A Thesis

entitled

Factors that Influence Physician Referral to Diabetes Self-Management Education in Patients with Type 2 Diabetes

by

Rebekah L. Panak, PharmD

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the

Master of Science Degree in

Health Outcomes and Socioeconomic Sciences

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May 2018

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An Abstract of

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Objectives: To determine the development of physician likelihood to refer based off the conceptual meaning of the hierarchical arrangement of items. To examine relationships between predictors* and the likelihood of referring patients to DSME programs. To determine the predictors* of physician likelihood to refer patients to DSME programs. To assess the likelihood of referral to DSME among practice specialties. *Predictors include: age, sex, practice specialty (family/general practitioner, internal medicine, endocrinology, or other), practice setting (hospital, medical group, private practice, or other), percentage of patients with diabetes seen monthly, attitude toward referring to DSME, social norm toward referring to DSME, and perceived behavioral control toward referring to DSME.

Methods: Rasch analysis was used to calibrate the survey instrument and asses development of likelihood to refer. Pearson's correlation was performed to assess relationships among predictors and likelihood of physician referral. A linear regression was used to determine predictors of physician likelihood to refer. After analysis and

assessing responses, it was determined additional post hoc analysis was needed. One-way ANOVA was conducted to assess the likelihood of referral among provider types and practice settings.

Results: Some attitudes and aspects of self-efficacy may be critical antecedents of intention to refer patients with type 2 diabetes to DSME. However, no conceptually meaningful arrangement of items was identified when assessing development of likelihood to refer. Physician intent to refer patients to DSME demonstrated a moderately positive relationship with attitude, subjective norm, and perceived behavioral control ($r = 0.369, 0.339, 0.478$, respectively, $p < 0.001$ all). Provider type was found to have a weak negative relationship with intent ($r = -.123$, $p = 0.013$) and perceived behavioral control ($r = -.153$, $p = 0.002$). Percentage of patients with diabetes had a weak a positive relationship with intent to refer ($r = .117$, $p = 0.018$) and perceived behavioral control ($r = .101$, $p = 0.041$). Age had a weak negative relationship with perceived behavioral control ($r = -.133$, $p = 0.007$) and sex had a weak positive relationship with attitudes ($r = .162$, $p = 0.001$). Overall, the model explained 31.9% of variance in intention to refer to DSME. Percent of patients seen monthly with diabetes contributed a small amount to the model ($\beta = 0.104$, $p = 0.018$). No other demographic factors were found to be statistically significant. Attitudes ($\beta = .341$, $p = 0.013$) and perceived behavioral control ($\beta = .447$, $p < 0.001$) also significantly contributed to the model. Subjective norms were not found to be a significant predictor of physician intent. One-way ANOVA was statistically significant ($F = 4.998$, $p = 0.001$). Post hoc analysis identified physicians who selected "other" for provider type had a statistically significant difference in intention to refer than

the provider types of interest to the study. No difference was found in intention to refer among any other provider types.

Conclusion: Despite how commonplace referrals are, there is substantial variation in how and when physicians choose to refer to DSME. Attitudes and perceived behavioral control had a moderate, positive effect on the variation in physician intent to refer patients with type 2 diabetes to DSME. Perceived behavioral control had the largest impact on physician intent. Percent of patients had a small positive impact. Overall, physicians' attitudes toward the benefits of referring a patient with type 2 diabetes to DSME were positive. There was no statistically significant difference in intention to refer among provider types of interest (general/family physicians, internal medicine physicians, endocrinologists).

I would like to dedicate this thesis to my loving fiancé, Dalton Stuart, my wonderful parents, Bernard and Charlene Panak, and my dog, Bella. Their constant love and support inspired me through my journey as a fellow at the University of Toledo. Words cannot express my immense gratitude for all of the encouragement, laughs, and hope they have given me throughout this experience. I love you all so much.

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List of Abbreviations

AADE ..... American Association of Diabetes Educators
AAMC ..... Association of American Medical Colleges
ADA ..... American Diabetes Association
ATT ..... Attitudes

BC-ADM ..... Board Certification in Advanced Diabetes Management

CDC ..... Center for Disease Control
CDE ..... Certified diabetes educator
CMS ..... Centers for Medicare and Medicaid Services
CPA ..... Collaborative practice agreement
CQI ..... Continuous quality improvement

DSME ..... Diabetes self-management education
DSME/S ..... Diabetes self-management education and support

ESRD ..... End stage renal disease

HCP ..... Health care professional
HEDIS ..... Healthcare Effectiveness Data and Information Set

INT ..... Intent

MNT ..... Medical nutrition therapy

PBC ..... Perceived behavioral control
PC ..... Pharmaceutical care

SN ..... Subjective norm

TPB ..... Theory of Planned Behavior

US ..... United States

Chapter 1

Introduction

1.1 Background

Diabetes is a serious and progressive disease that is reaching epidemic proportions. With increasing prevalence, it poses a substantial economic burden to health care systems everywhere. Currently, it is estimated that 30.3 million people in the United States (US) have diabetes, which equates to the presence of disease in roughly 1 out of every 10 people.[1] Diabetes is the seventh leading cause of death in the US and can lead to chronic complications when blood glucose remains uncontrolled over time. Appropriate self-management behavior is one of the key determinants of successful blood glucose control. It is also the primary goal of diabetes self-management education (DSME). The addition of patient-centered interventions, such as those provided with DSME, can lead to improved patient health outcomes.[2-7]

Diabetes is a chronic lifestyle disease where patients have to make numerous daily decisions and perform several complicated self-care activities. Effective patient self-management is crucial because 95% of diabetes care is provided daily by the patient at home.[8] DSME is the process of facilitating the knowledge, skill, and ability necessary for diabetes self-care. It provides a foundation that assists people in navigating daily self-

management decisions and activities related to diabetes. It has also been shown to improve health outcomes and reduce long-term medical costs associated with diabetes.[2,5-7,9-16] However, the utilization of DSME is abysmally low. On average, less than 7% of patients with diabetes are referred to a diabetes educator or DSME program.[9] DSME is not covered by all insurances; however, many insurance companies offer eHealth interventions for people with diabetes. Unfortunately, these interventions have high dropout rates.

With the expanding role of pharmacists in health care, new opportunities for direct patient care in disease state management have emerged. In the past, DSME was delivered by registered nurses, dieticians, or certified diabetes educators (CDE); however, this service has been expanded to pharmacists over a decade ago. Pharmacist-led interventions and direct patient care have been shown to improve health outcomes and disease states including diabetes.[17-19] Furthermore, pharmacists are an ideal provider of DSME as they see patients on a regular basis and are one of the most accessible health care professionals. Thus, utilizing pharmacists to provide direct patient care through DSME is a practical solution to help improve the quality of health care for patients with diabetes.

