mile' of converting that knowledge into action (KTA). Two innovations to the last-mile problem in management of patients with T2D are introduced. 1) Design of a platform for peer-to-peer groups where patients can solve KTA problems together in a structured and psychologically safe environment using all the elements of the Action Cycle phase of the KTA framework. The platform uses Self-Determination Theory as the behavior change theory. 2) A novel patient segmentation method to enable the formation of groups of patients who have similar behavioral characteristics and therefore who are more likely to find common cause in the fight against diabetes.

Keywords: Knowledge To Action (KTA) Framework, Diabetes Education, Behavioral change theory, patient segmentation, peer-to-peer education.

1. Introduction

The Knowledge to Action (KTA) Framework (Figure 1) is an evidence-informed ontology for making knowledge applicable to the daily life of patients with a variety of health conditions. This framework consists of two components: The Knowledge Creation Pyramid and the Action Cycle, each of which comprises multiple elements (Figure 1). Increasingly it is apparent that the action phase or 'last-mile' of adapting knowledge to patients' needs is sorely lacking in many patient education programs [1, 2]. Conceptual frameworks, such as the KTA, are recommended as tools to support the application of theories and models in the Action Cycle [1]. Recent conceptual analytic work in our lab shows that patient empowerment cannot occur through empowerment of individuals

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Figure 1. Knowledge to Action (KTA) Framework (Graham et al., 2006, with permission)

alone. Empowerment needs to occur at 3 levels –individual [3], communities and groups and the societal level [4].

The primary objective was to design a scalable reference architecture for a digital platform that incorporates all aspects of the KTA Action Cycle, can incorporate behavior change theory, principles of collective intelligence, behavioral economics, proven behavior change interventions and healthcare marketing to help patients with Type 2 diabetes (T2D) improve control of their disease by developing skills for healthy behaviors and habits. To our knowledge, this is the first description of a digital platform that incorporates all elements of the Action Cycle of the KTA framework. It is also the first digital KTA framework to incorporate a peer-to-peer component.

2. Methods

We initially developed a draft architecture for a peer-to-peer platform (P2PP) that can engage patients to take translated knowledge and convert it into action. The draft P2PP starts by extracting data from physician electronic medical record (EMR) systems, identifying patients with poor diabetes control, segmenting them into medication-taking behavioral segments using a k-means clustering algorithm [5], engaging them and encouraging them to enroll into a healthy skills development workshop and reporting the outcomes back to the physician.

Subsequently, we mapped elements of the Action Cycle of the KTA framework onto the draft P2PP and added new functions to accommodate elements of the cycle not included in the initial draft version. We iterated the P2PP until we obtained consensus on the feasibility and efficiency of the workflow that contained all elements of the KTA Action Cycle. We also mapped the Self-Determination Theory of behavior change [6, 7] onto the architecture and identified where behavioral segmentation could be added. Privacy and security are handled elsewhere and was not in scope for this project.

3. Architecture for KTA

The final architecture (Figure 2) is a closed loop to ensure that patients receive appropriate follow-up from their primary care providers and that continuity of care is preserved. Patients with poor control of their diabetes (e.g., uncontrolled blood pressure, cholesterol and/or hemoglobin A1c), are segmented (using a k-means clustering) to identify different behavioral segments (lifestyle, cholesterol, basic medication and extensive medication treatment preference groups), described elsewhere [5].

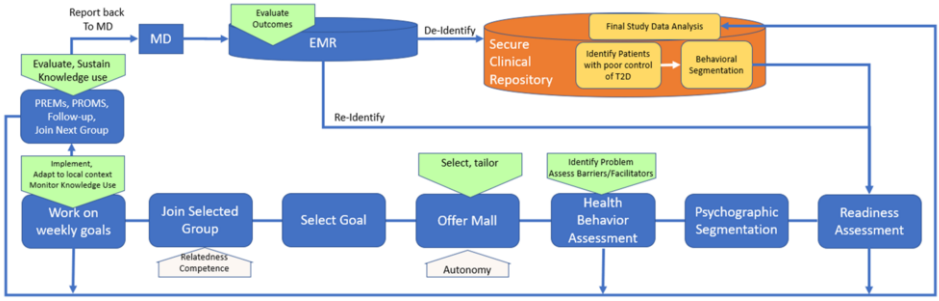

Figure 2. Reference Architecture for Peer-to-Peer KTA Diabetes Workshops

Then, patients are administered validated questionnaires to assess: readiness for change, health behaviors, health literacy and a psychographic (attitudinal) segmentation questionnaire. The psychographic segmentation and health literacy assessment are used to tailor the language of subsequent communications to the preferences of the patient. The health behaviors assessment is where the Action Cycle elements begin (lime green) [8]. At this stage, problems (why is the patient's disease out of control?) and barriers and facilitators to correct the problems are identified. Subsequently, the patient is offered a choice of lifestyle programs (diet, exercise, stress management, symptom management or medication adherence program) that is tailored to their individual health behaviors and disease control (The Mall).

