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HealtheLife: Using a Patient Portal App to Reduce Type 2 Diabetes in East Los Angeles - Pilot Program Proposal 2017- Capstone

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HealtheLife: Using a Patient Portal App to Reduce Type 2 Diabetes in East Los Angeles.

White Memorial Medical Center- Pilot Program Proposal

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HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

Executive Summary

The following proposal explores a potentially cost effective and cost efficient solution to alleviate the burden of type 2 diabetes among White Memorial Medical Center (WMMC) patients and their primary service area within Los Angeles County Service Planning Area 4 (SPA-4). SPA-4 is a medically underserved area with numerous key health indicators that indicate the need for increased self-management efforts among its Hispanic population. In response, WMMC has made a commitment to the SPA-4 community and made diabetes atop its community priority. An organization-wide Glycemic Control Project was created by WMMC administrators to provide more effective services by using Health Information Technology (HIT) within its operations. In support of this project, the WMMC Clinical Informatics Systems (CIS) department has proposed the use of Healthelife mobile application to improve diabetes self-management in WMMC transitional care. A literature review was conducted but, found very limited efficacy studies on mobile patient portal apps and patient portals mhealth interventions among Hispanic diabetics. However, several studies have implied that there are great research opportunities in tailoring the use of a patient portal mobile application for Hispanics, expanding its use within DMSE sessions through Community Health Workers, utilizing the trending mhealth functionality of patient portals, as well as proposing eHealth interventions that reduce health disparities. As a newly available resource to WMMC, the Healthelife mobile application is Cerner's multilingual patient portal mobile application that is already live and fully integrated with WMMC's "My Adventist Health" patient portal". Accordingly, WMMC CIS has proposed a HealtheLife pilot program among its Hispanic patients to determine if its use will improve self-management efficacy and glycemic control among WMMC Type 2 diabetics (18+ years old). Technological Acceptance Model (TAM), Social Support, and Social Cognitive Theory will be applied throughout the pilot to gradually condition Healthelife usage among WMMC patients/caregivers for tailored educational experiences that strengthen WMMC Diabetes Self-Management (DSME) sessions. Essentially, diabetes educators will conduct the pilot program on adult Hispanics (18+) who are inpatient diabetics transitioning to Adventist Health Physician Network (AHPN) Physicians and DSME outpatient services. Primarily, the pilot will aim to improve A1Cs, Self-efficacy, and DSME attendance. Secondary outcomes of the

intervention will be asses by qualitative assessment of Healthelife functionality, observed ED use, and ED readmission. All outcomes will be assessed through an internal quasi-experimental study examining an intervention group using Healthelife against a retrospective control groups from 2016. In sum, goal of the pilot program will set forth a care path that improve patients' continuity of care and diabetes prevention beyond the walls of WMMC operations. By adopting the use of Healthelife as a population health tool, WMMC has the potential to intensify current DSME curriculum, to preventative unnecessary ED use, and to improve type 2 diabetes prevention efforts within SPA-4. More importantly, the suggestion to pilot Healthelife progressively introduces the benefits of HIT to Hispanic populations who are underserved and with limited resources.

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

COMMUNITY ANALYSIS

Problem

In Los Angeles County, the prevalence of Type 2 diabetes among Hispanics is expected to increase 451% within the primary service area of White Memorial Medical Center by 2040 (WMMC 2016). Type 2 diabetes continues to increase in the general population and at a greater rate among Hispanic minorities than any other race or ethnicity (Gonzalez et al 2013/ CDPH 2017). As of 2016, Hispanics are still among the ethnicities significantly impacted within the 55% of Californians who have been diagnosed with diabetes, have pre-diabetes, or have undiagnosed diabetes (UCLA 2016).

Introduction

The physical and economic impacts of diabetes continue to effect Hispanics across California. For example, Californians with diabetes have had medical expenses 2.3 times higher than those who do not have diabetes (ADA 2015). The total of direct medical expenses for diagnosed, undiagnosed, prediabetes and gestational diabetes in California was $27.6 billion in 2012. In addition, $9.5 billion was accrued cost from lost productivity (ADA 2015). Type 2 diabetes is the most common form of diabetes that impacts 1.9 million adults in the state (CDPH 2017). Diabetes is a major risk factor of cardiovascular disease and stroke (CDPH 2017). Its effects are commonly associated with depression and is the leading cause of kidney failure, lower limb amputations, and adult onset of blindness (CDC 2016/ Chukweke et al 2010) Compared with non-Hispanic Whites, Hispanics have twice the prevalence of type 2 diabetes and are twice as likely to die from the disease (CDPH 2017). In Los Angeles County, the diabetic age-adjusted death rate is 24.3% per 100,000 (cdc.gov). And as of 2015, the period prevalence of diabetes among Latinos in Los Angeles County was 34% and accounted for the highest diabetic prevalence among all ethnicities (LACDPH 2015).

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

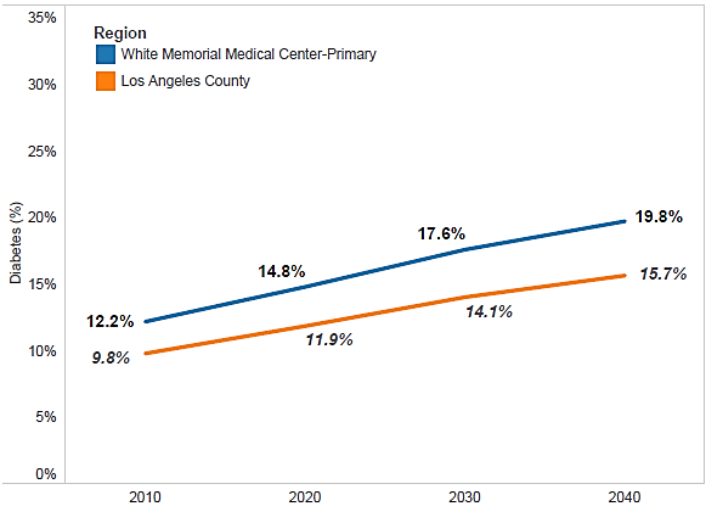
Some of the several causes of Type 2 diabetes among Hispanics are attributed to genetic, environmental, and social factors. For example, the risk of developing type 2 diabetes is associated with obesity, physical inactivity, family history, history of gestational diabetes, impaired glucose metabolism, age, and race/ethnicity (ADA 2013/ CDC 2014). The risk and prevalence of diabetes increases with age and is highest among Hispanics with low education attainment and/or low family income (CDPH 2017/ Schniederman et al 2014). In addition, lack of access to preventative healthcare, lack of health insurance, and English proficiency are also common causes of the disease. (Gonzalez et al 2013/ Mansyur et al 2016) Diabetic prevalence among Hispanics is also attributed to complexities rooted in Hispanic culture (Mansyura et al 2016 / Lopez et al 2016). Mythic health beliefs such as the misconception of insulin as a contributor to blindness are common factors in its impact (Campos, 2007WMMC KII/). Cultural competency to Hispanic values such as simpatia, personalisimo, respeto, familisimo, and fatalisimo effect how diabetes is conceptualized and managed between patients and providers (Camps 2007). Termed as acculturation, the process in which an immigrant culture adopts the beliefs and practices of a host culture also contribute to type 2 prevalence (Lopez et al 2016). Higher levels of acculturation have been negatively associated with poor dieting and sedentary behavior yet, acculturation has been positively beneficial to Hispanic education and wealth (Lopez et al 2016, Lara et al 2005).

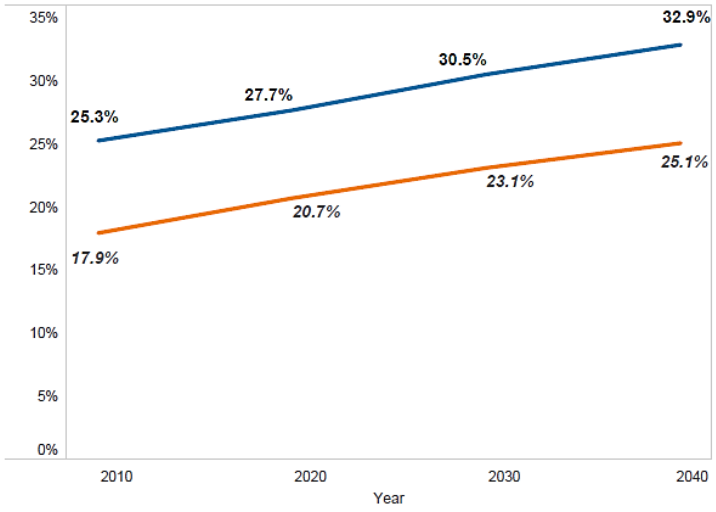
Proper management of Type 2 diabetes can be achieved by promoting lifestyle change and providing interventions that take a more active role in self-management such as Diabetes Self-Management Education (DSME) courses. The fundamentals of self-management and treatment of diabetes includes monitoring glucose levels, diet, exercise, insulin, and/or oral medication. Self-management interventions and patient activation have been advantageous to those suffering from the disease (ADA 2017). Systematic reviews show that self-management programs have been associate with reductions in A1Cs of about .81%(Chodosh et al 2005) Patient activation has been also associated with reductions in HbA1c, systolic blood pressure, body weight, and low-density lipoprotein cholesterol in adults (Bolen et al 2014) A specific approach that teaches the fundamentals of self-management with positive health outcomes are DSME courses (Tshiananga et al 2012). Nurse-led DSME

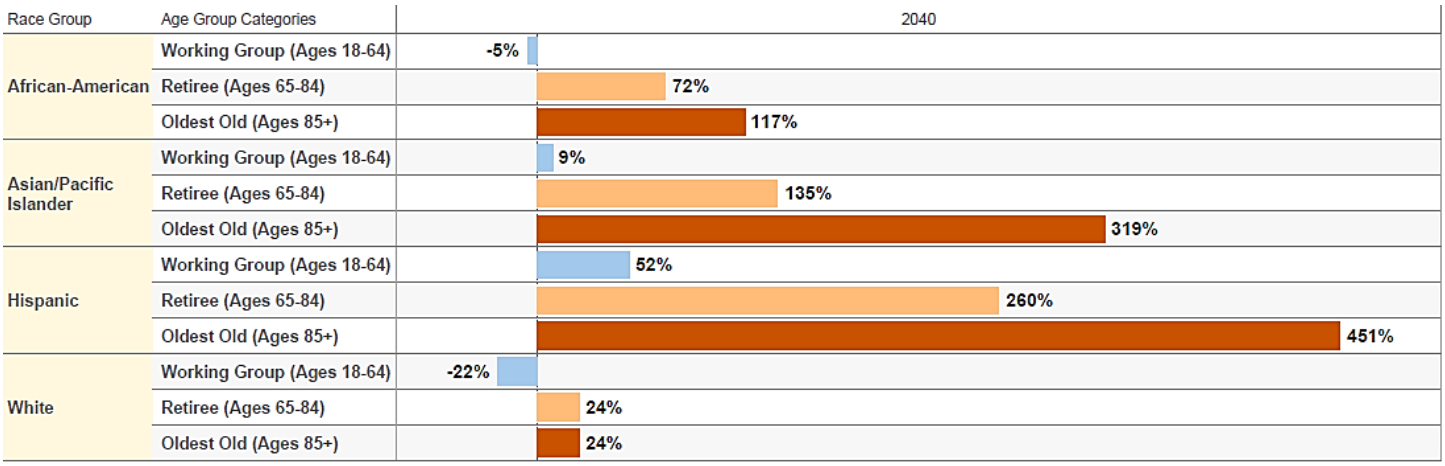
has been associated with average -.7% reductions to HbA1Cs in patients with Type 2 diabetes. (Tshinanga et al 2012). Diabetes Self-management education led by registered dieticians have also been associated with lowered HbA1cs >.7% (Huang et al 2010). Conducting individual DSME education sessions have proven to also be more effective than group DSME sessions and usual care by improving glycemic control in 6-7months (Sperl-Hillen 2011). Self-management education has been effective in improving diabetes knowledge and management in the less than 6 month (Norris et al 2001). However, among Latinos, DSEM education has been associated with changes in HbA1C as early as 4 months in addition to improved self-efficacy, blood glucose monitoring, and diet (Rosal et al 2011).