DSME offers numerous benefits to patients and their health. For instance, DSME can improve hemoglobin A1c by as much as 1% in patients with type 2 diabetes and can reduce the onset and/or progression of diabetes complications.[9-11] Additionally, it is reported to decrease the presence of diabetes-related distress[12,20] and depression.[9,13,21] DSME has also been shown to improve quality of life[2-4,14,22] and lifestyle behaviors such as increasing healthful eating patterns and engaging in regular physical activity.[9,23]

Lastly, psychosocial improvements attributed to DSME have been observed such as enhancements in healthy coping abilities, self-efficacy, and empowerment.[9,15,24] Although the health benefits of DSME are clear it continues to be underutilized.

Along with improved health outcomes, DSME has been proven to decrease hospital admissions and readmissions.[5,6,16] It also decreases estimated expenses associated with a lower risk for complications.[7,9] Given that the cost of diabetes in the US was $320 billion in 2015, there is a need to reduce costs by increasing utilization of DSME. With the projected increase in cost of diabetes, the health care system will be unable to afford the expenditure on care unless incidence rates and diabetes-associated complications are reduced.

Despite the overwhelming body of evidence supporting DSME and it's associated benefits, barriers exist to the provision of such a service. One barrier that is currently contributing to the underutilization of DSME is a lack of physician referral, which is necessary for insurance reimbursement. To the best of the researchers knowledge, no studies have been conducted regarding physician referral to DSME for patients with type 2 diabetes. There is a need to understand what impacts physician referring behavior regarding DSME to improve utilization rates.

In order to identify factors that influence the desired behavior, physician referral to DSME, the Theory of Planned Behavior (TPB) will be applied to this study. Physicians are generally a difficult population to reach in research, thus there have only been a limited number of studies examining physician behavior using the TPB. There is a need to contribute to this existing body of literature. The TPB is commonly used to investigate patient behaviors, however research suggests that the model has relevance for examining

the behaviors of physicians.[25] Studies that have used the TPB in predicting physician behavior or intention commonly examine demographic factors (i.e. age, gender, occupation, etc.), attitudes toward the behavior, subjective norms toward the behavior, and perceived behavioral control of the behavior. Demographic factors captured in other studies examining physician behavior often include age, gender, race/ethnicity, years of clinical practice experience, current practice setting, and occupation or specialty (i.e. internal medicine, endocrinology, etc.).[26-28] Including demographic factors has been shown to improve the model in physician prescribing studies and may also contribute to referral behaviors.[25] These demographic factors have not yet been studied in the context of referring to DSME hence their inclusion in this study.

1.2 Rationale

The prevalence of diabetes is increasing yearly. One third of the US population has prediabetes, 15-30% of which will develop type 2 diabetes in 5 years.[1] Diabetes is a costly disease that can lead to increased morbidity and mortality.[29] Patients with diabetes can benefit from being educated on the disease and key self-care behaviors. DSME provides this knowledge and facilitates the development of self-care skills to help patients become successful self-managers. Although diabetes is a chronic condition, with constant monitoring, lifestyle changes, appropriate medication therapy, and self-management a patient can lead a better quality of life and decrease their cost of medical care.[2-7]

DSME provides clinical, humanistic, and economic benefits yet referral rates remain extremely low. A study conducted by the Maine Department of Health and Human Services found that only 28% of patients reported that their physicians talked to

them about going to DSME classes.[30] There is little communication about DSME between patients and physicians.[31] Many patients prefer to get health information about their condition(s) or DSME from physicians, as they are a highly trusted source.[30,31] This is an issue because increasing time constraints during physician visits limits the amount of time available for education.[32] As a result, patients may not be receiving comprehensive diabetes education if they rely solely on their physician alone for information. Pharmacists could fill this gap, however patients would still require a physician referral for insurance reimbursement.

The Maine study discussed above also discovered that only 1 in 4 individuals who were newly diagnosed with type 2 diabetes were receiving DSME in 2006.[30] During 2011-2012, of those with private insurance who were newly diagnosed with type 2 diabetes, only an estimated 6.8% participated in DSME within the first 12 months of diagnosis.[9,33] Similarly in the Medicare population, only 4% of participants received DSME and/or medical nutrition therapy (MNT) within the first 12 months of diagnosis.[9,34] One retrospective study examined referral rates to DSME using secondary clinical data from 2006 to 2013 and found that only 7% of patients with type 2 diabetes received a referral to DSME.[35] In 2008, only 56.8% of adults diagnosed with diabetes reported ever having received any type of formal diabetes education.[36] On average, less than 7% of patients with diabetes are referred to a diabetes educator or DSME program.[9] The average number of referrals is significantly low suggesting that physicians may not be referring patients to DSME at appropriate times per the American Diabetes Association (ADA) guidelines. This literature implies that there is a gap between the use of recommended ADA guidelines and physicians' current clinical practice. It is important

to learn why this might be the case given the benefits of DSME, thus a better understanding of factors impacting physician referral is necessary.

This study used the Theory of Planned Behavior (TPB) as a framework to identify predictors of physicians' intent to refer patients with type 2 diabetes to DSME. The TPB asserts that the performance of a behavior is determined jointly by motivation and ability.[37] The TPB model has been used in research relating to physician referral and prescribing behaviors. The use of the TPB helped in understanding physicians' prescribing behavior and their intentions to implement clinical guidelines.[25] The TPB model has been used primarily to predict intentions and behaviors of patients; however, research indicates that the model has relevance for examining the behaviors of healthcare providers as well.[38]

1.3 Significance

This study aims to identify factors that influence physician referral to diabetes self-management programs in an effort to help increase referral rates. Knowledge of physicians' perspectives on the advantages of DSME may help pharmacists in creating new programs that compliment physicians' treatment of patients. This knowledge can also help pharmacists align their program to better suit physician needs and fill in the gaps of patient education. Involvement in planning may facilitate a more collaborative relationship between community pharmacists and physicians. It may also help pharmacists market their programs to physicians more effectively and increase referral rates.

