

Background

Public health Importance: The Center for Disease Control (CDC) estimated in its 2017 statistical report, that approximately 9.4% of the US adult population is living with diabetes.¹ That equates to roughly 30 million adults. Diabetes is an increasing public health problem locally in the state of North Carolina.²

Epidemiology: In NC, the prevalence of diabetes is very similar to that of the national average. Diabetes is the seventh leading cause of death in NC and can decrease the life expectancy of a person by 15 years.³

Mortality & Morbidity of Diabetes: One study found that on average, if an individual was diagnosed with diabetes at age 40, males would lose approximately 11.6 years of life and females would lose approximately 14.3 years of life.⁴ In 2012, the WHO estimated that 1.5 million deaths were related to diabetes worldwide.¹ A chronic hyperglycemic state can lead to multiple long-term complications, including:

- (1) Myocardial infarction
- (2) Cerebrovascular accident
- (3) Retinopathy and blindness
- (4) Extremity amputations
- (5) Poor wound healing
- (6) Neuropathy
- (7) Chronic Kidney Disease

Technology and Medicine: With technology advancing daily in today's world, there is increasing research to see how technology can help reach people with limited access to health care. Lepard et al found a retention rate of self-managed diabetes interventions up to 80% with the use of telemedicine and face-to-face meetings.⁵ A 2014 meta-analysis also found a correlation between the use of telemedicine and a decrease in hemoglobin A1C levels.⁶ More specifically, Hall et al found that "the majority of published text-messaging interventions were effective when addressing diabetes self-management."⁷

Project Goal: The goal of this project was to conduct quality improvement including a needs assessment and to design and pilot-test a text-messaging intervention for individuals with diabetes living in rural counties in North Carolina.

Needs Assessment

This project focused on a Chapel Hill Family Medicine Clinic (FMC). As part of the FMC's health care quality initiative, a metric-based preventative approach was implemented into the clinic. The clinic measures 15 different metrics (Figure 2) that have been shown to decrease mortality and morbidity. Due to the plethora of patients suffering from diabetes and its known health complications worldwide, we decided to focus this project on the FMC health metric of a Hemoglobin A1C < 9%, focusing on rural North Carolina patients.

Needs assessment goals were to:

- (1) Identify and analyze the patient population and community
- (2) Identify stakeholders (Figure 1)
- (3) Assess strengths, assets, and resources within the community of interest
- (4) Prioritize and design a plan to address the identified issue.