With the current adult prevalence in LA County SPA-4 reaching 11.6%, trending health indicators reflect a major public health need to promote the self-management type 2 diabetes. (LACDPH 2017-KIH). Los Angeles Service Planning Area -4 is a medically underserved area of Los Angeles County with several key health indicators that contribute to the current adult prevalence of diabetes in Hispanics (LA COUNTY KHI Stats / WMMC Community Assessment). For instance, 56.31% of Hispanic adults 25 years+ living in SPA 4 do not have a high school diploma (US Census Bureau 2014). Hispanics and Latinos experience the highest rates of poverty as 30.7% are living below 100% of the federal poverty level (US Census Bureau 2014) Median household incomes in SPA-4 range between $12, 000 and $43,000 (WMMC 2017). 32% of households with incomes <300% below the federal poverty level are food insecure (WMMC 2017). Only 16% of adults have reported to eat five or more servings of fruits and vegetables a day (LACDPH 2017). 30% of adults and 35% of adults say that they drink at least one can of soda per day (LACDPH 2017). Access to healthcare within SPA 4 have fallen below “Healthy People 2020” standards as 77% of individuals have regular access to care (WMMC 2017). Furthermore, current projections indicate that Type 2 diabetes prevalence will increase 116% among all races/ ethnicities in SPA-4 between 2010- 2040. (UCLA 2015/ WMMC 2017). Hispanics will see the largest increase of 451% in type 2 diabetic prevalence by 2040 (UCLA 2015/ WMMC 2017). Therefore, the intension

of this proposal is to explore an innovative method to enhance diabetic self-management within the SPA-4 community of WMMC in a cost-effective and cost-efficient manner.







BACKGROUND

White Memorial Medical Center (WMMC) has been a community staple of SPA 4, working to improve the population health status of Hispanic diabetics through numerous services. For example, WMMC Diabetes Center provides bilingual services in Diabetes Self-Management Education, Gestational Education, as well as Bedside consultation. All services are taught by Hispanic registered nurses and registered dieticians who work together to assist community members in navigating through their care path as well as adhere to preventative

behavior changes (WMMC 2017). Through the diabetes center, 1,062 encounters provided community outreach and educational programs for local diabetics recently diagnosed and at-risk (WMMC). WMMC also provided 1,167 free glucose screenings for those that might be at risk for diabetes during Diabetes Alert Day, National Diabetes Awareness Month, and health fair screenings for juvenile diabetes, and through community participation in the Type 1 Diabetes TrialNet Clinical Trial Program (WMMC 2017). Through the Community Information Center, Diabetes Program and Dietary Program, educational courses are offer promote healthy living among the 7,165 members of the underserved community (WMMC 2017). Also In 2015, The Center for Limb Preservation & Advanced Wound Care at WMMC was opened offering a unique, multidisciplinary, cutting-edge approach for patients at high risk for foot and leg amputation along with advanced outpatient treatment for non-healing foot or lower extremity wounds (WMMC 2017).

Given that 87% of WMMC's patient population are Hispanic and live within SPA 4, (Metro) (WMMC 2016) recent operational statistics indicate that self-management efforts should continue to be among the community's priorities. In 2016, WMMC experienced the highest amount of diabetes cases it has had in 5 years. 500 cases of Diabetes Mellitus were treated at WMMC with 61% of WMMC diabetic inpatient cases occurring among people 40-79 years of age, 31% occurring among people 0-39 years, and 8% among those 80+ years of age (Premier 2017). That same year, WMMC also experienced a diabetic mortality rate of 40% and a diabetic readmission rate of 8.26%. Of those 500 cases, 70% were admitted through Emergency Room at an average cost of $16,613 per case with 8.9% of those ED diabetics readmitting (Premier 2017). As a result, WMMC's team of providers have continue to apportion a significant amount of their resources to the treatment and prevention of this chronic condition. Recently released WMMC Community Needs Assessment has identified diabetes prevention and treatment as one of the 3 major priorities within the WMMC's 2017-2019 Community Health Plan (WMMC 2017). Their goal is to "Eliminate preventable disease in our community including Diabetes, Cancer, Stroke, Heart Disease, and others." (WMMC 2017) But more specifically, they intend to do

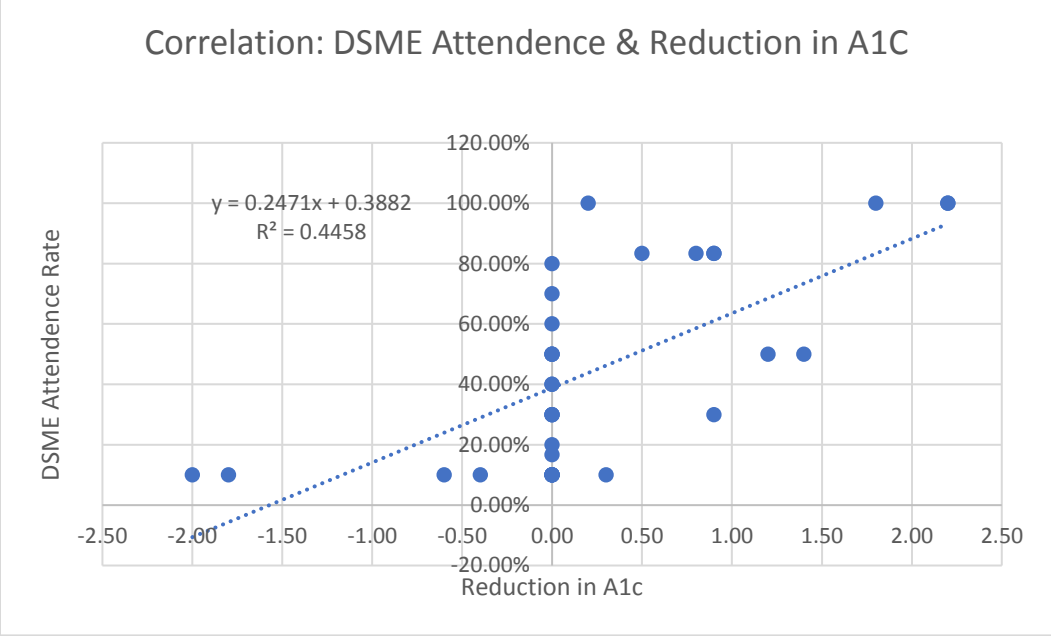
so by, “increasing prevention of diabetes and support diabetes education treatment” and “increasing awareness of health principals and preventative measures to chronic diseases.” (WMMC 2016)

WMMC Glycemic Control Efforts

Currently, WMMC has created a Glycemic Control Project that is looking to better utilize Health Information Technologies (HIT) to improve their glycemic control targets among its predominantly Hispanic patient population (WMM KII). WMMC has taken a multi-disciplinary approach in which several departments are taking ownership for specific roles towards glycemic control efforts. For instance, inpatient improvements to the treatment of adverse glycemic events are being led by the WMMC inpatient pharmacy and medical team. By potentially incorporating the use of Pharmaceutical HIT tools, WMMC clinicians are aiming to reduce times in achieving inpatient glycemic control (WMMC KII). In a previous in-house study conducted on WMMC hyperglycemic (n=35) and hypoglycemic patients (n=15), our inpatient pharmacy found that the average A1c levels of hyperglycemic inpatients were 9.3 (non-ICU)/9.0 (ICU) while hypoglycemic patients were measured at 7.7 (Ngyuen 2015). Patients’ stays averaged between 6.5 days among non-icu and 5.4 days among ICU. The average number of days’ hyperglycemic patients had blood glucose > 200mg/dl was 4.9 (non-ICU) and 3.3 (ICU). In 2016, the average time an inpatient was in range of suffering severe hypoglycemia was 1.65 hours, 2.48 hours for severe hyperglycemia, 12.60 hours for hypoglycemia, and 5.20 hours for hyperglycemia (Tableau 2017). As a result, our inpatient pharmacy and medical staff have explored the use of computerized insulin management systems such as Gluco-commander and Endo-tool to help reduce these times (WMMC KII).

For transitional care and outpatient services, WMMC Endocrinologists, diabetes educators and health navigators have been asked to improve self-management and educational efforts for optimal outcomes within WMMC Glycemic Control Project (WMMC KII). Currently, WMMC educators and endocrinologists have

found it difficult to encourage patients to comply with treatment plans and their educational appointments (WMMC KII). WMMC DSME courses are offered as an outpatient service to the local community and as follow up to inpatient care. WMMC DSME courses are composed of individual session that touch on glucose monitoring, medication, physical fitness, nutrition, and emotional support. (WMMC KII). Individual session are the only form of WMMC courses offered. Currently, they have been effective but show room to improve in A1C reduction and attendance. In 2016, patients (mean=59 years) entered DSME programs with a mean HbA1c of 9.49% with and average reduction of .27% and an average attendance rate of 45.00%.



x-axis = reduction in A1c, y-axis= % of DSME completed

Since the current goals of the Diabetes Center are to reduce patients' A1Cs to 7% with one comorbidity and 8% with more than one comorbidity, the significantly positive relationship between the average reduction in A1c and the average attendance rate of DSMEs (n= 34, r=.6676, p-value .00000160) reveal a need to intensify their DSME approach (WMMC KII).). Like the inpatient pharmacy, WMMC Diabetes Center and Endocrinologists have been also being seeking ways to improve patient self-management and educational curriculum through HIT approaches (WMMC KII). Recently they've turned to HIT tools to assist the task of

glycemic control (WMMC KII). In recent years, WMMC educator have notice more frequent use of cell phones among their elderly patients (WMMC KII). In response, WMMC diabetes educators have occasionally suggested mobile apps such as One Drop and Calorie King (WMMC KII). Correlatively, the WMMC Clinical Informatics (CIS) has been tasked to research online tools and applications that can enhance patient engagement while supporting the numerous department roles within the glycemic control project.

Literature Review

Since, common factors such as obesity, lack of treatment compliance, medication adherence, cultural beliefs, and low health literacy drive the burden of diabetes among adult Hispanics within this area; the WMMC Clinical Informatics department has identified the use of Cerner's HealtheLife patient portal mobile application as a potentially cost-efficient/effective population health tool to support the Glycemic Control Project efforts (Schillinger et al 2002, Nwasuruba et al 2009, LACDPH 2017, Lopez 2016).With the transition of healthcare moving towards patient-centered and value-based care, patient portals have been nationally integrated into numerous health systems to improve patient engagement and health outcomes (HIMSS 2014). Through the HITECH ACT of 2009 patient portals were leveraged into the healthcare system by requiring health care providers to offer medical record access to their patients as part of Meaningful Use Stage 2 core objectives (HIMSS 2014).

Stage 2 Meaningful Use: 17 Core Objectives

1. Use computerized provider order entry (CPOE) for medication, laboratory and radiology orders	10. Incorporate clinical lab-test results into Certified EHR Technology
2. Generate and transmit permissible prescriptions electronically (eRx)	11. Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research, or outreach
3. Record demographic information	12. Use clinically relevant information to identify patients who should receive reminders for preventive/follow-up care
4. Record and chart changes in vital signs	13. Use certified EHR technology to identify patient-specific education resources
5. Record smoking status for patients 13 years old or older	14. Perform medication reconciliation
6. Use clinical decision support to improve performance on high-priority health conditions	15. Provide summary of care record for each transition of care or referral
7. Provide patients the ability to view online, download and transmit their health information	16. Submit electronic data to immunization registries
8. Provide clinical summaries for patients for each office visit	17. Use secure electronic messaging to communicate with patients on relevant health information
9. Protect electronic health information created or maintained by Certified EHR Technology	

*HIMSS 2014

Using these web-based accounts, patients are given the ability to improve their self-management and health related decisions by improving engagement with their medical history, laboratory results, medications, and educational health tips (HIMSS 2014). Patients are also offered supplementary portal features such as EMR downloads, medication refills, direct provider/patient communications, and appointment reminders. In limited instances, the use of patient portals has provided positive health outcomes when addressing diabetes in a multi-disciplinary care team (Brown et al 2011) Simultaneously, the use of mhealth applications has been a developing approach to address diabetes treatment and self-management with clinical significance (Wu et al 2017).