Additionally, a better understanding of the influences impacting referrals can help pharmacists enhance programs through continuous quality improvement (CQI) plans that target the influential factors. Some of these metrics include the Centers for Medicare and Medicaid Services (CMS) star ratings and the Healthcare Effectiveness Data and Information Set (HEDIS). Both of these quality metric sets have specific measures for diabetes care, the focus of which is to improve health outcomes. The benefits of DSME impact a number of these measures for both pharmacies and physicians. For pharmacies, measures that can be improved through DSME include the following four out of five CMS star ratings: adherence to oral diabetes medications, adherence to blood pressure medications (if applicable), adherence to statin medications, and the number of patients with diabetes who are not on a statin for secondary prevention of cardiovascular events. For physicians, all of the HEDIS measures relating to diabetes may be improved through DSME. HEDIS quality measures that may improve as a result of patient participation in DSME include the following: patient adherence to hemoglobin A1c testing and comprehensive dilated eye exams, medical attention for nephropathy, and control of diabetes (reduction in hemoglobin A1c) and blood pressure. The impact DSME can have on quality metrics and health outcomes is yet another reason community pharmacists and physicians should collaborate to provide comprehensive team-based diabetes care.

1.4 Goal

To identify factors that influence physicians' referral behaviors to diabetes self-management education (DSME) programs.

1.5 Objectives

1. To determine the development of physician likelihood to refer to DSME based off the conceptual meaning of the hierarchical arrangement of items.
2. To examine relationships between predictors* and the likelihood of referring patients to DSME programs.
3. To determine the predictors* of physician likelihood to refer patients to DSME programs.
4. To assess the likelihood of referral to DSME among provider types and practice settings.

*Predictors include: age, gender, provider type (family/general physician, internal medicine physician, endocrinologist, or "other"), practice setting (hospital, medical group, private practice, or "other"), percentage of patients with diabetes seen monthly, attitude toward referring to DSME, social norm toward referring to DSME, and perceived behavioral control toward referring to DSME.

1.6 Research Questions

1. How do items arrange hierarchically and is this arrangement conceptually meaningful?
2. What is the relationship between the predictors and the likelihood of physician referral to DSME programs?
3. Do physicians' demographics, attitudes toward referring to DSME, social norm toward referring to DSME, and perceived behavioral control toward referring to

DSME have an influence on the likelihood of physicians referring to DSME programs?

4. Is the likelihood of referral to DSME different among practice specialties?

1.7 Research Hypotheses

1. Items will have a conceptually meaningful arrangement.
2. There will be a positive relationship between predictors and the likelihood of physician referral to DSME programs.
3. Physicians' demographics, attitudes toward referring to DSME, social norm toward referring to DSME, and perceived behavioral control toward referring to DSME will predict the likelihood of physicians referring patients to DSME.
4. The likelihood of referral to DSME will be different among practice specialties.

Chapter 2

Literature Review

This chapter provides an overview of the literature related to the study. It is divided into the following sections:

- Diabetes
- Diabetes Self-Management Education
- Pharmacist-Provided Interventions
- eHealth Interventions
- Collaborative Practice
- Perspectives of Healthcare Professionals
- Theory of Planned Behavior

2.1 Diabetes

2.1.1 Prevalence and Complications

Diabetes is a chronic disease and as prevalence increases, this serious disease is a major threat to public health. As of 2015, the Centers for Disease Control (CDC) reports that 9.4% of the population in the US has diabetes.[1] Furthermore, one third of the US

population, about 84.1 million people, has prediabetes.[1] Of these, 15-30% will develop type 2 diabetes within 5 years.[1] Diabetes is the seventh leading cause of death in the US and decreases life expectancy by up to 8 years.[29] Individuals who have diabetes have a two to threefold increase in all-cause mortality compared to those without diabetes. Additionally, they have an increased risk of morbidity from complications including retinopathy, nephropathy, neuropathy, and cardiovascular disease.[29] Diabetes is the leading cause of adult-onset blindness, end stage renal disease (ESRD), and non-traumatic lower extremity amputations.[39, 40] In addition, it is associated with an increase incidence of ischemic heart disease, stroke, peripheral vascular disease, birth complications, and sexual dysfunction.[39, 41, 42]

2.1.2 Economic Burden

As a result of the disease and its complications, individuals with diabetes take more medications, require more outpatient visits, have a higher possibility of being hospitalized, and are more likely to require emergency or long-term care than people without the disease. On average, people in the US with diabetes spend slightly more than two times the amount of money on medical care than people without the disease.[1, 43] The CDC estimated that the total expenditure on diabetes in 2012 was $245 billion.[1] According to the International Diabetes Federation, this increased to $320 billion in 2015.[44] Globally, health expenditure on diabetes is estimated to increase 19% by 2040.[44] With increasing trends in prevalence and health care spending, it is important to improve patient outcomes and reduce health care costs.

2.2 Diabetes Self-Management Education

2.2.1 Introduction

Diabetes self-management education (DSME) is the ongoing process of facilitating the knowledge, skill, and ability necessary for diabetes self-care. This process is guided by evidence-based research and incorporates the needs, goals, and life experiences of the person with diabetes. DSME programs are designed to address patient specific factors that impact an individual's ability to meet the challenges of daily self-management. DSME is individualized to the patient and addresses the patient's health beliefs and attitudes, cultural needs, current knowledge, readiness to learn, and health literacy.[9] It also addresses the patient's physical limitations, emotional concerns, family support, financial status, and medical history.[9] The main objectives of DSME are to support informed decision-making, self-care behaviors, problem solving, and active collaboration with the health care team.[9] Other goals include improving clinical outcomes, health status, and quality of life.[9]

2.2.2 Recognition and Accreditation

In order for insurance reimbursement, DSME programs must be recognized or accredited. The American Association of Diabetes Educators (AADE) and the American Diabetes Association (ADA) are the two organizational bodies that provide national accreditation or recognition to DSME programs. In order for a program to obtain recognition or accreditation, an application must be submitted along with a fee. In the application, programs must meet the requirements of the National Standards for Diabetes Self-Management Education and Support (see Table 1). The application must also show the progression of at least one de-identified pilot patient through the entire program.

Table 1. National standards for diabetes self-management education and support (DSME/S)[45]

National Standard	Description
Standard 1 **Internal Structure**	The provider(s) of DSME will document an organizational structure, mission statement, and goals. The DSME services are incorporated within the organization—large, small, or independently operated.
Standard 2 **External Input**	The provider(s) of DSME services will seek ongoing input from valued stakeholders and experts to promote quality and enhance participant utilization.
Standard 3 **Access**	The provider(s) of DSME services will evaluate the communities they serve to determine the resources, design, and delivery methods that will align with the population's need for DSME services.
Standard 4 **Program Coordination**	A quality coordinator will be designated to ensure implementation of the Standards and oversee the DSME services. The quality coordinator is responsible for all components of DSME, including evidence-based practice, service design, evaluation, and continuous quality improvement.
Standard 5 **Instructional Staff**	At least one of the team members responsible for facilitating DSME services will be a registered nurse, registered dietitian nutritionist, or pharmacist with training and experience pertinent to DSME or be another health care professional holding certification as a diabetes educator (CDE) or Board Certification in Advanced Diabetes Management (BC-ADM). Other health care workers or diabetes paraprofessionals may contribute to DSME services with appropriate training in DSME and with supervision and support by at least one of the team members listed previously.
Standard 6 **Curriculum**	A curriculum reflecting current evidence and practice guidelines, with criteria for evaluating outcomes, will serve as the framework for the provision of DSME. The needs of the individual participant will determine which elements of the curriculum are required.
Standard 7 **Individualization**	The DSME needs will be identified and led by the participant with assessment and support by one or more DSME team members. Together, the participant and DSME team member(s) will develop an individualized DSME plan.