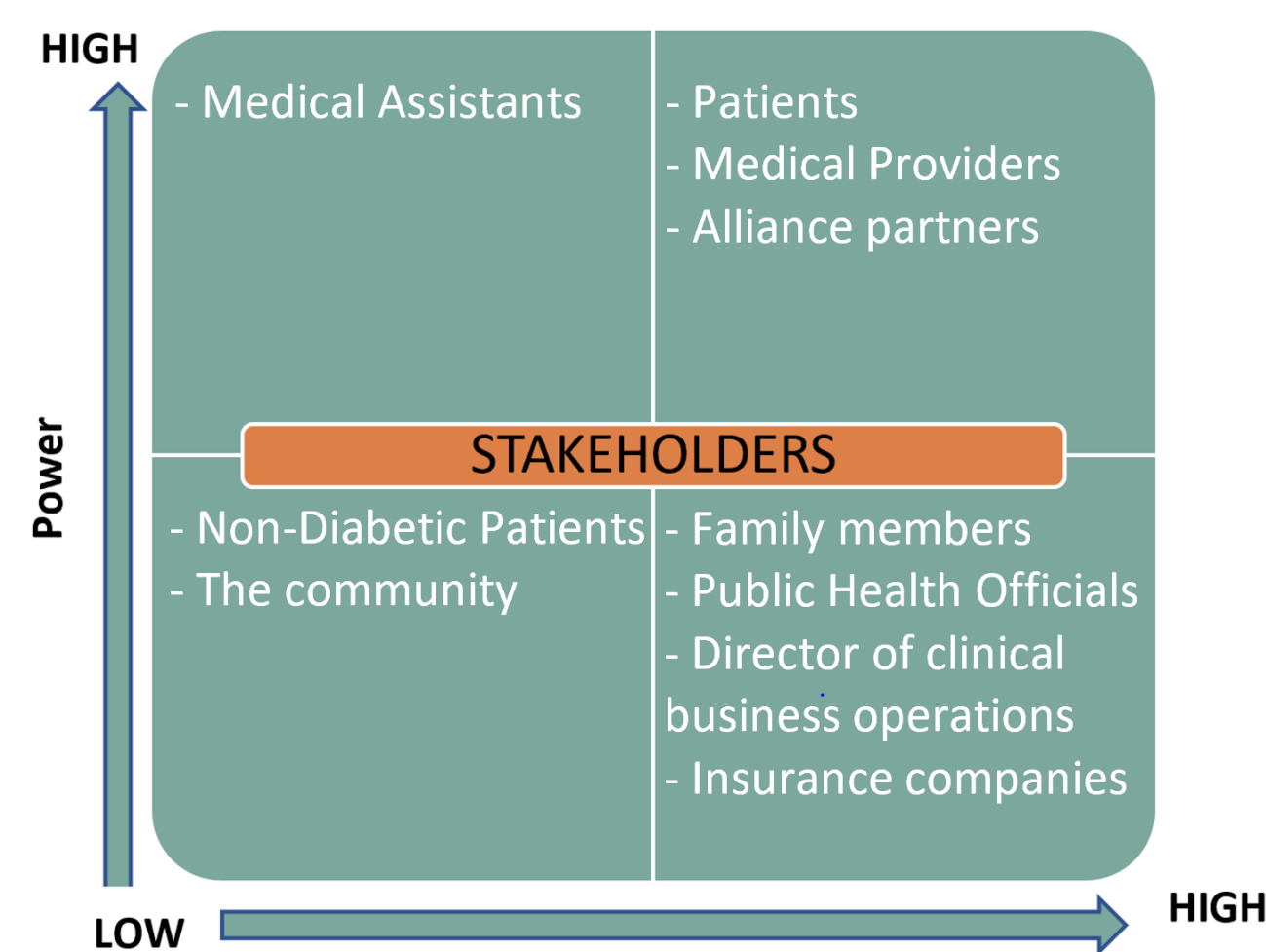


Figure 1. Stakeholders FMC.