With the recent availability of Healthelife patient portal mobile app, a literature review was conducted but, found very limited efficacy studies on the use of mobile patient portal apps and patient portals as mhealth interventions among Hispanic diabetics. However, the following studies provided central guidance to the appropriate use of patient portal apps as an innovative self-management tool to achieve optimal health outcomes among Hispanic type 2 diabetics patients.

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

I. Consumer Mobile Health Apps: Current State, Barriers, and Future Directions

Conducted in 2017, Kao et al's qualitative study was a quintessential report on the current state of all mhealth applications available for provider and patient use today. Currently there are more than 165,000 mobile applications available in all the major health stores. Mhealth applications have been held in high regard within the healthcare industry as a potentially cost efficient way to provide around the clock care to end users while improving compliance with treatment protocols via behavioral change models. Yet, because the mhealth application market is new, Kao's report highlighted the actual landscape of mhealth and future directions of the field.

According to Kao, consumer facing mhealth applications are segmented into six major categories: *Wellness management, Chronic disease management, self-diagnosis, medication reminder, electronic patient portal, and physical medicine/rehabilitation*. *Wellness* applications are those which monitor diet and physical activity to encourage lifestyle modification. They usually have connectivity to external devices that collect a variety of data from blood pressure, weight, heart rate, and physical activity. However, numerous studies have indicated that these apps have had a lack of controlled trials and a lacked involvement of health experts in their developments. *Chronic disease management* applications track the symptoms of specific diseases and provide reminders to help and guide self-management. For instance, diabetes apps remind patients to check blood sugar, guide the proper levels of insulin, track weight, track diets, and track medication adherence. *Self-diagnosis* apps allow patients to make avoidable trips to a provider. Despite risks of self-diagnosing complex conditions, the apps have been part of a growing market allowing patients to avoid unnecessary medical visits. Some allow patients to select their symptoms from a symptom checklist to generate all possible diagnosis or prompts to seek immediate medical attention.

Table 1
Examples of consumer mHealth apps*

Category	Example App	Description and Functions
Wellness management	Calorie counter and diet tracker [12]	The app allows consumers to track keep track of diets and exercises and manage their weights. • Allow patients to enter personal food and exercise diaries • Contain a substantial food database that allows barcode scanning for quick and accurate entries of food • Provide daily personalized advice towards the goal set by the consumers • Leverage social network to increase motivation for adherence
Disease management	BlueStar diabetes [13]	The app gives patients with type 2 diabetes a guided plan to help manage their glucose levels. • Prescription-only • Allow patients to log their glucose levels at home • Provide instructions for hyperglycemia and hypoglycemia events • Allow patients to enter their food diaries • Allow patients to share the report with prescribers
	AsthmaMD [14]	The app allows patients with asthma to keep track of their peak flows and symptoms and provides an action plan during asthma attacks. • Remind patients to use inhalers as scheduled • Allow patients to log their peak flow measurements and symptoms with date/time and triggers • Provide an action plan with instructions during asthma attacks • Gather anonymous data for researchers to better correlate asthma with environmental factors, triggers, and climate change
Self-diagnosis	WebMD [15]	The app provides a symptom checker that serves as a basic patient self-diagnosis tool. • Allow patients to enter their symptom characteristics and then generate a list of possible diagnoses sorted by probability • Provide patient education information for each possible condition • Advise patients to seek emergency medical attention if warning symptoms are entered • Provide a substantial database of patient education materials regarding diseases and medications on demand
Medication reminder	MediSafe [16]	The app functions as a digital pillbox that allows patients to manage their medications effectively. • Allow patients to enter their current medications' dosage, frequency, and amount • Remind patients to take the medication based on the schedule • Remind patients for medication refills • Allow patients to enter medication diaries to document drug responses and side effects
Electronic patient portal	Epic MyChart [17] Cerner HealtheLife [18]	The apps allow patients to access a portion of their medical records and also serve as a communication tool between providers and patients. • Allow patients to view laboratory results, imaging studies, current medications, and upcoming appointments • Allow patients to send messages to their providers for acute issues, unresolved symptoms, or medication refills • Allow providers to send reminders of preventive screening tests or vaccinations to patients
Physical medicine and rehabilitation	Patient Pal Pro [19]	The app allows physical medicine and rehabilitation providers and therapists to prescribe home physical exercises to patients. • Prescription-only • Provide pictures, descriptions, and videos to demonstrate each exercise • Remind patients to do the exercises based on their therapy schedule • Allow patients to record their exercises and send to their providers • Allow patients to keep track of their progress • Collect direct patient feedback regarding pain and difficulty during the therapy

Medication reminder apps enable patients to enter medications manually or by scanning prescription barcodes to populate a visual medication calendar which prompts push notifications when patients are due for dosages. *Electronic patient portal* apps provide similar access to patient portals which allow patients to access a portion of their medical records, including laboratory results, imaging studies, current medications, and upcoming appointments. They also serve as a 2-way communication tools between providers and patients to refill medication, send reminders, and schedule appointments. Physical rehabilitation apps monitor the efficacy of home exercises, collect patient reported measures, provide motivational health messages, and provide feedback pertaining to posture and body mechanics. Together, all six of these major categories are experiencing

a growing trend in use but the most popular and widely used apps are wellness management applications and disease management applications.

In relation to electronic patient portal apps, Kao sets forth the future of consumer facing mhealth apps by highlighting the barriers and trajectory of their use. Kao indicated there are still barriers in loose data security regulations and lack of consensus in best practices standards/ certification. Despite growing number of positive outcomes using wellness and disease management apps to address obesity and type 2 diabetes, evidence based literature is still lacking to support wider app use among clinicians and healthcare providers. This inadvertently provides opportunity for clinicians and healthcare providers to explore innovative ways to increase functionality and connectivity among diverse populations as well as other mobile app categories such as patient portal apps. For instance, mhealth apps are extending its development across major EHRs like Cerner and Epic. The steady integration of mobile health information into health systems and the increasing use of mobile clouds for improved interoperability and health information exchanging are also other trending developments. In addition, the act of prescribing applications is trending and aimed to improve of physician/patient engagement in all categories of apps. Essentially, Kao's examination of apps indicated that there are still very large gaps in research that must be establish. Although limited studies have been done to prove the efficacy of mhealth application on diabetes within Wellness Applications and Disease Management applications, the efficacy of patient portal mobile applications have yet to yield studies specific to any ethnic diabetic population. Patient portal mobile apps are still maturing in interoperability and clinical recognition.

II. Mobile App-Based Interventions to Support Diabetes Self-Management: A Systematic Review of Randomized Controlled Trials to Identify Functions Associated with Glycemic Efficacy

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

In 2017, Wu et al researchers conducted a systematic review to assess their glycemic efficacy of mobile application interventions, develop a taxonomy of apps for diabetic self-management, and explore the contribution of different functions to the effectiveness of the entire application intervention. They selected studies within MEDLINE, Cochrane Library, and EMBASE that were conducted between January 2007 and May 30, 2016. The researchers selected Randomized Control trials RCTs which compared mhealth application interventions with control groups using usual care among adult outpatients with diabetes. The inclusion criteria of the studies contained primary outcomes with changes in HbA1C and secondary outcomes with severe hypoglycemia or any related adverse events. They excluded were studies conducted on gestational patients, children, adolescents, therapeutic strategies for stricter glycemic control, apps using continuous glucose monitoring, interventions without real-time interactions, and those without HbA1c readings. The search produced 12 studies via 2 independent reviewers.

After creating the taxonomy of mobile applications, Wu's study emphasized that the use of mobile application interventions was associated with a clinically significant HbA_{1c} reduction of 0.48% (95% CI 0.19% 0.77%, I^2=83%, P<.001) compared with standard care alone. Post hoc exploratory analysis of trials with type 1 diabetes and type 2 diabetes indicted that no statistical significances was achieved among type 1 patients (MD 0.36%, 95% CI 0.08%-0.81%, I^2=88%, P<.001). However, larger reductions were observed among type 2 diabetes patients (MD 0.67%, 95% CI 0.30%-1.03%, I^2=47%, P=.11). With specificity to features within app based interventions, greater HbA1cs were noted in interventions with a complication prevention modules (with complication prevention: MD 1.31%, 95% CI 0.66%-1.96%, I^2=0%, P=.84 vs without: MD 0.38%, 95% CI 0.09%-0.67%, I^2=83%, P<.001; test for subgroup difference P=.01). Having structured displays were also associated with larger reductions in HbA1c (with structured display: MD 0.69%, 95% CI 0.32%-1.06%, I^2=63%, P=.008 vs without: MD 0.16%, 95% CI –0.16% to 0.48%, I^2=78%, P=.003; test for subgroup difference P=.03). For high-risk interventions with a clinical decision-making function, the reduction of HbA_{1c} was 0.18% (95% CI 0.21%-0.56%, I^2=83%, P=.003), while the reduction was 0.61% (95% CI 0.27%-

0.95%, I^2=64%, P=.005) for potential-risk interventions without clinical decision making (test for subgroup difference P=.10). Having a lifestyle modification and educational module within the interventions also trended towards reduced HbA1c. Conversely, interventions with manual entry features showed lower HbA1c without statistical significance (wire connection: MD 0.70%, 95% CI 0.33%-1.07% vs wireless connection: MD 0.53% CI 0.15%-0.92%, I^2=46%, P=.10 vs manual entry: MD 0.36%, 95% CI 0.08%-0.81%, I^2=88%, P<.001; test for subgroup difference P=.51). Results also showed limited efficacy with the use of personalized feedback and further evaluation must be conducted in future research.

Although no mobile patient portal interventions were included in the review, Wu's study bolstered the efficacy of mobile application interventions on type 2 diabetics. It provided strong quantifiable measurements for support among outpatients and clinically significant reductions in A1cs. It also highlighted updated suggestions that should be considered when using application features within a patient portal app intervention. For instance, including a structured display, a complications prevention module, a lifestyle modification module, and an educational module may intensify mhealth interventions for lowered HbA1cs. Sub analysis and associations across race/ethnicity, age, and socioeconomic status were gaps in data provided within the study. But like previous literature, lack of patient portal use within the interventions presents opportunities for future research and app innovation to more specific populations.

III. Use of Online Patient Portal and Glucose Control in Primary Care Patients with Diabetes.

Devkota et al explored the association of patient portal access with lowered of HbA1C levels among primary care patients diagnosed with type 2 diabetes. Engagement with patient portals were assessed by indicating whether patients were nonusers, active readers, or readers and writers of emails within the patient portals. Devkota's retrospective cohort study examined 1510 patients from the Department of Family Care and

Primary Care Patient Care Data Registry. Devkota selected this study design to overcome randomized control trial biases the recruitment of more educated individuals who are likely to better manage their health. From January 1, 2010 – July 31, 2013, patients were registered into a patient portal that enabled access to their medical records, lab results, diagnosis, medications, mediation refills, appointments, and patient/provider emails. The participants accessed their Patient Portal by either web-browser or mobile phone application and health education tips appeared based on EHR data. The researcher identified smoking, demographics, healthcare utilization, and comorbidities as potential confounders to patient portal effects on A1c levels using ICD-9 codes. Devkota et al also used ICD 9 codes to identify eligible participants that were diagnosed with type 2 diabetes. They also included patients in the study if they had at least one visit with a documented HbA1C values. Researchers also conducted a chi squared test to determine the associations between email use (nonuser, reader, reader & writer) and covariates. In addition, Devkota assessed the intervention's group effects on A1c levels at a 95% confidence interval by using linear models and odds ratios.