Standard 8 **Ongoing Support**	The participant will be made aware of options and resources available for ongoing support of their initial education and will select the option(s) that will best maintain their self-management needs.
Standard 9 **Participation Progress**	The provider(s) of DSME services will monitor and communicate whether participants are achieving their personal diabetes self-management goals and other outcome(s) to evaluate the effectiveness of the educational intervention(s), using appropriate measurement techniques.
Standard 10 **Quality Improvement**	The DSME services quality coordinator will measure the impact and effectiveness of the DSME services and identify areas for improvement by conducting a systematic evaluation of process and outcome data

As evidenced by these national standards, obtaining recognition or accreditation is a rigorous process. These standards ensure that the program utilizes evidenced-based and up to date information for patient education. They also ensure that the content delivered in the program is determined largely by and tailored to individual patient needs. The national standards serve as a structural backbone in developing a DSME program. They also help maintain quality through continuous improvement plans and feedback from stakeholders in the community.

2.2.3 Providers of DSME

Historically, DSME has been provided by nurses and dieticians, however this role has been expanded to other disciplines in recent years, particularly pharmacists. One or more key instructors are responsible for designing, planning, and providing DSME services. The national standards for diabetes self-management education requires at least one of these primary instructors be: a pharmacist with training and experience relevant to DSME, a registered nurse, a dietician, or another professional certified in diabetes care

and education. Other professionals certified in diabetes care include individuals such as a certified diabetes educator (CDE) or someone board certified in advanced diabetes management (BC-ADM).[45] Additionally, instructors must have educational training in diabetes beyond their academic preparation.[45] Instructors must also document annual continuing education to ensure their competence.[45] While the education must be provided by one of these key instructors, community health workers can contribute to DSME with appropriate training.[45] Although there are no identified differences in the quality of services delivered by different professionals, literature favors the use of pharmacists, registered nurses, and registered dietitians as the key primary instructors for diabetes education.[45]

2.2.4 Curriculum

DSME utilizes an evidence-based, flexible curriculum with an interactive approach to individualize content. A written curriculum serves as the framework for the provision of DSME, but the needs of each individual are assessed to determine what content will be delivered. The national standards for diabetes self-management education require that the curriculum used be dynamic, reflect current evidence and practice guidelines, and provide criteria for evaluating outcomes.[45] The two accrediting organizations for DSME programs, AADE and ADA, offer or sell their own published curriculums, which are commonly used. However, numerous published curriculums meet the national standard requirements, thus the curriculum used in different DSME programs varies widely. Though curriculums may differ among programs, there are similarities in the overall content delivered. Table 2 highlights fundamental topics that are commonly part of the curriculum taught in comprehensive DSME programs.

Table 2. Core topics common among DSME curriculums[45]

Topic	Description
Diabetes	Describing the diabetes disease process and treatment options
Healthy Eating	Incorporating nutritional management into lifestyle
Being Active	Incorporating physical activity into lifestyle
Medications	Using medication(s) safely and for maximum therapeutic effectiveness
Monitoring	Monitoring blood glucose and other parameters and interpreting and using the results for self-management decision making
Reducing Risks	Preventing, detecting, and treating acute and chronic complications
Healthy Coping	Developing personal strategies to address psychosocial issues and concerns
Goal Setting	Developing personal strategies to promote health and behavior change

2.2.5 Educational Process and Outcomes Measured

The educational process provided through DSME is interactive and collaborative. It assesses, implements, and evaluates the educational intervention to meet the needs of the individual.[46] DSME provides individualized education plans for each patient which include interventions to be implemented and desired outcomes. These plans are developed collaboratively with the patient and help to guide the process of working with each participant.[46] A support plan is created in a similar manner for each individual and details the patient's follow up and progress assessments. The education and support plans address action-oriented behavioral goals and outline a plan for progress towards achieving those goals.[46]

Education is an essential element of diabetes care, however, the acquisition of knowledge without behavior change is futile. In addition to patient knowledge, behavior change is a unique outcome measurement of DSME.[46] Behavior changes monitored in DSME involve key self-care behaviors such as healthy eating, being physically active, taking medication, monitoring blood glucose, problem solving, healthy coping, and reducing risks. DSME places equal emphasis on the content being taught and on facilitating healthy behavior change.[46] Effective self-management includes not only the acquisition of knowledge, attitude, and skills but also the adoption of behavior change strategies.[46]

2.2.6 Reimbursement

Currently, Medicare reimburses pharmacists in all 50 states for providing DSME services in a variety of settings. In order for Medicare to reimburse providers of DSME, the program must be nationally accredited through one of two organizational bodies, AADE or ADA.[47] Additionally, Medicare requires a referral from the treating physician with specified diagnostic criteria and lab results.[47] Once accredited, Medicare will reimburse for up to 10 hours of initial DSME in the year following referral and up to 2 hours of follow-up each year after.[48] Within the initial 10 hours of training, Medicare further stipulates that recipients may receive a maximum of 1 hour of individual education and up to 9 hours of group education.[47] Medicare will reimburse for one-on-one education for the full 10 hours if the beneficiary has special needs or if there is no group training available within two months of the date the training is ordered.[47] The 2 hours of follow-up after the initial DSME may be provided as individual or group education and requires a separate referral each year follow-up is needed.[47]

Medicaid eligibility and coverage of DSME varies among states. Medicaid covers DSME services in approximately two-thirds of the US with various state limitations or restrictions.[48] The following states do not cover or do not explicitly indicate that DSME services are covered for Medicaid beneficiaries: Alabama, Alaska, Arizona, Connecticut, Delaware, Florida, Georgia, Illinois, Kansas, Kentucky, Nebraska, New Hampshire, Ohio, Oklahoma, Oregon, Tennessee, Virginia, and Wisconsin.[48,49] For states that do provide coverage of DSME, each state has unique stipulations regarding coverage. Some states may limit DSME coverage based on the type of plan the beneficiary holds or if they are enrolled in managed care. Some states may limit coverage based on whether the individual is a medium or high-risk patient. While Medicare requires a physician referral, Medicaid requirements vary by state and may include a referral, a prescription, or a prior authorization. Coverage for the number of hours of DSME, the number of DSME sessions, and the amount of follow-up education also varies greatly between states.

