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Mobile Diabetes Diet Adherence Program (MoDDAP)

A Hybrid Technology and Coaching Solution

for Implementing Behavior Change and Reducing Emotional Distress

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Introduction of MoDDAP

As of 2015, Type 2 or adult onset diabetes has become a truly global pandemic with more than 415 million sufferers (Unnikrishnan et al, 2017). Despite the fact that they face the risk of permanent disability or death, most diabetics do not make the prescribed behavioral modifications necessary. In particular, diet compliance can be as low as 22% (Broadbent et al., 2011). The poor track record of existing remedies shows that purely medical and pharmaceutical interventions are insufficient. Therefore, I propose a treatment that also incorporates behavioral and psycho-emotional components. My program, the Mobile Diabetes Diet Adherence Program (MoDDAP), is based on social cognitive theory (SCT) and self determination theory (SDT). MoDDAP seeks to strengthen behavior change by boosting self-efficacy, a concept from SCT. It also reduces the patient's diabetes-specific depression and distress by promoting intrinsic motivation, a concept from SDT. To accomplish these aims, MoDDAP utilizes empirical methods from wellness coaching in a design that leverages learnings from developmental psychology.

As mentioned, MoDDAP seeks to deliver the twin outcomes of successful behavioral change and improved emotional health to diabetes patients. To do so, it is constructed as a hybrid 12-session remote wellness coaching program paired with a smartphone application. During the sessions, a professional wellness coach teaches patients the skills necessary for successful behavioral change, such as goal-setting, while also providing the emotional support they need to diminish their diabetes-specific depression and distress via motivational interviewing. The smartphone application reinforces the skills by automating goal-tracking in real-time, facilitating learning via mnemonics and reducing cognitive load. The entire program

is entirely personalized, to account for patients' dynamic development paths and ranges. By integrating concepts from different psychological theories and practices, MoDDAP addresses the behavioral and emotional gaps in mainstream treatments that until recently, have been mostly pharmaceutical and medical in nature.

MoDDAP's Motivations as Powered by Psychological Theory

As mentioned, MoDDAP's primary outcomes are increased self-efficacy and intrinsic motivation, two concepts explained by social cognitive theory (SCT) and self determination theory (SDT) respectively. Social cognitive theory is pioneered by Stanford psychologist Albert Bandura, who posited that human learning can be modeled by the dynamic interaction of three reciprocal forces -- personal factors, environmental influences, and behavior. A core component of SCT is agency, which Bandura explains as the capability for a human being to influence their functioning and the course of events in their life by their actions, rather than as a passive recipient of said experiences (Bandura, 2001). A quantifiable measure of agency is self-efficacy, or the amount of belief that one has the power to exercise some control over oneself and one's environment. The higher one's self-efficacy, the more one optimistically engages in self-enhancing behaviors (Bandura, 2001). MoDDAP seeks to elevate patients' self-efficacy by teaching them goal setting, a process by which patients can optimize every aspect of their goals, establish purpose, create targets, design a feedback system and learn to frame the goal in approach-oriented, positively motivated terms. In this way, goal setting directly supports behavior change.

However, we know that in addition to behavior change, emotional support by the way of identifying and alleviating diabetes related depression and distress also aids in diet compliance.

In MoDDAP, we look to SDT for a solution. As put forth in Ryan & Deci (2000), SDT theorizes that humans have three innate psychological needs -- competence, autonomy and relatedness. For patients, their sense of autonomy can be bolstered by uncovering and building their intrinsic motivation, or their motivation to persist in achieving their goals even in the absence of rewards (Deci & Ryan, 2000). In the process of working with recalcitrant alcoholics, psychologists Miller and Rollnick developed the counseling approach known as motivational interviewing: a way of patient-centered speaking by that counselor that enhances the patient's motivation to change by initiating the patient's intrinsic motivation (Rollnick & Allison, 2004). It has since been adopted by wellness coaches worldwide for all sorts of health problems including chronic illnesses like diabetes. While motivational interviewing does indeed build rapport between the counselor and patient, thus enhancing relatedness, it primarily heightens autonomy by highlighting the belief that the patient alone holds the key to a successful recovery (Rollnick & Allison, 2004). Most importantly, it provides emotional support. Not only does motivational interviewing help patients persist in the face of the difficult behavioral changes required of treatment, it has been shown to increase positive emotions, easing distress (Lovoll et al., 2017).