As a result, Devkota's indicated that 73% of participants were non-users of emails within the portal, 6% were readers, and 21% were readers and writers. On average, researchers found that older patients (mean age= 62) were composed of the non-users group, most of the reader category were younger patients (mean age= 58), and most of reader and writers within the portal were the youngest patients. Devkota also found that high healthcare utilizers were mainly reader/writers. They also found that comorbidities (Hypertension, obesity, vascular disease) were more common among non-users as opposed to readers and writers. Additionally, comorbidities were also associated with email usage. Devkota also stated that patients who were nonusers had significantly higher A1c values than reader and reader/writers. In unadjusted models, researchers discovered that patients who read/write emails within the or portals had significantly less A1c levels than non-users. After adjusting for demographics, health services utilization, and comorbid conditions, compared to nonusers, they also indicated that patients who read/wrote e-mails still had on average significantly ($p< 0.001$) lower average HbA1c values (ß= - 0.455; 95% CI: -0.63–-0.28). When analyzing readers with non-users, researchers found

similar results. The highest percentage of patients with controlled HbA1c were among readers/writers while the lowest percentage were from non-users. Moreover, Devkota also indicated that the odds of controlling HbA1c levels were also associated with email use as reader/writers and that readers (only) were significantly more likely to have controlled HbA1c levels than non-users. Lastly, researchers found similar results after adjusting for demographics, comorbidities, health utilization and smoking.

Although Devkota found that patient portal usage was significant in lowering HbA1c levels with active and passive reading of email, they provided a rare glimpse into the potential effectiveness of patient portal app use. They addressed the usefulness of the current messaging features within patient portals and their complimenting apps. However, the researchers did not identify the efficacy patient portals had on specific races/ethnicities and only specified "non-white" as a population examined. Also, researchers did not study the intensity of email usage. In addition, Devkota et al made no adjustments to show any association between type of portal access (mobile application vs. web-based) among race/ ethnicity, and socioeconomic status. In retrospect, it would have been more insightful for researchers to identifying its use within Hispanic populations. Devkota validated Kao's previous claim that mhealth apps have been producing positive outcomes related diabetes. However, there is still a lacking amount of supportive literature. Nevertheless, this study is of much importance to patient portal development since this was one of the only quantitative studies indicating efficacy, ethnicity, and patient portal mobile app use to lower HbA1Cs.

IV. Refilling medications through an online patient portal: consistent improvements in adherence across racial/ethnic groups

Lyles et al's 2016 study examined the use of medication refill features within patient portals to determine if statin adherence was equally observed between racial/ ethnic minorities and whites. Addressing the postulations of "inverse case law", which stipulates that healthcare interventions disproportionately benefits

patients with most resources, Lyles examined whether different racial/ethnic groups experienced greater of lesser benefits from using medication refill feature within patient portals. Lyle's retrospective cohort study was conducted among Type 2 diabetic patients from Kaiser Permanents diabetes patient registry between 2006 and 2012. Researchers selected patients who were prescribed statins (HMG-CoA (3-hydroxy-3-methyl-glutaryl-CoA reductase) and patients who were ongoing portal users. They categorized dose relationships into two groups: 1. patients initiating refill exclusively online and 2. Patients initiating refills at least one online. Lyles then compared people who used the refill functions of the portal and people who did not use the refill function but used other functions. Lyles also measured medication adherence by conducting a pre-test and post-test of time without medication among the various groups. Then she examined the difference in time among the exposed groups while the reference group provided a background for temporal change in statin adherence. Lyles also categorized race/ethnicity as either, white/ non-Hispanic, black/ non-Hispanic, Latino, Asian, Filipino, and Other. She specified age, gender, number of chronic conditions, number of log ins into portal and number of outpatient visits as covariates from baseline to 12-month period. Lyles also conducted her analysis by using a chi squared test to determining whether racial or ethnic make-up of portal users differed from overall diabetes registry. Chi squared and t-tests were also used to point out Racial/ Ethnic differences in refill function use and statin adherence among portal users. In addition, Lyles also examined Pre-post changes in statin adherence by race via paired t-tests. Yet when Lyles conducted adjusted analysis, she used difference-in differences framework to examine changes in statin adherence among those who exclusively used online refills and those who occasionally refilled online after subtracting background changes observed among the reference group. She calculated these differences by least suqred regression models. Lastly, Lyles compared the difference-in-differences estimator of the refill function across racial and ethnic groups to determine if the use of the refill function on medication adherence differed by race/ethnicity.

As a result, researchers indicated that the average age of individuals was 63 year of age who had an average of 6.7 medications and 11.4 outpatient visits per year. They found that race and ethnicity distribution was 58%

white, 10% Asian, 9$ Latino, 9% Filipino, 7% Black, and 9% Other. Online refill tendencies were conducted among those who were younger, those who utilized high number of medications, and those who had a high number of portal log-ins. At baseline, Lyles et al also stated that the average percentage of time a patient was without statin was 12.9%. Whites had the lowest percentage time without a supply of statins (11.8%), and all other racial/ethnic groups had worse baseline adherence (Blacks.15.7%, Asians.13.1%, Filipinos.13.4%, Latinos.15.7%, and Other.14.2%; all P<.01). When researchers examined unadjusted changes in adherence, all race/ethnicities among the occasional refill group saw a decrease in time without statin with statistical significance among whites only. Among people who exclusively refilled their medications online, significant decrease in time without statin across races all race (Whites 3.2%, Asians 5.1%, Filipinos 3.9% , Latinos 5.6%, and Mixed/Other/Unknown 3.0%, and Blacks 3.7%.) When Lyles et al adjusted changes in time without statin, there was significant decreases in time across race except for "Other/Mixed". They discovered that the greatest decrease among adjusted changes occurred among Latinos (6.1%) who exclusively refilled their medication online. However, they only found statistically significant improvement among those occasionally refiling online occurred among whites.

In all, Lyles et al's study indicated that medication refill functions may improve medication adherence. They found that populations that were most engaged with the medication refill function received the best benefits of the feature. They also stipulated that, if Latinos can be fully engaged with this feature, there may be a possibility of improved statin adherence among their diabetic population. However, researchers did not indicate whether online refill feature may be effective to medically adhere to other medications. Also, Lyles only examined patients who were already users of the patient portal. Thus, their study only reflected the effect of patients who were already willing to act upon their behavior change. In addition, they provided that lower patient portal registration among different racial and ethnic minority groups persisted. This means that there are still numerous factors that must be considered when engaging minorities registering for patient portal use. Lyle's also did not mention patient populations that are of lower socioeconomic statuses, lower health literacy,

as well as lower education. The use of mobile applications was not mentioned. This approach to medication adherence via patient portal may not be equally effective within another health service organization and its respective patient population. But, Lyles provided evidence that medication adherence within portal use was possible among Latinos.

V. Patient portals and health apps: Pitfalls, promises, and what one might learn from the other

Baldwin et al's 2017 report focused on the emergence of patient portals and its potential to achieve greater capabilities of patient engagement through the adoption of mhealth application characteristics. Baldwin reported that more patient-centered consideration to portal design should be considered. According to their researchers, Patient facing HIT tools are emerging with the rise of mhealth applications. Concurrently, patient portals have varied in its adoption among healthcare systems. From Athena health to Kaiser Permanente national patient portal adoption has ranged between 25% and 73%. However, various health organizations do not track portal utilization beyond initial portal registration. Thus, Baldwin et al highlighted that the true potential of patient portals in patient engagement has been limited.

Baldwin's exploration of portals and applications specified pitfalls and promises within the current state of each product. For example, although patient portals provide valuable access to a patients' health information, portal design and user-friendliness have been pertinent issues regarding adoption and improvements to patient centered care. Baldwin specified that patient portals need to include more educational components to its design and potentially including why certain lab test are important, what the interpretations of the results are, and what next steps should be taken. They also mentioned that patient portals could also benefit by including mobile app features that would allow a patient to record physical activity, diet, sleep, and disease specific data. Baldwin et al also stated that condition specific apps may improve health outcomes. They indicated that academic literature

has been suggestive that personal health records and institutionally generated health data should be incorporated into health apps to personalize increased use of more accurate data. However, poor regulation, lack of HIPPA compliance, compromised accuracy of data collected, and utilization adherence are barriers that hinder improved app usage.

Baldwin's study also compared the various features of portals and apps. By using the eight dimensions of the socio-technical lens, Baldwin established the attributes of patient portals and mobile applications that may lend well to each other.

Table 1
Comparison of patient portals and health apps on eight socio-technical dimensions.

Dimension	Patient Portals	Health Applications
Hardware and Software	• Accessible via computers, smart phones, and tablets • Data is entered in system by labs and physicians	• Accessible via computers, smart phones, and tablets • Data is entered by consumers and imported via tracking devices
Clinical Content	• Patients can access their personal health information (i.e., test results, immunizations) • Direct Messaging with physician and health care team • Contain medical terminology and acronyms that are unfamiliar to most patients[40]	• Consumers can enter health information • Data taken/entered in real-time • Data is taken in from the tracking devices (i.e., the accelerometer in the iPhone) • Generally no access to test results from physician • No communication access to physician or health care team
Human-Computer Interface	• Accessible from the web and smartphones • Information is not always displayed in an understandable way, specifically test results • Outdated user interface design	• Simple to access, use, and navigate • Information is often displayed in a way consumers without comprehensive medical knowledge can understand • Up-to-date, simple user interface design
People	• Aim to connect patients to information from health care system	• Consumers can often connect and compete with other patients
Workflow and Communication	• Patients sign up through their doctor's office • Patient password reset issues (e.g., in recent interviews, patients have complained about being "locked" out of their portal)	• Consumers download the app and create their own account • Consumers' activities are passively tracked, reducing data entry • Consumers have easy access to their data anytime, anywhere
Internal organizational policies, procedures, culture, and environment	• Subject to an organization's internal policies and procedures, which often create barriers to use (e.g., difficult sign-up procedures; reluctance of clinicians to participate in un-compensated work)	• Currently subject to very little internal or external oversight (e.g., App developers can "sell" patient data) • Culture is "move fast, fix problems later" • Some have been found to sacrifice quality or safety in the pursuit of functionality[22]
External Rules, Regulations, Pressures	• Must be HIPAA compliant • Must meet the legal and confidentiality needs of adolescents[41]	• HIPAA compliance under review • Accessible to anyone with a smartphone • Constantly evolving smartphone operating system requirements
System Measurement and Monitoring	• Few organizations monitor or measure how patient portal information is being used • Lack of real-time notifications and alerts to patients	• Consumers use apps to monitor their own health • Depending on the app, different alerts are sent to the consumer's phone

In turn, she argued that better patient portals can be achieved by adopting numerous features of mhealth apps. She advanced this point and said that portals should provide health information according to the patient population's literacy. Information should also be easy to understand. She also stated that push notifications

mechanizing access to educational materials would be beneficial to addressing specific conditions. Increased patient portal use should also incorporate innovative and user friendly designs by providing an mhealth app form of the portal, creating easy log-in access, simplifying data displays, including alerts notifications, and creating educational prompts for patients to seek additional care. She further her position and stated that the demand for improved usability and design will be needed as value based and patient centered care policies continue to grow. Internal health care policies within organizations will also change in accordance to external policies. Baldwin believed that continued iterative testing of portal usability among users and non-user will be needed by vendors and health systems to adjust for adoption problems in the future. In addition, Baldwin projected that the advent of Substitutable Medical Apps and Reusable Technology (SMART) on Fast Healthcare Interoperability Resources standards may incite more development in EHRs and Portals to advance the need for further testing.

Cumulatively, Baldwin's entire examination drew an updated conclusion that patient portals should incorporate the high yielding features of mhealth apps. Like other studies mentioned, her argument echoed the need for more research to provide best practices in combining features and to determine how patients should use their data more meaningfully towards improved health outcome. Baldwin's study also aligned with other patient portal application literature by supporting claims that patient portal mobile applications are still in its innovative phases. The future directions of portal development was aimed towards mhealth platforms. Also, Baldwin's study stated that the combined functionality of the tools within a patient portal can further enhance population health approaches to patient care among diabetic populations.

VI. Eliminating Disparities among Latinos with type 2 diabetes: effective eHealth strategies

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

In Lopez et al's 2016 study, researchers point to the successes of the limited amount of Latino focused IT interventions and emphasize the suitable eHealth strategies to help reduce health disparities caused by the digital divide among Latino diabetics. In the study, Lopez established that type 2 diabetes has been growing among the Latino populations and that they stand to benefit the most from Health IT Interventions. Referencing the landmark Hispanic Community Health Study/Study of Latinos, researchers indicated that diabetic prevalence was roughly 17% among all Hispanics, men and women. Latino sub populations of diabetic prevalence also varied as result of acculturation: South Americans (10%); Cubans (13%); Dominicans, Puerto Ricans, and Mexicans (18%). Lyles reported that diabetic prevalence has been negatively related to education and household income. There has also been a continued lack of improvement in diabetes quality care indicators among Latinos. Currently, researchers detailed that 52% of Latinos were uninsured, 59% were aware of having diabetes based on discordance between self–report and lab results, and only 48% demonstrated adequate glycemic control (A1c<7%). Structural features of the healthcare system, high costs, financial/ language barriers, and poor health literacy were also some of the factors that exacerbated poor health outcomes among Latinos.