Private insurance coverage of DSME services also varies from state to state. Private insurance includes coverage provided by an employer, purchased through an Affordable Care Act Marketplace, or purchased directly from an insurer. A majority of the state laws require most or all private health insurance plans to cover DSME services. The following states do not have laws in place requiring private insurances to cover DSME: Alabama, Arizona, Delaware, Idaho, Mississippi, North Dakota, and Ohio.[48] In some states like Missouri, state laws only require private insurers to offer policies that cover DSME.[48] Similar to Medicaid, some states limit coverage based on the type of plan the beneficiary has. For instance, Illinois and Oregon only cover DSME under group policies.[48] Although not all private insurances reimburse for DSME, some provide their

own self-management education that focuses on general "healthy behaviors" while others provide eHealth interventions.

2.2.7 Benefits

The provision of DSME through an accredited or recognized diabetes education program is clinically beneficial and cost-effective. For instance, DSME can improve hemoglobin A1c by as much as 1% in patients with type 2 diabetes.[9-11] Steinsbekk et al[50] conducted a systematic review with meta-analysis and found significant reductions in A1c at 6 months, 12 months, and 2 years as depicted in Table 3. This study also found significant reductions in fasting blood glucose levels (1.26 mmol/l; $P < 0.00001$, 5 studies, 690 participants).[50]

Table 3. A1c reduction: Findings of a systematic review with meta analysis

Time	A1c Reduction		Number of Studies	Number of Participants
6 months	0.44%	(P = 0.006)	13	1883
12 months	0.46%	(P = 0.001)	11	1503
2 years	0.87%	(P = 0.00001)	3	397

Through this reduction in hemoglobin A1c, DSME can reduce the onset and/or progression of diabetes complications.[9-11] There are numerous complications associated with diabetes; however, DSME reinforces the importance of clinical process measures to reduce the risk of complications. These clinical process measures include having annual lipid panels, annual kidney function tests, and annual dilated eye exams performed along with monitoring hemoglobin A1c levels. DSME also emphasizes the importance of patients receiving an annual comprehensive foot exam and regular dentist visits. These

tests and exams are crucial for early detection and treatment of complications. Research has shown that patients who participate in DSME have higher adherence to medications and necessary annual exams.[5] One study examined adherence to necessary annual tests or exams over a 3 and 4-year period and found that patients who participated in DSME were significantly more adherent compared to those with no diabetes education.[5] Through improved glycemic control and early detection of complications, DSME helps to prevent or reduce long-term consequences of diabetes related complications.

DSME has also been shown to improve quality of life[2-4,14,22] and lifestyle behaviors such as increasing healthful eating patterns and engaging in regular physical activity.[9,23] Literature has reported that DSME increases self-efficacy in diabetes self-care, which has consistently been linked to an increased quality of life in patients with type 2 diabetes.[2] Positive health behavior change among adults with diabetes, such as lifestyle changes or healthy coping, has also been documented to improve quality of life.[2] One systematic review with meta-analysis saw significant improvements in lifestyle outcomes, such as diabetes knowledge (Table 4), and self-management skills at 6 months (SMD 0.55; P = 0.01, 4 studies, 534 participants).[50]

Table 4. Improvement of diabetes knowledge: Findings of a systematic review with meta analysis

Time	Standardized Mean Difference (SMD)	Number of Studies	Number of Participants
6 months	0.83 (P = 0.00001)	6	768
12 months	0.85 (P < 0.00001)	5	955
2 years	1.59 (P = 0.03)	2	355

Lastly, psychosocial improvements attributed to DSME have been observed such as enhancements in healthy coping abilities, self-efficacy, and empowerment.[9,15,24] For instance, Steinsbekk et al[50] found significant improvements in patients' sense of empowerment and self-efficacy after 6 months of DSME (SMD 0.28, P = 0.01, 2 studies, 326 participants).[50] Additionally, it is reported to decrease the presence of diabetes-related distress[12,20] and depression.[9,13,21]

Along with improved health outcomes, DSME is cost-effective by decreasing hospital admissions and readmissions,[5,6,16] as well as estimated expenses associated with a lower risk for complications.[7,9] The lower risk of complications stems from improved glycemic control and increased adherence to necessary annual screenings or exams as discussed previously. Duncan et al[5] found that over a period of 3 years, patients who participated in DSME had higher adherence rates for hemoglobin A1c tests, annual lipid panels, and annual kidney function tests; however, there was no difference in the completion of a dilated eye exam between those with and without diabetes education. The same study also examined the cost per person in both the Medicare and commercial population. This study found that DSME is associated with lower cost trends as patients who received DSME had a significantly lower per person per month insurance cost in both the Medicare and commercial populations.[5] Although the benefits of DSME are clear it continues to be underutilized due to existing barriers.

2.2.8 Barriers to DSME

Numerous barriers exist to patients receiving DSME. These barriers can be categorized into the following themes: access issues, perceptions, psychosocial or behavioral issues, program content and structure, and referring provider issues.[30]

Access issues can include physical and mental challenges, lack of transportation, inconvenient timing of classes, reimbursement issues, and limited educator availability.[30] Patient attendance issues also exist due to consumer perceptions and psychosocial or behavioral issues. Low attendance rates are in part due to both consumer perceptions and perceptions of diabetes in general. Examples of consumer perceptions include a patient believing they are managing their diabetes well or that they get all of the DSME they need from their physician.[30,31] A general perception of diabetes that may decrease attendance is the belief that diabetes and its associated complications are not serious. Psychosocial or behavioral issues can include patient attitudes such as denial or fear, patients not placing priority on diabetes management, or failure of the healthcare professional to individualize recommendations.[30]

Education program barriers vary from program to program and can include multiple factors relating to content and structure. For instance, a program may not be conducive to those requiring low literacy or a specific cultural focus. Other barriers in this category include a lack of an individual empowerment approach, the length of classes, and overwhelming patients with too much information.[30]

Physician referral issues can stem from a lack of awareness of or information about DSME. For those who are aware of DSME, there may be a misunderstanding of the scope of the program and all its benefits.[30] Some physicians may be aware of DSME, but might not realize this opportunity or may provide diabetes education in office. Other factors that may limit referral to DSME are confusion about the referral process, the difficulty of referral procedures, or a lack of access to referral resources.[30,31] One of the largest barriers of patients receiving DSME is physician referral. For DSME to be

covered by insurance, a physician's referral is required. Additionally, literature suggests that physician referrals and recommendations are an important factor in patients' decisions about health care.[31] Thus, it is essential to understand factors that influence physician referral to DSME.