MoDDAP's Design as Informed by Developmental Psychology

Once the outcomes of MoDDAP had been determined to be elevating self-efficacy and lessening diabetes-related emotional distress, I looked to developmental psychology to provide insights for program design. Fundamentally, MoDDAP is a program that delivers new metacognitive strategies -- defined by Perkins et al. (1990) as the monitoring and enhancing of cognitive processes -- in an emotionally supportive environment leveraging technology. While the strategies taught are few, continual self-assessment and reflection are needed in order to

successfully select the appropriate one in the chaos of everyday living in the real world. In MoDDAP, this is both built into the smartphone application in the journaling functionality as well as in the coaching sessions, where significant time is devoted to reflection and assessment.

In addition, given MoDDAP's goals of behavior change and emotional support, it is clear that its success hinges on the ability to provide a highly personalized and also high-touch experience. In striving for the former, two works in particular -- Wiske's (1998) *Teaching for Understanding* and Fischer and Rose's (2001) *Webs of Skill* -- were most crucial to informing the program's overall structure. The first, *Teaching for Understanding*, advocates for a dynamic feedback system of explicit criteria and frequent assessments leading to constantly evolving goals (Wiske, 1998). As will be evident, MoDDAP builds this philosophy into each of the weekly coaching sessions by beginning with a clear-cut agenda, reviewing last week's progress, and then using this information to adjust next week's goals. Secondly, in *Webs of Skill*, we learn that students do not always acquire skills in a linear manner, but instead have multiple paths of development whereby each one may progress along different strands of knowledge and display highly inconsistent performances of proficiency until the final integration occurs (Fischer & Rose, 2001). For this reason, MoDDAP has been designed so that all core concepts are introduced in the first quarter of the program, with all remaining sessions devoted to practice and eventually, tapering off. By building in such substantial blocks of time for review and practice, MoDDAP is able to accommodate this fluctuation of skill while learning acquisition occurs.

Finally, while personalization can enhance patients' learning of behavior change skills, adequate emotional support is equally important to MoDDAP's success. We see this echoed by Immordino-Yang and Damasio (2007), who explained that emotions give support to cognition

and guide thought and action. It is for this reason that MoDDAP elects to use a human rather than artificial intelligence-powered software coach, who may not be as well equipped to detect changes in the patient's affect and respond effectively to modulations in emotion. It is also a main reason for the relatively lengthy period of time the patient spends with their coach. In conclusion, at every junction, MoDDAP's program design has been informed by the theories of notable thinkers in developmental psychology.

MoDDAP Understanding Goals and Program Overview

As stated above, MoDDAP's objectives are to enable patients to engage in behavior change and reduce emotional distress by practicing skills such as goal setting and through engaging in motivational interviewing with trained counselors to increase intrinsic motivation and positive affect. While these are derived from SCT and SDT respectively, the patients' understanding goals do not hinge upon their grasp of these theoretical underpinnings. Instead, the patient needs to comprehend and be able to practically apply two overarching understanding goals. These goals, which inform and organize the individual session sub-goals reviewed in a later section, are as follows:

- 1. How to promote behavior change by utilizing skills such as goal setting to increase self-efficacy*
- 2. How to reduce diabetes-related emotional distress by strengthening intrinsic motivations*

In order to facilitate both behavior change and emotional support, MoDDAP has two components: a one-on-one virtual counseling program with a credentialed non-physician wellness professional, and a mobile app component that solicits the patient for daily input on a variety of measures. These methodologies were chosen for their demonstrated effectiveness in

previous field research. Coaching has been shown to be effective in improving key diabetic indicators such as blood sugar levels and reducing complications of the disease over time (Bray et al., 2008). Similarly, a systematic review of mobile health interventions showed that the majority of robustly designed studies, most of which were smartphone applications, found such solutions effective in improving diabetic health indicators (Garabedian, Ross-Degnan & Wharam, 2015). As we can see, wellness coaching and smartphone apps that focus on physical indicators have separately proven themselves to be effective solutions for diabetes care.

MoDDAP seeks to combine them with one main change -- a focus on tracking and improving not just physical outcomes but also behavioral and psychological ones such as self-efficacy and intrinsic motivation, concepts informed by SCT and SDT.