Given the improvement of internet access and the surge in cell-phone ownership among Latinos, Lopez emphasized specific lessons learned from Latino eHealth interventions which have improved HbA1cs and patient engagement. As a non-IT component to an intervention, Lopez initially highlighted that Diabetes Self-Management Education (DSME) should be considered into any e-health interventions because of its gold-standard in enabling cultural tailoring through face-to face interactions. Comprised of blood glucose monitoring, taking medication, healthy eating, being active, reducing risks, healthy coping and problem solving; he emphasized the importance of DSMEs since they have proven to be effective among minorities populations. Frequent bidirectional communication with multimodal delivery was another strategy Lopez suggested for a successful eHealth intervention. This suggestion stemmed from the TexTMED study which was successful in improving self-management efficacy and HbA1cs levels using unidirectional text messages between diabetics

and providers. Incorporating the use of Clinical Health Workers (CHW) was also another strategy Lopez mentioned. This suggestion was made about the video conferencing and telemonitoring interventions of Informatics for Diabetes Education and Telemedicine (IDEATel) and Promotoras- Telemedicine Care Provider Interaction Model. Researchers of that study found that using CHWs to culturally bridge community engagement with the IT intervention intensified the efficacy of addressing multidimensional barriers in diabetes self-management. Respectively, this was why tablet use and CHW support was also suggested by Lopez. Through the example set in iDecido intervention and its effort to use iPads and CHWs to educate diabetic about self-management and medication; Lopez highlighted that multimodal IT approaches (mobile texting, mobile app, tablets, etc.,) coupled with in-person support may overcome literacy barriers to show greater outcomes.

Lopez's most emphasized suggestion to successful implementation was that eHealth interventions must be specifically tailored to Latinos. According to Lopez, the cultural context of Latinos must be taken into consideration when tailoring an intervention. He stated that health messaging should be personalized to include age, name, behavioral history, behavioral barriers or behavioral goals as variables in delivery. Very few studies have been specifically tailored to address socioeconomic, cultural and linguistic challenges facing Latinos. So, key approaches to tailoring should consider the deep structures of Latino culture when providing educational curriculum. This meant providers should be mindful of family orientations, respect for religion, provider trust, folk beliefs, and perceptions of body. Lopez also mentioned that acculturation must also be observed. The complexity of acculturation among Latinos requires tailoring to assess nuances created by socioeconomic status, language ability, and cultural preservation. According to Lopez, measuring acculturation may indicate the appropriate level of tailoring needed to conduct an effective intervention. Furthermore, Lopez also stated that tailoring must incorporate the appropriate personnel to administer the intervention. His findings mentioned that, some populations of Latinos, CHW and peer educators may be effective while the preference health professionals would be beneficial for others.

Collectively, Lopez's suggestions provided great depth into the limited implementation of eHealth interventions among Latinos. His study provided valuable epidemiological profile of the Latino population to help establish the complexity of administering eHealth interventions. Lopez's analysis supported that HIT interventions within the Latino populations is still very limited. Although no in-depth quantitative data was provided in his review of health interventions, Lopez's study pivoted the opportunity to further research patient portals. Lopez's rich cultural framework provided a reference when exploring further developments in patient portal mobile application use among Latinos.

VII. Implication

In addressing the use of patient portals within WMMC operations, the studies implied that there are great research opportunities in tailoring the use of a patient portal mobile application for Hispanics, expanding its use within DMSE sessions through CWHs, utilizing the mhealth functionality of patient portals, as well as proposing eHealth interventions that reduce health disparities. After further review of patient portal mobile apps among Hispanic type 2 diabetics, limitations in research offer a great breadth for innovative opportunities. As Kao mentioned, mhealth applications are abundant and that health applications have provided beneficial results in addressing obesity and diabetes. Yet, despite mentions of MyChart and HealtheLife patient portal applications within the study, the landscape of the mhealth market lacks evidence based literature in patient portal apps for clinical implementation. This is because app developments are currently undergoing expansion into EHRs such as Cerner and Epic. Devkota exemplified this same lack in evidence based literature as well but specifically explored how the use of messaging functions within a patient portal and its mobile application lowered HbA1cs for whites and "non-whites". Devkota's argument was generally supportive of patient portal efficacy on type 2 diabetes. But its significance stemmed from being one of the only efficacy studies that implemented use of a patient portal mobile app within the intervention. The lack of specificity and association between ethnicity and modality administered (mobile access vs. online access) were limitations to Devkota's

study. But, Devkota's rare quantitative glimpse into the potential effect of patient portal mobile apps on "non-white" diabetics equalized the study's significance for considered guidance. Longitudinally, Lyles peered into the potential of medication adherence among Latinos and proved that statin adherence was feasible across multiple ethnicities with the use of in-portal medication refills. More importantly, Lyles drew conclusions that patient portals may also improve statin adherence among Latinos. Baldwin supported patient portal apps by pressing the need for patient portals to adopt more characteristics of mobile applications. Specifically, Baldwin stated that more considerations must be placed into portal designs and user friendliness to increase the expansion of its utility and reduce barriers in patient portal use. Her article was indicative to the future development of patient portals progressive efforts towards innovative functionality into the mhealth platform. Supplementary to her study, Wu's systematic review indicated that mobile application interventions have been associated with clinically significant reduction in HbA1cs. Wu's review specified features that may intensify the effect of mobile application interventions such as complication prevention modules, structured displays, lifestyle modification modules, and education modules. Finally, Lopez's examination of successful eHealth strategies supported the need for more research not only in patient portal apps but also in Hispanic eHealth interventions. He stressed the epidemiological need for electronic self-management efforts as means to reduce health disparities. His suggestions of using DSME education, bidirectional messaging, CHWs, and cultural tailoring highlighted a wealth of cultural insight drawn from successful eHealth interventions specific to Latino diabetics. But more importantly, the lacking mention of mobile patient portals within the study postured Lopez's suggestive strategies as a framework for innovative portal implementation using face-to-face DSMEs and CHWs as in-person support for IT interventions. Therefore, WMMC CIS has decided to use Healthelife as a population health tool to assist self-management efforts among Hispanic patients transitioning from inpatient to outpatient services.

SOLUTION/ INTERVENTION SELECTION

As a newly available resource to WMMC, the Healthelife mobile application is Cerner's multilingual patient portal mobile application that is already live and fully integrated with WMMC's "My Adventist Health" patient portal". The app is currently available to patients for free download in the Apple App Store and Android Store. It contains a "one touch" accessibility feature as well as all the consumer facing features of the "My Adventist Health" portal which include viewing lab results, reviewing medical records, reviewing medications, requesting prescription refills from providers, reviewing doctors' notes, setting appointments, securely messaging providers, accessing uploaded educational content, connecting to social media, downloading/sending records, paying bills, receiving push notifications, and viewing advanced care videos. Healthelife also has the potential to integrate personal devices into the spectrum of diabetic care. Some of the unique and innovative features of the HealtheLife application is that it can integrate mobile APIs to connect with Cerner's EHR system. Essentially, this would allow patients to use third party mobile applications to connect with their portal for greater collection of patient generated data. Digital health platforms such as Validic are already compatible with Healthelife application and allow patients to connect their glucose meters, Fitbits, digital blood pressure cuffs, and weighing scales with their patient portal. This will allow patients to experience more effective medical encounters if they opt to send their daily health data to their providers using Cerner's Clipboard. Since recent research has indicted that the mobile phone ownership among Hispanic populations have reached 98% with 75% owning smartphones, CIS would like to take advantage of Healthelife's features because we think that these features may be resourceful in addressing communication and educational elements to diabetes self-management (Pew 2017). To date, WMMC has not yet put this application to use nor promoted it among its patient population

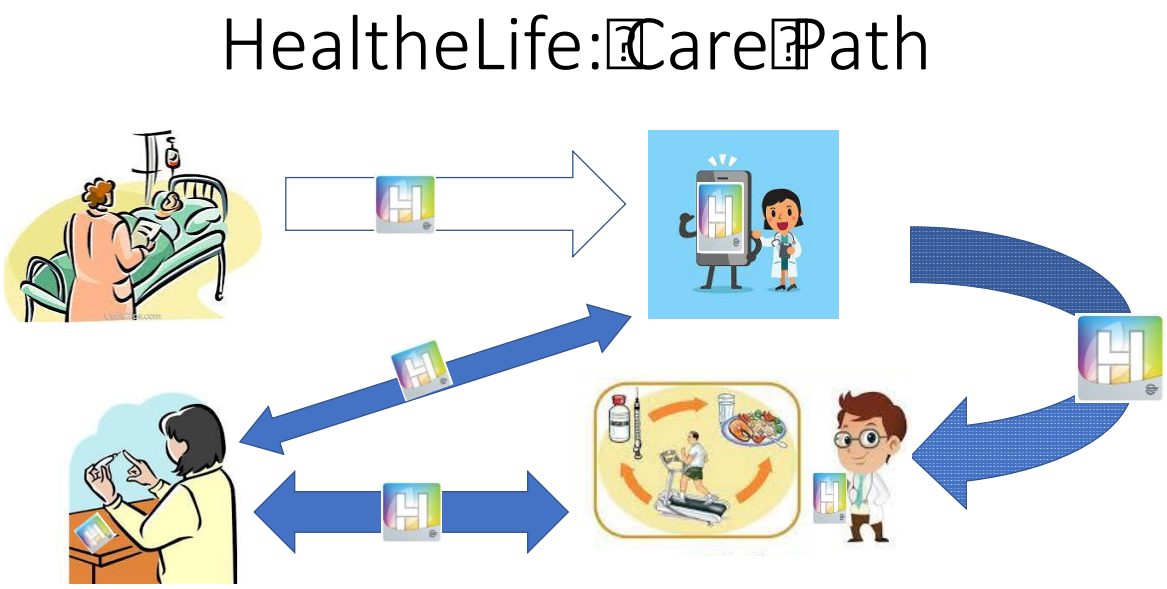
In turn, WMMC CIS has requested a pilot of the HealtheLife mobile app to be conducted among its Hispanic patients as a low-cost mhealth intervention. CIS proposed this idea because researchers have found

that mobile and web-based patient portal interventions can lowered HbA1c levels among type 2 diabetics with patient-provider communications and accessibility to health records. (Devkota et al 2016/ Tang et al 2012). Systematic reviews have also indicated that the use diabetic mobile application interventions for outpatient self-management have been associated with clinically significant reduction in HbA1c. (Wu et al 2017). When examined in a well-controlled intervention, Latino/ Hispanic populations also showed a 5.6% decrease in time without statin when using medication refills within portals as well (Lyles et al 2016). CIS believes that this finding may support the possibilities that Healthelife may improve medication compliance. Implementing the use of the HealtheLife app may provide the "My Adventist Health" portal with easier mobile health (mHealth) accessibility, better patient engagement, portal use, and increased ubiquity of health information access among Hispanics because of its mobile app features (/ Kao et al 2016, Baldwin et al 2016/ healthit.gov/ Lopez et al 2016). Also, CIS believes that the use of Healthelife mobile application may align with current trajectory of mhealth application development as well as WMMC goals and objectives focused on improving the prevention and treatment of diabetes (Kao et al 2016, Baldwin et al 2016, WMMC 2017). This implementation of a pilot that may contribute to glycemic control efforts, research gaps of patient portal mobile applications, innovative HIT interventions on Hispanic diabetics, and WMMC Community Health Priorities (Kao et al 2017/ Lopez et al 2016). In concert with the Glycemic Control efforts, CIS believes that using Healthelife as a population health tool will support preventative behavior change and treatment adherence after discharge.