2.3 Pharmacist-Provided Interventions

The role of pharmacists is expanding in health care. One method that can improve the quality of diabetes health care provided is effective implementation of a team-based care approach involving pharmacists. Pharmacist-led interventions have been shown to improve health outcomes.[17-19] For instance, once systematic review with meta-analysis found statistically significant favorable results for the following: therapeutic and safety outcomes, hemoglobin A1c, LDL cholesterol, blood pressure, adverse drug events, medication adherence, patient knowledge, and quality of life.[17] This meta-analysis found that pharmacist-led interventions resulted in mean difference reductions of hemoglobin A1c (-1.8%, CI = -2.7 to -0.9), LDL cholesterol (-6.3mg/dL, CI = -6.5 to -6.0), and blood pressure (systolic: -7.8mm Hg, CI = -9.7 to -5.8; diastolic: -2.9, CI = -3.8 to -2.0).[17] These results are similar to those reported in other literature.[17] These findings are relevant as these clinical markers are often referred to as the ABC's of diabetes management. The 'A' represents hemoglobin A1c, 'B' stands for blood pressure, and 'C' is for cholesterol. Pharmacist-led direct patient care has favorable effects on patient outcomes and disease state management. Thus, utilizing pharmacists to provide direct patient care is a viable solution to help improve the quality of health care for patients with type 2 diabetes.

Pharmacist-provided services that target patients may improve quality of life and clinical outcomes in patients with chronic conditions such as diabetes, hypertension and asthma.[51] A systematic review examining the effect of outpatient pharmacists' non-dispensing roles identified seven studies targeting patients with diabetes. Five studies assessed HbA1c, three of which demonstrated significant improvements in HbA1c ranging from 0.5% and 2.1%.[52] Three studies assessed blood glucose levels, two of which reported improvements in blood glucose between 7 mg/dL and 15 mg/dL. The Fremantle Diabetes Study conducted a randomized control trial examining the effect of a community pharmaceutical care (PC) program on vascular risk in type 2 diabetes. The PC program interventions echo those provided in DSME as both offer face-to-face visits with phone calls between visits, individualized education, and regularly scheduled follow up.[9,53] Both the PC program and DSME also offer medication reviews and communication of drug-related information between other healthcare providers.[9,53] Researchers found significant reductions of glycemia and blood pressure in the PC group. Furthermore, pharmacist intervention in the study contributed to improvement in HbA1c independently of pharmacotherapeutic changes. Thus, programs provided by pharmacists, like DSME, may prove to be a valuable element of community-based multidisciplinary diabetes care.

2.4 eHealth Interventions

Some insurance companies and drug manufacturers provide online education and support, known as eHealth interventions, for patients with diabetes. With eHealth interventions provided, not all insurance companies reimburse for DSME services from

healthcare professionals in the outpatient setting. However, eHealth interventions have significant dropout rates with some eHealth interventions showing dropout rates of up to 80%.[54,55] A recent qualitative study examined the dropout rates of eHealth interventions and found that losing motivation for participation was a major theme.[56] This theme was based on four categories: (1) frustrating technology, (2) perceiving the content as irrelevant and incomprehensible, (3) choosing other activities and perspectives, and (4) lacking face-to-face encounters.[56] This suggests that eHealth interventions lacking face-to-face encounters have a negative influence on participants' motivation for the intervention, resulting in dropout. Additionally, this study implies that patients' motivation to improve self-management of type 2 diabetes is not sufficiently supported by eHealth resources alone.[56] This aligns with other literature suggesting that planning for human support and interaction could be fundamental to upkeep motivation with the use of digital interventions.[57] One meta-analysis examined the effectiveness of Web-based tools for people with diabetes and found that participant difficulties in understanding the use of Web-based interventions led to higher dropout rates.[58] DSME provided in person decreases the use of "frustrating technology" and can improve patients' understanding of diabetes and self-care behaviors that are important to the individual.

2.5 Collaborative Practice

Traditionally, pharmacists' role in patient care involved dispensing medications and providing medication counseling. Pharmacists' role in patient care has now expanded to working with other healthcare professionals and the public. Due to fragmentation

within the US healthcare system, there is a need for pharmacist-physician collaboration. Additionally, most insurance providers require a physician order or referral to reimburse for DSME services provided by another healthcare professional. Collaborative practice agreements (CPAs) provide a unique opportunity for physicians and pharmacists to team up in the management and provision of patient care. This partnership helps to expand the capacity of health systems, to deliver more comprehensive care, and to contain costs.[59] With low physician referral rates for DSME services, it is crucial for pharmacists providing DSME to develop professional working relationships with physicians and establish collaborative practice agreements.

2.6 Perspectives of Healthcare Professionals on Disease State Management Programs

Diabetes is a complex disease that requires a multidisciplinary approach for comprehensive care. Literature shows that most healthcare professionals with direct experience of disease state management programs hold favorable views of them.[60] [61] One multisite, randomized control trial that looked at physician satisfaction before and after a collaborative disease state management program for late in life depression found that more than 85% of physicians felt a similar program would be at least somewhat helpful for treating patients with diabetes, heart failure, or depression.[61] Physicians in this study found close patient follow-up and patient education as the most helpful components of the program. Given physicians' limited time, educators who had the time and a structured protocol to provide education with systematic follow-up were seen to be crucial features

of the program.[61] These features could both strengthen the physician–patient relationship and facilitate an adequate and effective treatment course for patients.[61]