The counseling portion of the program is composed of 12 weekly sessions of one hour each with a remote wellness coach (RWC). The RWC is expected to have a minimum of a bachelor's degree or equivalent in a health-related area and have completed a rigorous training program from one of the major accredited wellness coaching programs. The coaching sessions are organized into 5 distinct topics: ambivalence, change talk, goal setting, maintenance, and tapering off. First, MoDDAP teaches the foundational principles of motivational interviewing: ambivalence, which is about accepting resistance, and change talk, which is recognizing and listening for change (Rollnick & Allison, 2004). Both of these ask the patient to look inwards to their emotions with the support of the counselor. Then, as consistent with Immordino-Yang and Damasio's (2007) work that emotions give support to cognition, MoDDAP follows these sessions with goal-setting, a metacognitive skill. It is important to note that the topics are not spread evenly across the sessions. Instead, the first three topics each take only one week, while

over half of the sessions are devoted to practice, also called “maintenance” As mentioned, this is to provide patients with ample time to become consistent in their individual development web (Fischer & Rose, 2001). Finally, as we will discuss later, the last two weeks of “tapering off” are primarily to provide further emotional support, reinforcing the psychological focus of MoDDAP as an intervention in comparison to traditional pharmaceutical treatments.

In addition to the flow of session topics, each coaching session itself is also carefully designed. First of all, as is consistent with SDT, MoDDAP respects and encourages the patient’s autonomy by asking that the RWC engage in motivational interviewing throughout. That means the RWC recognizes the patient’s motivation as a dynamic state that shifts and responds to the RWC’s own behavior (Rollnick & Allison, 2004). Thus, the RWC must be very careful to neither advise nor prescribe what needs to be done, but instead support the patient to problem-solve using open-ended questions, with the intention of bringing the patient to a place of greater awareness and insight (Schneider et al., 2011). Each session follows a similar format, with the exception of the first, which devotes slightly more time for introductions. During this first pivotal session, the RWC must convince the patient that they care about the patient’s perspective, irrespective of what anyone else has said and what the patient’s own medical history may indicate (Miller & Rollnick, 2012). For the remainder of the program, however, the first 5 minutes are typically reserved for setting expectations for the session, the last 10 for planning for the following week, and the bulk of the session devoted to evoking statements committing to change through reflective listening and open questioning. The sessions follow the motivational interviewing methodology of engaging, having a clear focus, activating change-oriented self-talk, and collaborative planning (Miller & Rollnick, 2012). They are also, as I have

explained, designed in accordance with Wiske's (1998) Teaching for Understanding framework that advocates for clear criteria, frequent assessment and continuous planning.

To supplement and strengthen the learnings from the remote coaching sessions, the smartphone application is designed for the patient to use in self-monitoring. The patient receives real-time feedback or reminders in ways that have been proven to have a positive impact on primary outcomes (Garabedian, Ross-Degnan & Wharam, 2015). Initially, the application prompts the patient a default of at least six times a day to input their diet, blood sugar levels, activities, moods and goals, although, respecting the patient's full autonomy, these settings can be adjusted at any time. In addition to prompting for mood tracking, the application also offers a journaling function. Journaling is a metacognitive activity in that the patient is encouraged to reflect on their own thinking. Furthermore, as explained by Perkins et al. (1990), it is also an opportunity to evaluate and direct their cognitive activities more effectively.

The core of the application lies in the ability of the software to link all of the patient's inputs and reflections together, so that they can see how their diet and activity level may affect their blood sugar levels and moods, as well as vice versa. In previous cognitive behavior therapy interventions for diabetes, the ability for the patient to see how their behavior alters mood has been shown to be a crucial component of treatment (Lamers et al., 2010). Finally, following previously studied successful implementations of mobile health solutions, the data collected will also be actively shared with the RWC (Garabedian, Ross-Degnan & Wharam, 2015). In fact, discussion about the data that has been collected is a core component of each counseling session. That is because the RWC takes a rather Vygotskian role in the patient's learning, by engaging in collaborative problem solving with the patient as their more advanced peer and acting as the

scaffolding for them to reach their next stage of development (Miller, 2016). More specifically, beginning the second session, the RWC and the patient will spend the majority of each hour reviewing the patient's data and talking through their motivations, with a focus on using this information to modify goals for the next week. Therefore, as consistent with Vygotsky's theory, the RWC does not only help to assess the patient's actual level of diet adherence, but also their potential future development level (Miller, 2016).