DELIVERY/ NEW COMPONENT – PILOT DESIGN

The primary objective of the pilot program is to determine if the use of Healthelife application improves self-management efficacy and glycemic control among WMMC Type 2 diabetics (18+ years old). By getting patients and their caregivers to use Healthelife, CIS intends to improve the glycemic control among Hispanic patients, prevent patients from experiencing adverse glycemic events beyond discharge, and reduce the possibilities of unnecessary ED use or readmission in the future. The facilitated use of Healthelife will occur

with the collaborated support of Dr. Nilem Patel and the WMMC Diabetes Center Team. Essentially, providers will present Healthelife to patients/caregivers as a “mhealth diabetes toolkit” that will educate them in self-management during and after encounters with their WMMC Diabetes Health Navigator, AHPN endocrinologists, AHPN PCPs, and Diabetes Educators. During these patient-provider interactions, we anticipate that the patients’ use of Healthelife will enhance patient engagement for better treatment compliance, DMSE attendance and A1Cs levels (healthit.gov). Patients/caregivers will be introduced to Healthelife through their initial contact with WMMC’s bilingual diabetes educators to initiate in-person support and maintain the utmost level of cultural competency (Lopez) et al 2016. These encounters will be the beginning of a patients’ Healthelife care path and will occur when WMMC diabetes educators consult diabetic inpatients who are ordered beside education before discharge (Lopez et al 2016). Thereafter, continued reinforcement for better self-management will occur as the patient/caregiver is taught and expected to use the mobile application features (messaging, reminders, educational videos, medication refills), starting from discharge to follow up visits and then heavily throughout the completion of DSME sessions.



Technological Acceptance Model (TAM), Social Support, and Social Cognitive Theory will be applied throughout the pilot to gradually condition Healthelife usage among WMMC patients/caregivers for tailored educational experiences that strengthen WMMC DSME sessions (Lyles et al 2012, Lopez 2016, Mansyur et al 2015, Bandura 1971/ CHIRR/ Miller et al 2015/ Rosal et al 2005). The mixture of theories will begin when diabetes educators and AHPN Endocrinologists provide brief educational sessions to demonstrate usefulness upon each patient-provider interaction (Bandura 1971/ CHIRR). Starting at bedside consultation, educators will initiate the patient's/caregiver's download of Healthelife as part of initiating self-efficacy into the patient and establishing the perceived usefulness of the app (CHIRR). During this time, educators will also inform the patient of reminder messages they will receive from WMMC Diabetes Center staff during the interim of patient-provider encounters. These initial messages will be sent as reminders to attend their AHPN follow-up visit and initial DSME session upon reception of DSME referral. The messages will include a hyperlink to complimentary video explaining previously discussed management tips and the importance of their next step in care. Despite health literacy levels, the educators' use of videos and messages are intended reinforce the behavioral intention to use Healthelife as well as provide knowledge for greater personal behavior change among patients (Bandura 1971/ CHIRR/Irizarry et al 2017). The first two videos will act as primers that explain the functional use of Healthelife, the importance follow up visits with their doctors, and the value of DMSE attendance (CHIRR). However, the bulk of Healthelife application will be incorporated into the pre-existing DSME individual curriculum (Lopez et al 2016). Behavior change for better self-management will occur when educators teach patients/caregivers how to reference newly featured "bilingual DSME education videos" after each completed DSME session (Miller et al 2015/CHIRR/Lopez 2016/ Rosal et al 2005). The DSME educational videos will star current WMMC diabetes educators and will reinforce patient/caregiver self-efficacy by presenting knowledge in nutrition, medication, glucose monitoring, physical activity, emotional support, DSME attendance, and medical attention protocols (Bandura 1971/ Mansyur et al 2015/Lopez). This feature will give patients, their caregivers, and their family more personal and culturally tailored self-management

information for on-demand social support even after treatment has been completed (Lopez 2016/ Bandura 1971/ CHIRR/ Mansyur et al 2015). Prescription refilling features within the application will also be encouraged to improve medication adherence (Lyles et al 2016, Fitzgerald et al 2016/ Healthit.gov/ Lopez 2016). Additionally, patients may choose to receive more social support by using Healthelife messaging to contact the Diabetes Center throughout the DSME course (Devkota et al 2016/ Lopez et al 2016/ Bandura 1971/Mansyur et al 2015).

Program SMART GOALS:

SPECIFIC:

What: *Primary*: Improve average of HbA1c levels, increase self-efficacy, and increase average of DSME attendance among type 2 diabetics.

Secondary: qualitatively assess the functionality of the mobile application and any observe economic benefits through reductions in ED use and readmission between the intervention groups and control group.

Who: *Target population* - adult Hispanic Type 2 diabetics (18+ years) transitioning from inpatient care to AHPN outpatient services and WMMC DSME sessions.

Internal stakeholders: WMMC Administration, WMMC Diabetes Center Staff, WMMC CIS, AHPN Physicians/ Endocrinologists, WMMC Decision Support, WMMC Organizational Excellence.

When: *short-term goal*: observe the associated use of Healthelife with increases in self-management efficacy, increase DSME attendance, and lower HbA1c within 3 months.

long-term goal: to incrementally improve from baseline, 3 months, and 6 months. Other long term goals are to observe (0) ED utilization and re-admission among participants during the pilot.

Where: *Primary* - DSME sessions.

Secondary- Bedside consultation and AHPN physicians/Endocrinologist follow up visits.

How: Diabetes Center Team members will introduce the use of the mobile app to patients upon bedside consultation of patients within AHPN network. Diabetic educators will send reminder messages and video links

in between points of care. Upon follow up visit after discharge, AHPN physician will show utility of the app by gathering information from it and giving short education on app use before referral to DSME. When the patient arrives to the DSME program, Educators will reinforce the use of messaging, medication refills, and sent videos as part of the existing DSME session.

Why: The purpose of the intervention is to condition the use the Healthelife app as a low cost self-management tool for patients that suffer from type 2 diabetes.

MEASURABLE: (Performance Indicators, count or quantity)

- Primary: HbA1C, DSME attendance, self-efficacy (appendix 1), and frequency of utilization.
- Secondary: ED utilization and readmission. Qualitative assessment of mobile app functionality and design.
- All collected data can be analyzed via decision support department.

ACHIEVABLE: (Realistic within time frame and with resources available)

- Present and Coordinate intervention specifics to WMMC Administration, Diabetes Center, CIS, Participating AHPN Physicians/ Endocrinologist.
- Create bilingual videos using WMMC Marketing Department.
- Request access for Diabetes Center Team to send messages out of Cerner Millennium.
- Training all relevant Cerner Millennium users about current features of HealtheLife and how to send messages, videos, and reminders from Cerner Millennium.

-Create CIS fact sheet to educate providers about Healthelife functions.

- administer implementation of intervention.
- Create video content and program protocol.

RELEVANT: (Applies to program goals)

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

This intervention is relevant to WMMC operations because the diabetes prevalence in their primary service area is at 11.6% and there is need to improve self-management efforts for better glycemic control among type 2 diabetic patient population.

TIME:

The expected completion of the pilot will take no longer than one year from the time of proposal.

Logic Model

Planned work:

1. Resources / Inputs:
   - WMMC Departments: WMMC Administration, WMMC CIS, WMMC Diabetes Center, WMMC Decision Support, WMMC Marketing Department,
   - AHPN Physicians/ Endocrinologists
   - WMMC Patients and Caregivers.
   - HealtheLife mobile application messages, reminders, medication refill.
   - Cerner Millennium EHR
   - Patient data
   -CIS Student Intern/ Volunteer

2. Activities:
   - Obtain approval of pilot program from WMMC Administration.
   - Solicit and confirm the involvement of all relevant departments' role in pilot program.
   - Train WMMC Diabetes Center and train all participating AHPN Physicians/Endocrinologists and relative staff how to send messages within Cerner Millennium.

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

- Coordinate creation of educational video content with Diabetes Center Staff, participating AHPN Physicians/Endocrinologists, and WMMC Marketing Department.
- Create program protocol for patient treatment and diffusion among AHPN Endocrinologist and Diabetes Center.
-Film and produce 12 bilingual educational video.
- Conduct a one year pilot program.
- Collect and Analyze data to provide guidance for future use of Healthelife.

Intended Results:

3. Outputs:
   - WMMC HealtheLife Pilot protocol created by WMMC Diabetes Center and AHPN Physicians.
   - WMMC DSME Educational Videos.
   - More efficient use of resources with the use and implementation of Healthelife mobile application.
   - Provide exemplary implications for future glycemic control policies among AH facilities.
   - Provide contributions to research gaps in patient portal app use among Hispanic Diabetics.
   - Potentially improve cost effectiveness/cost efficacy of pre-existing diabetes care.
   - Provide patient portal usability and design feedback for further development of portal functionality.

4. Outcomes:
   - Lowered HbA1Cs
   - Increased health behavior change by providing on –demand education for patients after DMSE sessions.
   - Increased patient engagement/patient satisfaction
   - Increased patient portal use.

- Improved medication adherence.
- Increased participation in DSME/ Diabetes Center programs.
- Increased employee engagement.
- Increased self-efficacy
- Reduce number of readmissions
- Reduce unnecessary ED use.

5. Impact:

- Create innovative use of patient portal apps to address diabetes.
- Provide innovative way to increase patient self-efficacy within DSME.
- Improve glycemic control efforts at WMMC and among its patients.
- Improve the diabetic health status of Hispanics suffering from Type 2 Diabetes in SPA 4.
- Introduce population health program as an incremental step towards patient centered and value based care.
- Better communication between provider and patients.
- Opportunity to tailor future WMMC Policy for improved HIT approaches.
- Reduce Hispanic health disparities created by the digital divide.
- Create better access to healthcare

GANTT CHART: **Please See attached Excel Spreadsheet**

PROGRAM BUDGET: $0.00

- *Train WMMC Diabetes Center and all participating AHPN Physicians about patient portal functionality* = $0.00
- *Coordinate creation of educational video content* = $0.00

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- *Create program protocol for patient treatment and diffusion* = $0.00

- *Conduct one year pilot program* = $0.00

- *Collect and Analyze data to provide pilot results (through WMMC Staff / CIS Student Volunteer)* = $0.00

- *Use/ Cost of HealtheLife app* = $0.00

- *Production of (12) 3-4 minute bilingual educational videos through WMMC Marketing* = $0.00

- CIS/ Pop. Health / Student Volunteer = $0.00

BUDGET NARRATIVE:

The proposed budget above represents the additional cost of a HealtheLife pilot program contingent of the support of WMMC Administration, WMMC Marketing Department, WMMC Diabetes Center Staff and AHPN Endocrinologists' participants. As indicated, the cost of the pilot program will be $0.00. This is possible because the CIS proposed slight changes in the current processes and workflow of the Diabetes Center Staff and AHPN Physicians/Endocrinologists allocated for the Glycemic Control Project. This minimal cost of the pilot is based on interdepartmental participation and coordination upon approval of WMMC Administration. Also, we created a budget that is dependent on WMMC marketing making all the bilingual educational video in-house.

EVALUATION PROCESS:

Formative Evaluation

The formative evaluation of the pilot will be structured through the following questions:

1.How do we gain participation from patients and internal stakeholders?

2.How do we identify the patient participants?

3.How do we sustain improvements in self-efficacy and glycemic control?