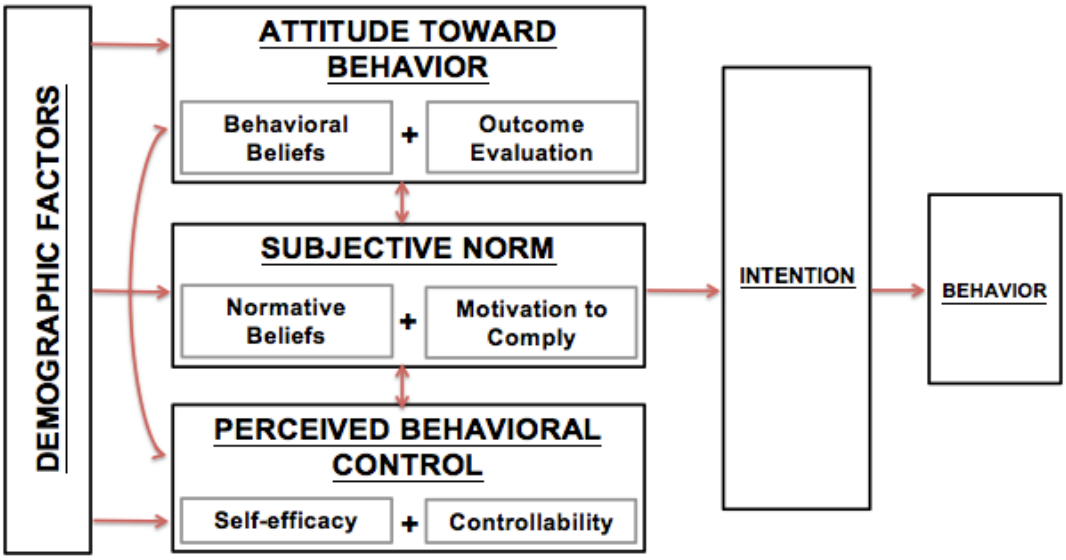
2.7 Theory of Planned Behavior

This study will utilize the Theory of Planned Behavior (TPB) as a framework to identify predictors of physicians' intent to refer patients to DSME. The TPB asserts that the performance of a behavior is determined jointly by motivation and ability (Figure 1).[37] Motivation to perform a behavior is determined by attitudes and subjective norms.[37] Ability is determined by perceived control which also impacts motivation.[37] In the TPB, attitudes are determined by individual's behavioral beliefs weighted by their evaluation of the outcome.[37] An individual's perceived social norms weighted by their motivation to comply with significant others determines subjective norm.[37] Lastly, perceived behavioral control is determined by an individual's self-efficacy in addition to controllability of performing the behavior.[37]

The TPB model has been used in research relating to physician referral and prescribing behaviors. For instance, one study examined physician behavior in following statin prescribing guideline recommendations. This study found that 48% of the variation of intent to follow prescribing recommendations per guidelines was explained by the TPB.[25] Interestingly, physicians' subjective norm was not a predictor of variation in intentions, but attitude and perceived behavioral control were.[25] Although no significant relationship was found between intention and prescribing, the use of the TPB helped in understanding physicians' prescribing behavior and their intentions to implement clinical guidelines.[25] Kam et al[26] conducted a study utilizing the TPB to assess professionals'

patterns of referral to support services for cancer patients. Findings from this study reported that 51% of the variance on 'intention to refer' was explained by TPB constructs in addition to awareness and past referral.[26] Unlike the previous study, Kam et al[26] found that subjective norms and attitudes, but not perceived behavioral control, were significant predictors of intention to refer patients to support services. This may be due to the nature of the behavior in question (i.e. prescribing vs referring). The TPB model has been used primarily to predict intentions and behaviors of patients; however, research indicates that the model has relevance for examining the behaviors of healthcare providers as well.[38]

Figure 1. Theory of Planned Behavior with Background Factors



Chapter 3

Methods

This chapter provides an overview of the methods used in this study. It is divided into the following sections:

- Study Design
- Theoretical Framework
- Study Population and Sample Size
- Instrument Development
- Instrument Reliability and Validity
- Instrument Administration and Data Collection
- Data Analysis

3.1 Study Design

This study utilized a cross-sectional survey-based approach. This approach was used as the problem in question required identification of factors that influenced a behavior, physician referral to DSME. An online survey based off of the TPB model was provided to physicians who treat patients with type 2 diabetes and practice in one of the

following specialties: internal medicine, endocrinology, or general/family practice. The survey was distributed to all physicians in the state of Ohio who met the specified criteria above. The survey was administered and data collected online using the web-based survey system Qualtrics®. This approach was chosen due to its advantages such as surveying a large population, increased adaptation of Internet use in the US, convenience, and rapid turn around time in data collection.[62]

3.2 Theoretical Framework

The framework that was applied to this study is the Theory of Planned Behavior (TPB) as depicted in Figure 2. Demographic factors were collected for each participant and included: age, gender, practice specialty (family/general practitioner, internal medicine, endocrinology, or "other"), practice setting (hospital, medical group, private practice, or "other"), and percentage of patients with diabetes seen monthly. These demographic factors were chosen based off of use in previous literature.

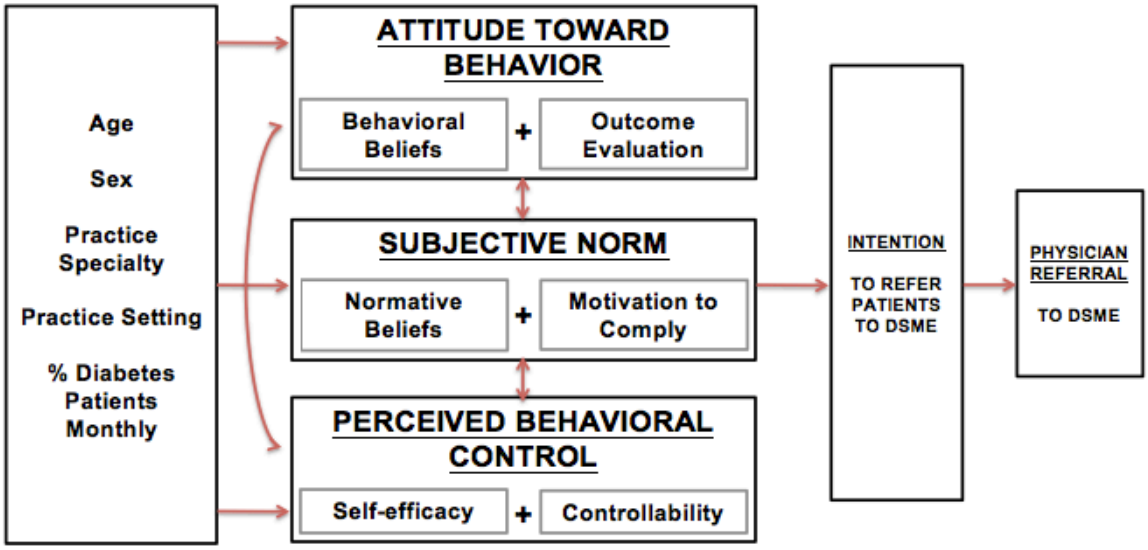
Attitude toward the behavior in the context of this study refers to physicians' positive or negative feelings about the benefits of referring a patient to DSME. Specifically, behavioral beliefs in this study include the benefits of referring a patient, while outcome evaluation refers to the physician's assessment of whether the outcome is desirable or not. Benefits for patients in the context of this study include: improvements in clinical markers (A1c), individualized education, and enhanced self-care skills (monitoring blood sugar regularly, using healthy coping techniques, problem solving when blood sugar levels are out of goal). Additional benefits for patients in the context of this study include: engagement in a more healthful lifestyle with regard to nutrition and

physical activity, decreasing long-term medical expenses related to diabetes, and increased adherence to medications and annual exams (comprehensive eye exam, renal function, A1c, blood pressure, comprehensive foot exam, etc.). Other benefits in this study apply to physicians' practice and include: decreased workload, increased revenue, and improved CMS star ratings.