Further Details on Coaching Sessions

Session 1: Ambivalence

Understanding Goal: Struggling with ambivalence is a common experience amongst those seeking to make behavior change.

As stated above, the first coaching session begins with the RWC seeking to engage the patient, specifically making them feel like their perspective is being heard, often lacking in non patient-centered, more prescriptive interventions. Having established that, the session moves on to the topic of ambivalence because exploring and resolving it is the cornerstone of motivational interviewing. The concept of ambivalence, in the context of motivational interviewing, refers to the fact that patients may have both pro-change (i.e. pro diet adherence) and against / counter-change arguments within themselves simultaneously, usually in the form of self-talk (Miller & Rollnick, 2012). The main activity of the session is to have the patient express this self-talk interpersonally to the RWC. The RWC merely listens, and explicitly does not argue for change, as that is likely to prompt anti-change responses from the patient.

In terms of program understanding goals, this session helps build the patient's intrinsic motivation by allowing them to articulate and accept their motivations for change as well as the

accompanying internal struggles against them. Utilizing a sensitive and welcoming process, the RWC helps the patient feel understood in their frustration with the inconvenience of change and establishes a direction for change without eliciting their defensiveness (Rollnick & Allison, 2004). Separately, from a developmental psychology perspective, MoDDAP chooses to begin with this emotionally supportive exercise as would be advised by Immordino-Yang and Damasio's (2007) finding of the important role emotion plays in steering cognition. In addition, the session establishes one strand in the patient's web of skills that will be built upon further in the next session (Fischer & Rose, 2001). Finally, Wiske (1998) tells us that successful learnings should be able to be demonstrated in performances of understanding that are not private, but able to be observed by others. Therefore, by the end of a successful first session, a suitable performance of understanding by the patient would be to not just understand that ambivalence is a natural part of behavior change, but be able to express and identify the ambivalent thoughts they harbor towards diet adherence.

Session 2: Change Talk

Understanding Goal: The patient understands the difference between sustain talk, change talk and activated change talk and that the last is most preferable.

In this second session, the RWC works with the patient to move beyond merely observing ambivalence and towards the direction of initiating motivation for change. This is accomplished by teaching the patient how to examine the self-talk that takes place when they contemplate change. The RWC explains that arguments for change are referred to as "change talk," and arguments against change are labeled as "sustain talk," with high-quality arguments for change that include an intended action named "activated change talk" (Miller & Rollnick,

2012). By practicing open-ended motivational interviewing, especially through the use of non-judgmental, reflective statements, change talk, also called self-motivation statements, has been shown to arise naturally (Rollnick & Allison, 2004). They have also been shown clinically to be elements of effective change when enacted autonomously (Deci & Ryan, 2012). In summary, it is clear that as it relates to MoDDAP's overall program understanding goals, this second session builds upon the first by strengthening the patient's intrinsic motivation via enabling the production of statements for change. Developmentally, it is one more strand in the patient's web of skills, albeit one focused on reducing emotional distress (Fisher & Rose, 2001). Finally, in the same vein as the previous session, a performance of understanding should have the patient not just understanding that activated change talk is most helpful for enacting behavior change, but be able to demonstrate that they can accurately categorize their own self-talk as one of the three types.

Session 3: Goal Setting

Understanding Goal: The patient understands what is and how to create specific, measurable, actionable, realistic and time-bound (SMART) goals.

In this third session, after reviewing the patient's recorded behavior for the last week, the RWC introduces yet another strand in the patient's web of skills: goal setting. Effective goal setting is when patients are able to, in a self-directed manner, discover the optimal number of goals to set, establish purpose, create targets, design a feedback system and learn to frame the goal in approach-oriented terms (Swoboda et al., 2017). Goals are cognitive representations that guide behavior by focusing on outcomes, and there is a positive relationship between goals and self-efficacy (Bandura, 2012). Furthermore, goals must be SMART (specific, measurable,

actionable, realistic and time-bound) in order to have a high chance of being successfully executed (Swoboda et al., 2017). SMART goal-setting, when taught and practiced in a patient-centered coaching program, was found to be successful at improving diabetes self-efficacy, quality of life and reducing BMI (Nishita et al., 2012). For the bulk of the session, the RWC supports the patient in designing plans to achieve their goals, address potential obstacles, and help identify sources of support. Different from the first two sessions, this session is devoted to the program understanding goal of effecting behavior change as facilitated by goal setting. Developmentally, however, it is like the first two sessions in that it is yet another necessary additional strand to the patient's web of skills (Fisher & Rose, 2001). Finally, as a performance of understanding, the patient should be able to demonstrate that they can either craft a goal that meets these criteria, or be able to modify an existing one to make it so.