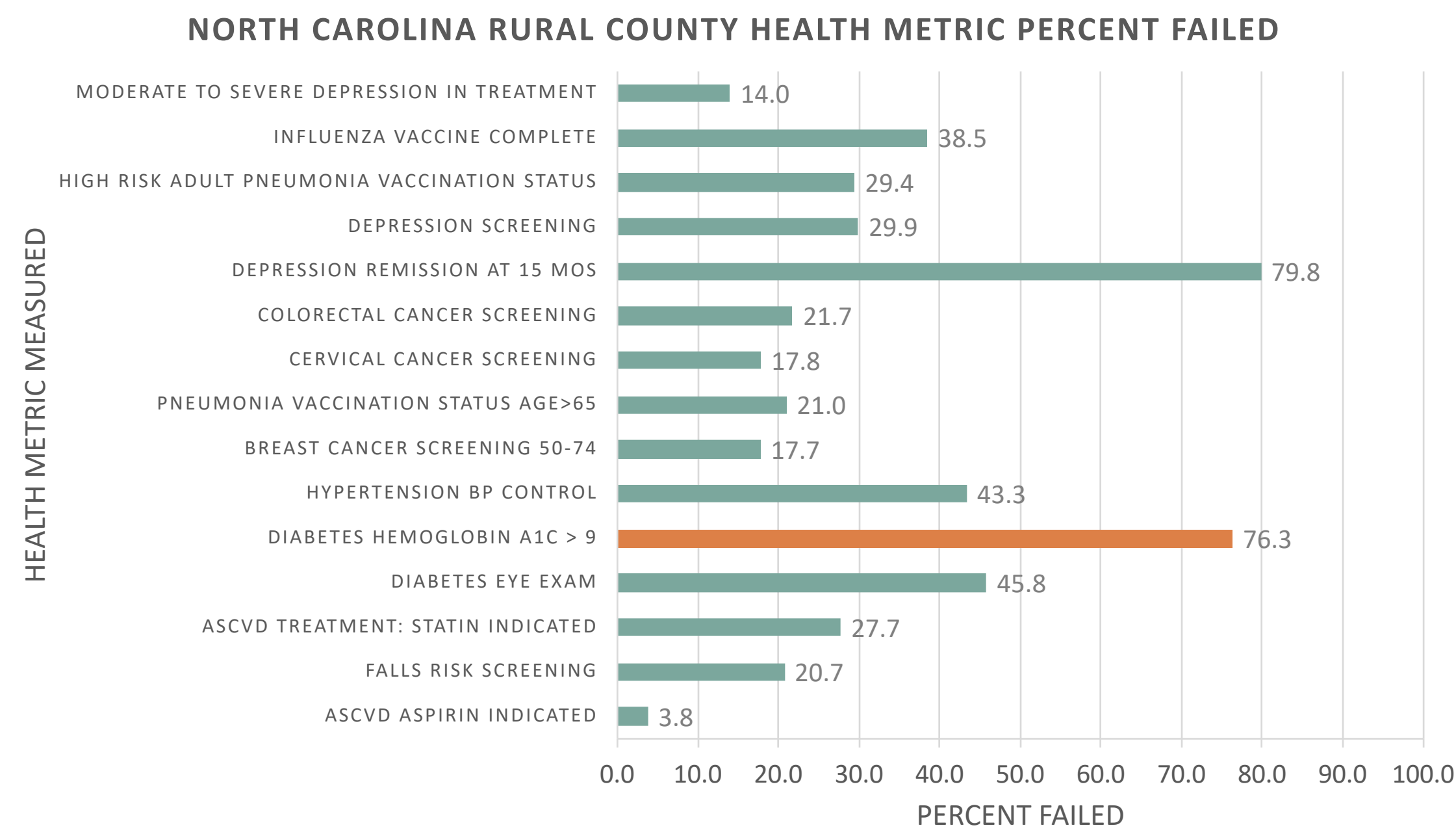


Figure 2: North Carolina Rural County Health Metric Percent failed.

Methods and Materials

Inclusion Criteria: Patient inclusion criteria were:

- (1) Diabetes mellites (either Type I or Type II)
- (2) Active FMC patient
- (3) Age of 18 – 70 years old
- (4) Chatham County resident
- (5) Valid cell phone number with text capability
- (6) English language fluency

Recruitment: All patients at the FMC that met the inclusion criteria were recruited via telephone to assess whether they would be interested in participating in our quality improvement project. The goal was to recruit at least 50 -100 individuals for the project.

Intervention: To help educate and motivate diabetics in Chatham County we decided to use technology as a tool, specifically using SMS text messaging. All participants could opt in or out of the four categories of messages by simply replying to the original text message with a keyword. Each participant got two messages per category per week.

Categories included (Figure 3):

- (1) General diabetic information
- (2) Nutrition
- (3) Exercise
- (4) Medication management

Outcome Measures: A diabetic self-efficacy survey was used to measure the impact of the SMS messages. The self-efficacy survey consisted of 8-questions that rated each answer on a scale of 1 – 10. This survey was administered pre and post text messages to see if the participants felt an improvement in self-efficacy in their own diabetes care.



Figure 3. Sample Text Messages

Results

- 126 participants who met our inclusion criteria and were contacted either via telephone or a "MyChart" message.
- **44 participants (34.9% enrollment rate)** agreed to enroll in the project
- After the initial enrollment messages were sent out to the 44 participants, **39 participants opted** into the general group.
- Of the general group, 10 participants opted into the medication only group, and 7 participants opted into both the nutrition and exercise groups, but not the medication group.
- Each group participant was sent 2 text messages randomly during the week. A total of 8 messages were sent per week; 24 text messages were sent in total.
- **8/44 self-efficacy pre-surveys** completed, demonstrating a survey completion rate of 18%.
- **6/44 self-efficacy post-surveys** were completed (Figure 4).