4. Who will monitor and report participation?

5. How do we maintain the fluidity of program logistics?

6. How do we sustain fiscal resources?

These questions are important to the evaluation because the pilot program relies on patient engagement as well as leveraged cooperation and support from WMMC staff. In turn, CIS will request the full support of the WMMC Administration to leverage efforts of the pilot program throughout the necessary and relevant WMMC departments. Ideally, we plan to execute these tasks through a series of coordination meetings. Initially, CIS will meet with WMMC Administration to obtain their full participation. Upon approval, meetings between AHPN physicians/ endocrinologists, CIS, Organizational Excellence, WMMC Marketing, WMMC Decisions Support and Diabetes Center managers will be conducted to fine-tune the logistics of the intervention (i.e. establish department role, confirm targeted patient population, create video content, plan video production timeline, etc.). The identification of inpatient diabetics will be triggered when a diabetes educator is ordered to conduct bedside education on a Type 2 diabetic inpatient. The pilot program will also incorporate the use of the Healthelife app messaging feature and culturally tailored series of bilingual diabetes educational videos. As part of pre-existing Glycemic control tasks, the development of educational materials and content will be created by the Diabetes Center, WMMC Marketing, CIS Volunteers, and WMMC Endocrinologist (Dr. Patel) to appropriately optimize health messaging, participation, and treatment compliance. Prior to implementation, the CIS volunteer created a process survey which was preliminarily approved by WMMC Diabetic Educators that will evaluate "self-efficacy and willingness to change" behaviors at baseline, 3 months, and 6 month (appendix a). Protocoled use of the app will also be developed by the Diabetes Center, Dr. Patel, and CIS. The protocol should explain how clinical staff will introduce Healthelife to adult patients, how important it is to involve and educated the patients' caregiver, how to encourage self-management through the application, how to navigate through the application, how to utilize the products for practices at home, how to access personal information, how to send/ receive messages, how to navigate through tech problems, and when to refer medical attention to patients. The diabetes navigator and educators will be the designated program monitors and evaluators. Oversite will be conducted by WMMC Administration and monthly meetings with internal department managers and

monitors/evaluators will minimize logistical barriers throughout the pilot program. Prior to implementation, a final task force meeting will be held among all involved stakeholders to finalize and confirm the roles and responsibilities of all departments. This task force meeting will also finalize protocoled use of mhealth app and program specifics between AHPN Physician/ endocrinologist, WMMC CIS, and Diabetes Center Team. Lastly, all processes will occur as part of current Glycemic Control Efforts. The implementation of the pilot will occur as part of pre-existing workflow within DSME curriculum and outpatient follow up visits. The consolidated data collection and analysis will determine the clinical and economic success of the intervention. Final outcomes will be considered to establish the future use and development of Healthelife within WMMC operations.

Process Evaluation

WMMC Administration will determine the success of the program planning by evaluating the level of feedback from the Diabetes Center, AHPN Physicians/Endocrinologists, WMMC Administration and CIS during monthly meetings. CIS will examine the planned use of the Healthelife app by evaluating by the number of technical issues observed and the qualitative input provided at the end of the pilot. WMMC Administration and CIS will also examine the success of implementation by the DSME attendance rate and frequency of Healthelife use. WMMC Administration and the Diabetes Center will determine the success of the management process. Success will be measured by the increasing improvements to self-efficacy, improvement to physiological metrics, any associated reduction of ED use by the end of the year, compliance to program protocol (consistency in treatment compliance, completion of surveys, attendance of sessions/ follow up), and logistical fluidity between all internal stakeholders (compliance to roles and responsibility and fluidity of operational communications).

The program's performance metrics will include DSME attendance rate, HbA1c levels, level of self-efficacy, number of ED visits during intervention, number of re-admissions, and the frequency of usage. The Diabetes Health Navigator will aggregate primary metrics such as DMSE attendance, frequency of use, self-

efficacy and HbA1c will be consolidated as part of his regular workflow. Data pertaining to frequency of Healthelife usage will be retrieve within the mobile application under “account activity logs” during DSME sessions. The Diabetes Center staff will collect metrics within the Healthelife application (account activity logs) will be granted in accordance to HIPPA compliance. The self-efficacy scores will be administered via SurveyMonkey.com and reflect the level of curriculum adjustments to DMSE treatment. Decision Support will collect the number of ED visits and re-admission cases from Organizational Excellence as secondary metrics needed by the end the intervention. In addition, operational discrepancies and administrative quality assurance will be addressed via monthly meetings to resolve any issues. Any miscellaneous assistance in data collection and analysis can be done by the CIS Student Volunteer. Final consolidation of performance metrics will be conducted by Decision Support at the end of the year. The total cost of the evaluation is assessed at $0.00 per year.

Outcome Evaluation:

To assess the outcomes of the pilot program, a quasi-experimental trial will be conducted by WMMC. WMMC will compare a retrospective control group of WMMC DSME adult (18+) patients against an experimental group exposed to the HealtheLife pilot program over the course of 6 months. The control group will comprise of adult DSME patients who are Hispanic type 2 diabetics that were WMMC patients and referred to DSME by an AHPN physician/Endocrinologist in 2016. The experimental group will consist of Hispanic type 2 diabetes with the same criteria but, recruited between January 2018-May 2018. Additional inclusion criteria into the experimental group will require transitioning patients to have access to a smartphone (personal or caregivers) that uses an Android or IOS operating system. The exclusion criteria will include patients that are non-Hispanic, have a life-threatening disease, eating disorders, severe mental disorders, already enrolled in a weight loss program, taking weight loss medication at time of recruitment, or already enrolled in a diabetes self-management program. A1Cs and DMSE attendance will be examined for significant

improvements between the two groups. Patients' utilization rate of Healthelife will be measured against their A1Cs, self-efficacy scores, and DSME attendance for correlation analysis. The collection of self-efficacy, utilization, and physiological metrics will be done from baseline, 3 months, and 6 months. ED use and re-admission throughout the intervention will provide the foundation of cost efficiency and cost effectiveness of the pilot. Any reported ED use or readmission during the pilot will be compared to ED utilization and readmission among the 2016 control group. Successful outcomes will be determined if the HealtheLife utilization rate is associated with significantly greater improvements in A1C and DSME attendance in the experimental group than the control group. Additional success will be determined if Healthelife use is associated with increases in self-efficacy scores, reduction in ED use, and less readmission in the experimental group than the control group. Qualitative input regarding application design and functionality will be consolidated from monthly meetings notes and all findings will be provided to WMMC administration for further development of app use. If successful, this would allow the WMMC glycemic control team an opportunity to establish exemplary policies towards innovative and cost effective use of patient portals to treat diabetes while providing a foundation to further build CIS capabilities within the portal.

Sustainability Plan

A main component of this intervention was to maximize cost effectiveness and cost efficiency to address Type 2 diabetics among Hispanics by utilizing existing resources. CIS has proposed an intervention that optimally operates within the budgeted operation of the WMMC. The intervention design aimed to minimally impact the workflow of all internal stakeholders. Therefore, the pilot is self-sustaining in terms of personnel because the processes and workflow will occur as part of the WMMC Glycemic Control Project and require no additional cost. Although additional components of the pilot will require the production and use of "diabetes educational videos," CIS has suggested that video production will be completed within the WMMC Marketing department. This was done to avoid any licensing cost associated with the use of free online bilingual videos as well as any excessive costs in hiring third party companies to produce the videos. A CIS/ Population Health Volunteer was

also included into the interventions budget to lend any miscellaneous assistance among all internal stakeholders where needed. The quasi-experimental study examining the use of Healthelife serves the purpose to fill gaps in research by potentially providing foundational evidence for clinical efficacy, innovative population health practices for future grants, and new opportunities to advance HIT capabilities within WMMC.

CONCLUSION:

All in all, this proposal has explored an innovative solution to help alleviate the burden of type 2 diabetes among the SPA-4 Hispanic community. Currently, we have identified the epidemiological need to improve self-management efforts within the primary service area of WMMC as projected increases of type 2 diabetic prevalence is expected to be higher in this area. We have also identified the current efforts WMMC is making to improve their glycemic control practices through HIT tools. Specifically, there is a need to improve self-management education and treatment compliance within the WMMC Diabetes Center and their DSME courses. And as a result, WMMC CIS has selected the Healthelife patient portal mobile application in accordance to this issue and the overall community efforts of the hospital. New studies have indicated that patient portals apps have great potential to reduce A1Cs when used as a tailored mhealth intervention within DSME curriculum which offers in-person support from a provider. In turn, WMMC CIS has requested that the piloted use of Healthelife be conducted during the process of transitional care but, mainly through WMMC diabetes educators and within their current DSME program. By using the use of Healthelife messaging features, educational videos, and prescription refill requests among patients; WMMC hopes to provide a cost-effective tool to aid their behavior change and self-management efficacy for better glycemic control.

Overall, this pilot program sets forth a care path that promotes patient care beyond the walls of WMMC. The use of Healthelife as an mhealth intervention implies that health service organizations take more incremental strides towards population health approaches in their operations. By adopting app as a population health tool,

WMMC has the potential to intensify current DSME curriculum, enhance preventative efforts towards unnecessary ED use, and improve type 2 diabetes prevention efforts within SPA-4. More importantly, the suggestion to pilot Healthelife introduces the benefits of HIT to populations who are underserved and with limited resources.

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HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

Reflection:

In retrospect, my experience with White Memorial Medical Center really opened my eyes to the realities of public health administration and management. As a population health intern, I was able to gain first-hand experience in project management especially when creating and designing the Healthelife pilot and its proposal. I found that working independently can be very difficult, especially when you are given free range to implement ideas and improvements to an operation. However, I realized the value of establishing goals and objective were also vital to guiding my workflow and expectations. This helped me conduct my research as well as daily activates throughout my internship. In turn, this internship also reintroduced me to the importance of maintaining the communication lines among the different internal stakeholders in any operation. Delving back into the workforce, I had to re-acclimate myself into this practice when conducting meetings with the different personnel at WMMC and reporting my progress to my supervisor. Being highly adaptable is helpful when working among a multi-disciplinary team. Yet, had it not been for my MPH course preparations, I can honestly say that this experience wouldn't have been as pleasant and exciting as it was. From creating the pilot program to interacting with patients on the hospital floor and even coordinating with hospital administration; I felt that my course work fully prepared me for an experience relative to all of the lessons learned while obtaining my MPH.

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

MPH Program Competency Inventory

USF MPH Competencies	Notes
1. Assess, monitor, and review the health status of populations and their related determinants of health and illness.	Researched diabetes related morbidity, mortality, and the health indicators of WMMC patient population and its service planning area in Los Angeles County.
2. Demonstrate the ability to utilize the proper statistical and epidemiologic tools to assess community needs and program outcomes.	Compiled data from SPA-4 health indicators, WMMC Priorities, WMMC Key Informant Interviews and referenced them against the WMMC DSME annual performance data.
3. Identify and prioritize the key dimensions of a public health problem by critically assessing public health literature utilizing both quantitative and qualitative sources.	Conducted academic literature review on the efficacy of mobile Patient portal interventions among Hispanic Diabetics. I also researched health interventions that have already contributed to decreases in its morbidity.
4. Specify approaches for assessing, preventing, and controlling environmental hazards that pose risks to human health and safety.	Researched WMMC operational needs and community needs by utilizing previously completed community needs assessment and one-on-one key informant interviews.
5. Apply theoretical constructs of social change, health behavior and social justice in planning community interventions.	Used Technological Acceptance Model, Social Support, and Social Cognitive theory as the basis of applying my proposed pilot program within WMMC operations.
6. Articulate the relationship between health care delivery and financing, public health systems, and public policy.	Created a pilot program proposal within the allocated budget of WMMC Glycemic Control Project to improve Meaningful Use 2 compliance, reduce unnecessary ED visits and readmissions, reduce A1C levels of patients, as well as create on-demand education for post treatment references.
7. Apply evidence-based principles to the process of program planning, development, budgeting, management, and evaluation in public health organizations and initiatives.	Used qualitative methods to collect data for the creation and design of the pilot program.
8. Demonstrate leadership abilities as collaborators and coordinators of evidence based public health projects.	Collaborated with multidisciplinary glycemic control team to research, collect data, and ensure program sustainability. Conducted meetings with various hospital administrators to encourage pilot input and "buy-in" prior to formal program proposal.
9. Identify and apply ethical, moral, and legal principles in all aspects of public health practice.	The pilot program proposal was created within the legal and safety compliance of WMMC operations. Also the intensions of providing improved population health services was done in accordance to Meaningful Use 2 guidelines.
10. Develop public health programs and strategies responsive to the diverse cultural values and traditions of the communities being served.	Created the pilot program with considerations to the need for self-management efforts within SPA-4, WMMC, and the Hispanic community. The pilot was also created to provide a free, culturally-

	competent services for low-income and low literacy Hispanic patients within the community.
11. Effectively communicate public health messages to a variety of audiences from professionals to the general public.	Favorable results of the pilot program can be used to fill in research gaps pertaining to patient portal mobile applications among underserved Hispanic populations. In addition, the use of educational videos, efficacy surveys, and personalized messages aims to provide tailored experiences within the targeted population.
12. Advance the mission and core values of the University of San Francisco.	HealtheLife pilot program advocates the use of HIT tools to assist low-income and low literacy Hispanic diabetes achieve better diabetes self-management in medically underserved areas of Los Angeles. At its root it aims to reduce health disparities by improving healthcare access and quality of care amidst communities with minimal resources.