Sessions 4-10: Maintenance

Understanding Goal: The patient should understand that normalizing relapse is a crucial part of behavior change and accept it, not fight it.

Maintenance is one of the most crucial aspects of MoDDAP and as such, comprises more than half of the program's coaching sessions. This is because developmentally, patients need time to practice reducing variability in executing their new skills, as well as receive the ample support from their RWC necessary to achieve an above-functional, optimal level of proficiency (Fischer & Rose, 2001). From a Vygotskian perspective, these sessions are when the RWC really proves their worth as temporary "scaffolding" for the patient's emerging skills in detecting ambivalence, activating change talk, and setting SMART goals (Miller, 2016). Thus, in terms of

time allocation, the bulk of these sessions are spent in deepening practice by repeating the same exercises and performances of understanding completed previously.

When optimal or high proficiency of previous sub-goals has been demonstrated, but as soon as is feasible, the RWC will introduce the final concept of normalizing relapse. Typically used to refer to the cessation of substance abuse, here relapse is defined as consciously abandoning all attempts to adhere to the prescribed diet. Unfortunately, most people will not achieve sustained behavior change permanently and instead revert to old habits, at least temporarily. A reason may be that even after the new behavior has been learned, the old noncompliant behavior has not been unlearned (Bouton, 2000). In any case, the patient must be prepared for failure. As Miller & Rollnick (2012) explains, normalizing relapse early and being prepared for setbacks, such as new problems that may arise out of the patient's new diet, will prevent them from becoming completely derailed. In studies involving alcoholics, relapse can be predicted by nonverbal displays of shame (Randles & Tracy, 2013). Similarly for diabetic patients, becoming aware of and resolving in advance such feelings of shame or disappointment can prevent relapse. It also directly relates to and supports the program understanding goal of reducing diabetes-related emotional distress. As for a performance of understanding, the patient should be able to identify their obstacles to normalizing relapse, whether it be shame, disappointment, lack of self-confidence or something else.

Sessions 11-12: Tapering Off

MoDDAP does not introduce new understanding goals in the last two sessions, but instead requests that RWCs and patients take this time to further review any concepts that may need further reinforcement or practice. In addition, the RWC will work with the patient on

coming up with a list of other resources and contingency plans should they relapse into noncompliance. While the patient can use these sessions to improve their achievement of either program-wide understanding goal, the tapering off process itself is designed to protect intrinsic motivation and alleviate diabetes-related emotional distress. Relapse, as we already know, can be anticipated by and almost certainly will exacerbate negative emotions such as shame and disappointment. Developmentally, as Vygotsky would likely advise, MoDDAP helps the patient prepare for this by identifying other potential sources of scaffolding and collaborative problem-solving before the RWC is no longer available, so that learning may continue.

Learners and Learning Challenges

The patients enrolled in MoDDAP may experience several learning challenges, such as managing cognitive load and improving their emotional wellbeing in support of greater cognitive understanding. However, I will also explain how the program has also been designed to mitigate these issues. First, there is immense cognitive load required of diabetic patients who are prescribed a new diet, especially if they are also newly diagnosed with the disease and assigned a pharmaceutical intervention as well. Merely remembering the regimen, which is often complicated and unintuitive, will expend magnitudes more cognitive effort than patients are used to spending on what to eat. Furthermore, as Perkins et al. (1990) noted, not only does executing strategies constitute cognitive load, but so does the beneficial “metacognitive reflective monitoring and management during (the) execution” (Perkins et al., 1990, p. 292). That is, if MoDDAP is to teach the patient metacognitive coping strategies such as goal setting and overcoming ambivalence, then it is making further demands upon an already taxed resource.