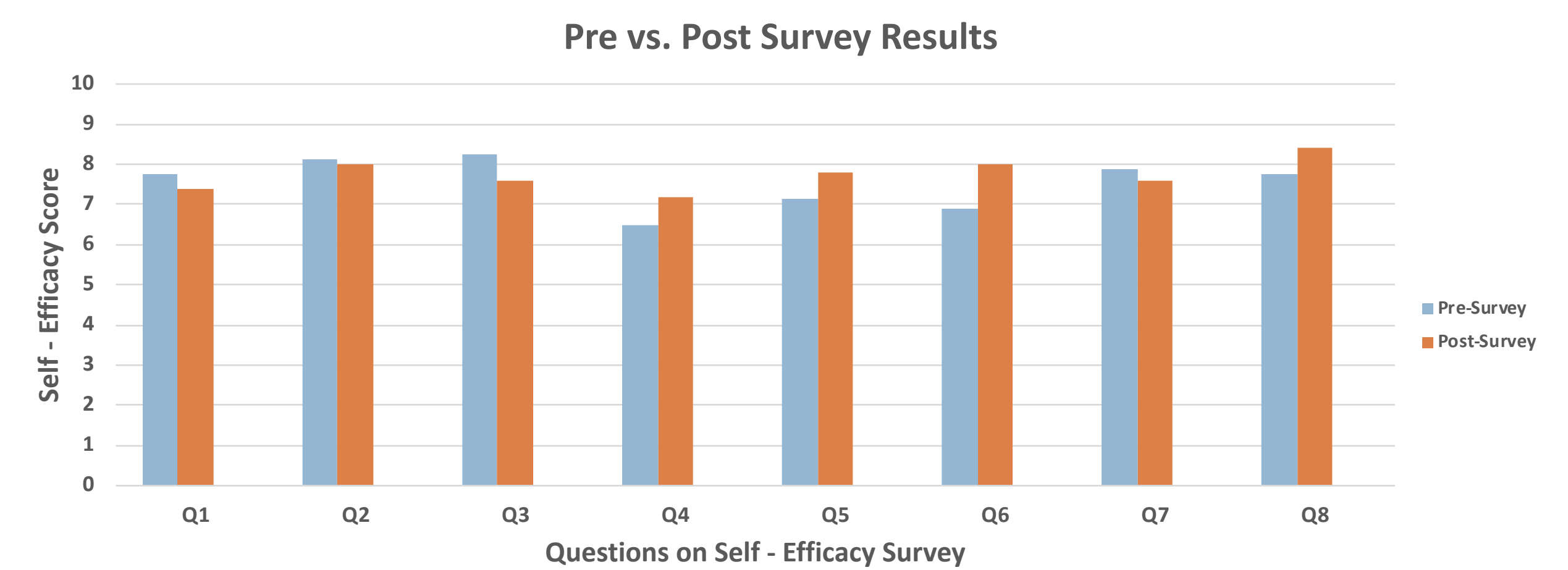


Figure 4. Pre vs. Post Survey Results

Discussion

The focus of this program plan was to positively impact diabetic patients' disease self-management using technology. Our intentions were to set up a program that would send patients SMS text messages pertaining to their diabetes. Based on the health belief model, we believed that if we educated and motivated the participants, then we would see a positive change. Despite previous research showing a positive change in diabetics with the use of text messages, our results are inconclusive as to whether there was a positive change.^{6,7} As figure 4 shows, the pre- and post-survey results are inconsistent. About half of the self-efficacy questions demonstrated a positive change and the other half showed a negative change.

Limitations:

- Complexity of technological platform used
 - Age of patients may have impacted familiarity with technology
 - Patients replied to many messages incorrectly, such that the website alerted the researchers of this issue via email.
- Compressed timeframe- Project was conducted within a typical college semester
 - Expanded duration of time would allow for better planning and implementation.
 - Sending participants messages for a greater duration of time may be more impactful.
 - Other metrics could have been studied, such as trending Hemoglobin A1C measurements.

Strengths:

- Recruitment rate (35%)- demonstrated patient interest in engagement outside of a clinical setting
- Successful focus on rural patient population with high prevalence of Diabetes
 - Implementing precise inclusion criterion led to identification of many appropriate patients

Conclusions

Diabetes continues to be a huge medical concern that affects millions worldwide. With diabetes becoming a societal norm, a solution is needed now more than ever to aid in the billions of dollars diabetics spend on their medical care related to their diabetes and diabetes-associated comorbidities. Due to our world becoming more technologically driven and advanced, telemedicine is shaping to be a viable option to reach more patients worldwide. With the use of technology, healthcare providers can better educate, motivate, and hold patients accountable for their actions that impact their health beyond the clinic walls. Our project was able to support that telemedicine may be a viable option to reach patients in under-resourced areas, and we need to continue to explore this in order to optimize the delivery of care to improve health outcomes for the ever-pressing diabetes epidemic.

Contact

William Churchwell, PA-S; Jeanette Elfering, PA-S
University of North Carolina Chapel Hill, Physician Assistant Program
Bill_churchwell@med.unc.edu; Jeanette_elfering@med.unc.edu

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