The Mall allows the patient to select the intervention of their choice, promoting autonomy in line with Self-Determination Theory (SDT, cream) and supports selection and tailoring, as described in the Action Cycle. Once the patient has set their goal, they are enrolled into a workshop where they meet other patients with similar characteristics. The workshop is a 12-week peer-to-peer skills development, problem solving and relationship building program, consistent with the Relatedness and Competence elements of SDT (cream arrow). The workshop participants meet weekly, engage each other to implement micro-goals, measure and display their collective progress and help each other find ways of adapting materials to their local context, consistent with the elements of the Action Cycle.

Once the patients have completed the workshop, they are asked to complete regular post-workshop questionnaires and patient reported measures. A report is generated and sent to the physician so that they are kept informed and can reinforce participation and encourage other patients to adopt the program. Finally, data from the patient's visit with their physician is used to assess the impact of the program on diabetes control.

4. Benefits of the P2PP architecture

This P2PP reference architecture has several characteristics which distinguish it from other similar projects. (i) Integration into existing EMRs helps to identify all patients that have poor control of their disease. Population-level data makes it easier to identify missing data, increases transparency and decreases risk of bias, unlike when patients are approached individually and opportunistically in a clinic. Integration with EMRs enables scalability and integration into the healthcare system. (ii) The Action Cycle of the KTA Framework adds an evidence-informed design component to the P2PP that is rarely included in similar projects. Addition of the Self-Determination Theory explicitly includes functions that support a behavior theory. (iii) Unlike current one-size-fits-all education programs, the P2PP is designed to suit each T2D patient based on their individual preferences, attitudes and habits; e.g. language, diet, exercise, sleep, stress, and regardless of sex, gender, social or ethnic characteristics. Behavioral and psychographic patient segmentation enable tailoring of communications and personalization of options for workshops. (iv) Patients classified in the same segment who share similar preferences, outlooks and constraints but have distinct problem solving and self-motivation capabilities work together to achieve collective goals that might be difficult to achieve individually. Utilizing positive deviance and experience sharing among individuals of the same group, the P2PP enables patients to learn from peers who have better control of their disease and helps them develop healthier attitudes and behavior change skills in an environment that supports relationship building and group motivation. (v) The P2PP enables person-centered decision-making by creating a choice architecture that maximizes opportunities for improvement of disease control. This approach increases scalability, sustainability and patient engagement by enhancing autonomy in the individual's natural environment and augments existing educational programs and physician-mediated recommendations. (vi) The reference P2PP architecture is scalable to additional interventional components such as additional behavior change theories, mobile apps, explainable artificial intelligence, nudges and other behavior change techniques. (vii) The P2PP architecture enables patients to join additional workshops to develop additional skills whenever they are ready to do so. This addresses the issue of one-off interventions which make an impact, only for patient behavior to revert to previous behaviors after the intervention is over. Long-term behavior change needs consistent and on-going intervention. (viii) Finally, the reference P2PP architecture proposed is technology agnostic and can be developed using cloud-based no-code and low-code applications readily available on the web which helps address the problem of affordability and sustainability.

5. Conclusion

To our knowledge, this peer-to-peer platform for translating knowledge into action is the first of its kind that incorporates an evidence-informed ontology and provides T2D patients a platform that is designed based on their own behavioral and psychographic segments, preferences and socioeconomic contexts. This approach encourages patients to change their behavior towards a healthy lifestyle by looking at and following peers with better control of biomarkers as role models and thus challenges current group interventions which do not use segmentation, and which have clinicians or experts as facilitators.

The platform can also be adapted for other diseases (e.g. cardiovascular diseases, dementia and cancer) that can be improved through lifestyle change. By leveraging individual attitudes and beliefs in a group-centered, patient-led way, this new system is designed to contribute to empowering patients at the group and community level and transforming the healthcare system from a reactive to proactive stance.

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