With this in mind, MoDDAP seeks to use both software and the RWC to alleviate this demand. The smartphone application is designed to assist with processing cognitive load without eliminating the helpful “reflective monitoring.” That is, the application intelligently prompts the patient to enter data throughout the day and is able to produce real-time visualizations of the patient’s progress on demand similar to a “mnemonic download onto external objects” (Perkins et al., 1990, pp. 293). These capabilities do not fully eliminate but greatly lower the patient’s cognitive load in complying with their diet. The patient can then devote more resources to the metacognitive aspects of their treatment.

Another challenge is the importance of emotion to cognition and their large role in decision making as put forth by Immordino-Yang and Damasio (2007). Diabetes patients are not just physically ill but also emotionally fragile, with an estimated 10% to be suffering from clinical depression, twice that of the normal population, with another 10% registering subclinical but nonetheless pervasive depressive symptoms (Ali et al., 2006). Fortunately, MoDDAP focuses on uncovering and developing intrinsic motivation as a way to increase positive affect and indirectly improve emotional wellbeing. In this way, patients can be better positioned emotionally and thus guide themselves to better decisions when it comes to their health.

Assessment Plan

As a personalized intervention, MoDDAP’s assessment plan is also highly individual to the patient. Since each patient’s exact condition, personal circumstances and physician’s prescription will differ, MoDDAP does not use a uniform assessment to determine patient success. Taking into account that each patient’s starting point and desired result will vary in both a medical as well as psychological sense, the emphasis is on measuring the relative and not

absolute progress that the patient has made in increasing their self-efficacy and intrinsic motivation.

The program has an assessment component to both of its coaching and application elements, although they are very different. The RWC helps the patient learn and apply self-assessment, itself a fundamental part of goal setting. On the other hand, the application records quantifiable data, which can be used to generate reports that display objective measures of progress. Both the underlying data and the reports are then utilized in each coaching session as a starting point for understanding patient advancement.

This assessment plan is consistent with Wiske's (1998) seminal work on education, *Teaching for Understanding*. With the exception of lacking multiple sources of assessment, a critique that I address in the next section, the current plan contains all the criteria for effective, ongoing assessment as described by Wiske: relevant, explicit, and public criteria, frequent assessments, and gauging progress and informing planning (Wiske, 1998). The criteria is made explicit by the functions available in the application, which make clear the objective measures -- diet intake, blood sugar levels, mood, etc. -- the patient should be monitoring for improvement. They are further reinforced during discussion with the RWC during one-on-one sessions. The assessments are also frequent. Digital progress reports can be accessed any time, in real time, by the patient, and is also pushed to the patient on a daily and weekly basis in the form of a smartphone notification. Assessment is also completed in person with the RWC at the beginning of every session. Finally, the assessment is designed to be iterative and past behaviors instruct future plans. This is enabled in the weekly coaching sessions whereby patients, with the support of their coach, draft their next week's goals based on how well they coped with the last week.

Consistent with the ideals outlined in Teaching for Understanding, MoDDAP is a practical program requiring patients to use what they know in the real world, in their real lives (Wiske, 1998).

It is important to note, however, that MoDDAP is ultimately patient-centered and therefore all evaluations are effectively self-assessments. The feedback systems as proposed by Nichol and Macfarlane-Dick (2006), contains elements such as requiring a standard definition of good performance, and so is not always appropriate here. However, elements such as promoting self-assessment and reflection in learning is very much the core of MoDDAP's assessment plan (Nichol & Macfarlane-Dick, 2006). In particular, successful goal setting requires the patient to not just execute on their goals, but to take the results of their attempt and reflect upon how to improve upon the process more generally in a sort of metacognition. MoDDAP encourages this type of reflection explicitly. The "journaling" function of the application prompts patients to record their reflections about the choices they are making or have just made, in real time. The beginning of every coaching session, devoted to reviewing the past week, is also an act of reflection. At the end of the MoDDAP, it is not a necessary condition for success that patients are completing their weekly goals in full. However, they do need to demonstrate proficiency in their performances of understanding as described previously. In MoDDAP, the true assessment is in gaining understanding of the concepts and of lesser importance, their practice. This is especially true considering the multiple strands in the web of skills patients must learn, practice and integrate; consistent, optimal proficiency is desired but unlikely to be achieved by the end of the program.