HealtheLife: Using a Patient Portal App to Address Type 2 Diabetes

(Appendix 1) – **Sample Survey:** subject to change in accordance to final Diabetes Center and Endocrinologists approval.

1. How confident are you in your ability to manage your diabetes?

Not confident
Slightly confident
Confident
Very Confident

2. I know what an A1C is.

Not True
Slightly True
True
Very True

3. I know what my A1C level needs to be.

Not True
Slightly True
True
Very True

4. I am confident with my knowledge about fasting glucose.

Not true
Slightly true
True
Very True

5. I am confident with my knowledge about what my post-meal glucose needs to be.

Not True
Slightly True
True
Very True

6. How likely am I to take my medication everyday?

Very unlikley
Somewhat unlikely
somewhat likely
Very likely

7. How confident are you in checking your blood sugar?

Not Confident
Slightly Confident
Confident
Very Confident

8. How confident are you in knowing when to check your blood sugar?

Not Confident
Slightly Confident
Confident
Very Confident

9. How often do you exercise?

never (0-1 time per week)
once in awhile (2-3 times per week)
Most of the time (4-6 times per week)
Everyday (7 days a week)

10. How difficult is it to make healthy decisions about food choices?

Very difficult
Somewhat difficult
Not so difficult
Not at all difficult

(Appendix 2)- WMMC Key Informant Interviews Format for Internal Assessments

Name:
Position:

1. **What is your key role in the WMMC Operations?**
2. **Describe your typical day and workflow like, if there is some uniformity.**
3. **Diabetes is a chronic condition that is extremely prevalent to much of the patient population. What are some trends and issues that you have seen or experienced in handling these patients within the scope of your position?**
4. **To what extent has the current HIT infrastructure worked for you in educating patients? and to what extent would you say it works against you?**
5. **What do you believe will help alleviate some of these issues within your internal operations?**
6. **What do you believe CIS can do to assist you in helping the patient population/community?**

Throughout the course of the interview, each interviewee was allowed to elaborate on each of the questions provide further input and clarification. Some examples of additional questions and remarks used to guide the interviews were:

- *Could you please tell me more about that?*
- *Can you elaborate more?*
- *What did you think of that?*
- *What do you think should happen?*
- *How did you handle that?*
- *Would you like to add anything else? Or make further suggestions?*

(Appendix 3) - Executive Summary (WMMC COO Submission)

HealtheLife: Combining mHealth and patient portals to address glycemic control among underserved Hispanics in Los Angeles.
White Memorial Medical Center- Pilot Program Proposal

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Community Assessment

In Los Angeles, prevalence of Type 2 diabetes among Hispanics is expected to increase 451% within the primary service area of White Memorial Medical Center by 2040. Type 2 diabetes continues to increase in the general population and at a greater rate among Hispanic minorities than any other race or ethnicity. As of 2016, Hispanics are still among the ethnicities significantly impacted within the 55% of Californians who have been diagnosed with diabetes, have pre-diabetes, or have undiagnosed diabetes. The physical and economic impacts of diabetes continue to effect Hispanics across California. Some of the several causes of Type 2 diabetes among Los Angeles Hispanics are attributed to genetic, environmental, and social factors. Proper management of Type 2 diabetes can be achieved by promoting lifestyle change and providing interventions that take a more active role in self-management such as Diabetes Self-Management (DSME) courses. With the current adult prevalence in LA County SPA-4 reaching 11.6%, trending health indicators reflect a major public health need to promote the self-management type 2 diabetes. White Memorial Medical Center (WMMC) has been a community staple of SPA 4, working to improve the population health status of Hispanic diabetics through numerous services. Given that 87% of WMMC's patient population are Hispanic and live within SPA 4, (Metro) operational statistics indicate that self-management efforts should continue to be among the community's priorities. Therefore, the intension of this proposal is to explore an innovative method to enhance diabetic self-management within the SPA-4 community of WMMC in a cost-effective and cost-efficient manner.

Background

Currently, WMMC has created a Glycemic Control Project that is looking to better utilize Health Information Technologies (HIT) to improve their glycemic control targets among its predominantly Hispanic patient population. For transitional care and outpatient services, WMMC Endocrinologists, diabetes educators and health navigators have been

asked to improve self-management and educational efforts for optimal outcomes within the WMMC Glycemic Control Project. Since the current goals of the Diabetes Center are to reduce patients' A1Cs to 7% with one comorbidity and 8% with more than one comorbidity, the significantly positive relationship between the average reduction in A1c (.27%) and the average attendance rate of DSMEs (45%) (n= 34, df=33 r=.6676, p-value .00000160) reveal a need to intensify their DSME approach. Correlatively, the WMMC Clinical Informatics (CIS) has been tasked to research online tools and applications that can enhance patient engagement while supporting the numerous department roles within the glycemic control project.

Intervention Selection

Since, common factors such as obesity, lack of treatment compliance, medication adherence, cultural beliefs, and low health literacy drive the burden of diabetes among adult Hispanics within this area; the WMMC Clinical Informatics department has identified the use of Cerner's HealtheLife patient portal mobile application as a potentially cost-efficient/effective tool to support the Glycemic Control Project efforts. With the recent availability of Healthelife patient portal mobile app, a literature review was conducted but, found very limited efficacy studies on the use of mobile patient portal apps and patient portals as mhealth interventions among Hispanic diabetics. However, several studies implied that there are great research opportunities in tailoring the use of a patient portal mobile application for Hispanics, expanding its use within DMSE sessions through Community Health Workers, utilizing the mhealth functionality of patient portals, as well as proposing eHealth interventions that reduce health disparities.

As a newly available resource to WMMC, the Healthelife mobile application is Cerner's multilingual patient portal mobile application that is already live and fully integrated with WMMC's "My Adventist Health" patient portal". The app is currently available to patients for free download in the Apple App Store and Android Store. It contains a "one touch" accessibility feature as well as all the consumer facing features of the "My Adventist Health" portal which include viewing lab results, reviewing medical records, reviewing medications, requesting prescription refills from providers, reviewing doctors' notes, setting appointments, securely messaging providers, accessing uploaded educational content, connecting to social media, downloading/sending records, paying bills, receiving push notifications, and viewing advanced care videos. In turn, WMMC CIS would like to pilot the HealtheLife mobile app among our Hispanic patients as a low-cost mhealth intervention to determine if it can enhance self-management among type 2 diabetics.

Delivery -Pilot Design

The primary objective of the pilot program is to determine if the use of Healthelife application improves self-management efficacy and glycemic control among WMMC Type 2 diabetics (18+ years old). By getting patients and their caregivers to use Healthelife, CIS aims to improve glycemic control among Hispanic patients, prevent patients from experiencing adverse glycemic events beyond discharge, and reduce the possibilities of unnecessary ED use or readmission in the future. The facilitated use of Healthelife will occur with the collaborated support from Dr. Nilem Patel and the WMMC Diabetes Center Team. Essentially, the pilot will portray Healthelife as a "mhealth diabetes toolkit" that educates patients/caregivers in self-management during and after encounters with their WMMC Diabetes Health Navigator, AHPN Endocrinologists, AHPN PCPs, and Diabetes Educators. During these patient-provider interactions, we anticipate that the patients' use of Healthelife will enhance patient engagement for better treatment compliance, DMSE attendance and A1Cs levels. Patients/caregivers will be introduced to Healthelife through their initial contact with WMMC's bilingual diabetes educators to initiate in-person support and maintain the utmost level of cultural competency. These encounters will be the beginning of a patients' Healthelife care path and will occur when WMMC diabetes educators consult diabetic inpatients who are ordered beside education before discharge. Thereafter, continued reinforcement for better self-management will occur as the patient/caregiver is taught and expected to use the mobile application features (messaging, reminders, educational videos, medication refills), starting from discharge to follow up visits and then heavily throughout the completion of DSME sessions. Technological Acceptance Model (TAM), Social Support, and Social Cognitive Theory will be applied throughout the pilot to gradually condition Healthelife usage among WMMC patients/caregivers for tailored educational experiences that strengthen WMMC DSME sessions. To assess the outcomes of the pilot program, a quasi-experimental trial will be conducted. The trial will compare a retrospective control group of WMMC DSME adult (18+) patients against an experimental group exposed to the HealtheLife pilot program over the course of 6 months. The control group will comprise of adult DSME patients who are Hispanic type 2 diabetics that were WMMC patients and referred to DSME by an AHPN physician/Endocrinologist in 2016. The experimental group will consist of Hispanic type 2 diabetes with the same criteria but, recruited between January 2018-May 2018. The expected completion of the pilot will take no longer than one year from the time of proposal.

- ***Primary outcomes*****:** 1.) Improve average of HbA1c levels 2.) increase self-efficacy 3.) increase average of DSME attendance
- ***Secondary outcomes***: 1.) Qualitatively assess the functionality of the mobile application for future use 2.) Observe economic benefits through reductions in ED use and readmission between the intervention group and control group.
- ***Performance metrics*****:** DSME attendance rate, HbA1c levels, level of self-efficacy, number of ED visits during intervention, number of participant re-admissions, and frequency of application usage from Healthelife log

Timeline of Work/GANTT CHART: Please See attached Excel Spreadsheet

Program Budget: $0.00
- *Train WMMC Diabetes Center and Train all participating AHPN Physicians about patient portal functionality* = $0.00
- *Coordinate creation of educational video content* = $0.00
- *Create program protocol for patient treatment and diffusion* = $0.00
- *Conduct one year pilot program* = $0.00
- *Collect and Analyze data to provide pilot results (through WMMC Staff / CIS Student Volunteer)* = $0.00
- *Use/ Cost of HealtheLife app* = $0.00
- *Production of (12) 3-4 minute bilingual educational videos (w/o Animation graphics) WMMC Marketing* = $0.00
- *CIS/ Pop. Health / Student Volunteer = $0.00*

BUDGET NARRATIVE:
The proposed budget above represents the additional cost of a HealtheLife pilot program contingent of the support of WMMC Administration, WMMC Marketing Department, WMMC Diabetes Center Staff and AHPN Endocrinologists' participants. As indicated, the cost of the pilot program will be $0.00. This is possible because the foundations of pilot program propose slight changes in the current processes and workflow of the Diabetes Center Staff and AHPN Physicians/Endocrinologists allocated for the Glycemic Control Project. This minimal cost is based on interdepartmental participation and coordination upon approval of WMMC Administration. Also, the budget is dependent on WMMC marketing making all the bilingual educational video in-house.

(Appendix 4) - Gantt Chart

TASKS	Aug. 2017	Sept. 2017	Oct. 2017	Nov. 2017	Dec. 2017	Jan. 2018	Feb. 2018	Mar. 2018	Apr. 2018	May. 2018	June. 2018	July. 2018	AUG. 2018	Sept. 2018	Oct. 2018	Nov. 2018	Dec. 2018
1. Obtain pilot approval from WMMC Administration																	
2. Conduct meetings to coordinate interdepartmental roles of pilot program.																	
3. Re-test and resolve any																	

application issues prior to roll out.																	
4. Create program protocol, develop video content. (WMMC Marketing, AHPN Endocrinologist, Diabetes Center, Admin)																	
5. Conduct necessary training on Healthelife functionality and request "Communication/ Messaging" capabilities for entire Diabetes Center Staff.																	
6.Film and produce "WMMC Diabetes Education Videos"																	
7. Facilitate final task force meeting among internal stakeholders to resolve any logistical issues before roll out.																	
8. Initiate year one pilot program.																	
9.Recruitment of participants.																	
10.Monitor Healthelife for issues and resolve.																	
11. Begin monitoring and evaluating year ever month.																	
12. Monitor and record intervention group data at baseline, 3 months, 6 months.																	
13. Year one: data collection and																	

analysis for administrative review.																	
14. Administrative considerations to scale up intervention, apply for grants, and/or increase Healthelife functionality.																	