Critique

There are several limitations with MoDDAP as currently conceived, including addressing comorbidities, incorporating more stakeholders, the relatively short timeline, as well as accounting for dropouts and relapsed patients. MoDDAP has been designed to specifically target diet compliance for diabetes 2 treatment. However, comorbidities are common with sufferers, with one study showing that as many as 98% of patients have at least one comorbid condition and 89% have at least two (Iglay et al., 2016). The extremely high incidence of comorbidity means that it would be too restrictive to treat patients only suffering from diabetes, as that would eliminate nearly all sufferers. In addition, since the most common comorbidities such as hypertension and obesity, the bulk of which also have diet as a major component of treatment, it follows that MoDDAP will aid in the remedy of multiple underlying conditions. However, this may not be true depending on the specific combination of diseases. Finally, while the program intends to lower diabetes-related stress, it is not designed to care for the clinically depressed, who may need more hands-on therapies. It is unknown currently whether MoDDAP will benefit those with clinical levels of depression, and the program does not currently screen for it.

For simplicity in achieving a first prototype, only two parties are involved in MoDDAP as it is presently envisioned: the patient and the RWC. However, there is research to support that incorporating additional stakeholders may improve outcomes. This is especially relevant for reducing diabetes-related emotional distress because of its effect on patient relationships with friends and family, who may not understand the severity or burden of the disease. For this reason, some studies have concluded that interventions with ample peer support and multiple stakeholder inclusion, where friends and family, as well as social workers, and even other community members such as academics collaborate together, are successful (Kwan et al., 2017).

Researchers have been able to show improvement in depressive symptoms by using peer support and coaching programs (Khodneva et al., 2016). For future iterations of MoDDAP, adding peer support and including more shareholders is a desirable direction of development.

Thirdly, MoDDAP's 12-session timeline is not as long as what has been conducted in experiments involving human coaches. An effective mobile diabetes prevention program with human coaching assistance, for example, lasted 24 weeks (Michaelides et al., 2016). However, while the program lasted twice as long, the interaction was much lighter than the hour long weekly sessions currently proposed in MoDDAP. In fact, in the prevention program, human coaches communicated daily with the patients through text, but only briefly on the phone twice a month, a fraction of the 12 hours currently envisioned by MoDDAP (Michaelides et al., 2016). For comparison, a larger study on the impact of wellness coaching on motivation sponsored by one of the largest wellness coaching institutes in the world showed that 12 sessions was sufficient to improve motivational readiness for behavior change (Mettler et al., 2014). Schneider et al. (2011) also concluded that their year-long diabetes program should have been shorter because coaching is meant to be an accelerated and intensive process rather than a long and drawn out one. Based on results from the field following the first implementation of MoDDAP, I suggest that adjustment to the length and frequency as well as communication mode between the patient and the RWC should be considered for future cohorts.

A fourth vulnerability with MoDDAP is that as conceived, it currently has limited capabilities built in for addressing "relapse" or for treating patients who may have failed, even repeatedly, to adhere to their diet in the past. Intuitively, patients who have experienced repeated relapses behave differently from those who are embarking on their first attempt, and can be more

persistent as has been studied in the case of personalized smoking cessation programs (Balmford, Borland, Benda, 2008). Currently, MoDDAP ignores the prior experience of patients and does not distinguish between those who have failed once or more in their diet adherence or are attempting regimen compliance for the first time. It also does not take into account mid-program dropouts nor whether patients should be or are enrolling more than once. While the program anticipates relapse and actively incorporates it into the tapering off segment, more studies need to be done to determine whether or not MoDDAP should be offered again to patients who either did not complete it successfully or to those who do complete it but fail to demonstrate proficient performances of understanding anyway.

Conclusion

Type 2 diabetes is a chronic and potentially fatal condition affecting nearly half a billion people globally. Current conventional treatments focus on medical and pharmaceutical interventions while ignoring valuable lessons from psychological theory as well as empirical evidence from wellness coaches in the field. MoDDAP addresses this gap with a hybrid smartphone application and remote health coaching session program in a design that is informed by learnings from developmental psychology. The program focuses on strategies to help patients adopt behavior change and lower the disease-specific emotional distress that presently prevents many from complying with their difficult diet regimen. MoDDAP combines the inherent advantages in an always-on, automated software program as well as the deep emotional support provided by human coaches engaging in motivational interviewing for a personalized, patient-centered experience. As conceived, it is evidence-based, technology-enabled,

data-driven, and outcomes-oriented. I look forward to bringing MoDDAP to diabetes patients worldwide.

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