Subjective norm for this study refers to physicians' perceptions of social pressure to refer patients to DSME. Normative beliefs in this study are defined as physicians' beliefs about whether significant others think they will refer patients to DSME. For this study, normative beliefs were evaluated using the following groups: those who are important to the individual, patients with type 2 diabetes, physicians, and other healthcare professionals (pharmacists, nurses, dietitians). Normative beliefs in combination with physicians' motivation to comply with significant others' expectations will determine the subjective norm.

Perceived behavioral control for the purposes of this study refers to physicians' perceptions regarding their ability to refer patients to DSME. Self-efficacy and controllability will be measured directly to determine perceived behavioral control. In this study, self-efficacy refers to physicians' beliefs about their capability to refer patients to DSME and follow recommended guidelines on when to refer. Controllability refers to physicians' perceptions about the extent to which referring to DSME and following recommended guidelines is within their control.

Figure 2: TPB Framework for Physician Referral to DSME



3.3 Study Population and Sample Size

The target population for this study was a purposive sample of Ohio physicians who treat patients with type 2 diabetes in addition to being one of the following provider types: internal medicine physician, endocrinologist, or general/family physician. Inclusion criteria were determined by considering which physicians would find the topic most interesting and relevant to their practice. Literature has shown that potential respondents are more likely to respond to a survey if the topic is of high interest to the individual.[63] Physicians were excluded if they listed pediatrics as a specialty as this study is interested in physicians treating type 2 diabetes, which is significantly less common in children. The sampling frame consisted of 11,249 physicians. Study participants were identified through a database provided by the Ohio State Board of Medicine. As of October 2017, table 5 outlines the total number of physicians in Ohio who met the eligibility criteria for this study.

Table 5. Sampling frame: Ohio physicians by provider type

Provider Type	Total (%)
Family/General Physician	5,223 (46.4)
Internal Medicine Physician	5,786 (51.4)
Endocrinologist	240 (2.1)
Total Sampling Frame	**11,249 (30.2)**
Total Physicians in Ohio	37,263 (100.0)

The response rate for this study will be calculated conservatively by taking the total number of completed surveys divided by the total number of surveys distributed. Response rates vary greatly among physicians. In one meta-analyses, the mean response rate for 68 web-based surveys reported in 49 studies was 39.6%.[64] Another study examining barriers to DSME surveyed a total of 1,342 physicians and received a response rate of 26.6%.[30] However, a majority of studies report lower response rates from physician surveys administered on the Internet, with rates of 2-20% not being uncommon.[65] The response rate desired for this study is 100%; however, based on findings from the literature, a response rate of 2% will be accepted. Additionally, a 2% response rate will provide more than the suggested sample size for high prediction of intent using the TPB (n = 148).[66,67] The ideal sample size for correct power of the study was 371 respondents based on a 5% margin of error and a 95% confidence interval. This sample size was determined using the Qualtrics® sample size calculator. All 11,249 physicians identified were emailed a link to the survey.

3.4 Instrument Development

Elicitation interviews regarding referral behaviors were conducted with 6 University of Toledo Medical Center physicians specializing in family/general practice, internal medicine, or endocrinology. Initial drafts of the survey used in this study were created based on results of a literature search and the findings of the elicitation interviews. These drafts were circulated for feedback to four faculty members at the University of Toledo along with seven current and past students in the Master's of Health Outcomes and Socioeconomic Sciences program. Reviewers were asked to match each survey item with the objective and construct the item addressed. Faculty and students were provided with the study objectives and operational definitions of TPB constructs to aid in this process. Additionally, reviewers were asked for feedback regarding phrasing and framing of survey items. The survey was edited based off of reviewer comments and ability to match objectives and constructs to survey items. The revised survey was submitted to the survey research vendor, Qualtrics®, and was further edited in response to feedback from their professional staff.

3.5 Instrument Reliability and Validity Analysis

Reliability and construct validity and were examined using Rasch analysis and the tool was calibrated based on data outputs. Rasch analyses were performed using WINSTEPS software to calibrate the developed survey instrument used in this study. Rasch analysis is useful in creating a linear measure of latent traits.[68] This analytical approach delivers information pertaining to reliability, separation, fit statistics, and rating scale functionality.[68] Reliability data from Rasch analysis provides information about the

items, the participants, and the tool. Separation refers to the number of distinct groups of items and participants. Fit statistics examine the degree that items and participants respond as expected.[68] Rating scale functionality assesses if participants are appropriately distinguishing between item response options.[68] Rasch analysis helped to determine if the developed instrument measured physicians' intention to refer to DSME, and how well the tool performed. Data outputs from Rasch analysis helped to identify items or participants that did not function properly to improve instrument precision.

3.6 Instrument Administration and Data Collection

Surveys were administered and data collected on the Internet using the online service Qualtrics®. A single-stage sampling procedure was used. In Web based survey research, literature suggests that higher response rates are associated with the number of contacts and personalized contacts.[64] Potential participants were sent a link to the survey according to the following schedule:

February 23, 2018 – Initial survey distribution

February 26, 2018 – First reminder for non-respondents

March 1, 2018 – Second reminder for non-respondents

March 12, 2018 – Third reminder indicating the survey will close soon

March 19, 2018 – Fourth reminder for non-respondents

March 28, 2018 – Survey closing notice

3.7 Planned Data Analysis

Data was analyzed using IBM SPSS, version 24.0 for Mac and WINSTEPS software. Descriptive statistics were used to summarize and describe demographic variables. Development of likelihood to refer patients to DSME was determined based off the conceptual meaning of the hierarchical arrangement of items in the WINSTEPS keyform. Pearson's correlation was used to test relationships between the likelihood to refer to DSME and constructs (demographic factors, attitude, subjective norm, perceived behavioral control) in the TPB model.

Composite variables were calculated by combining survey questions for each TPB construct. Scoring of the survey instrument can be found in Appendix D. Scoring of composite variables for attitude and subjective norm were based off of a 4-point Likert-type scale with values ranging from 1 to 4.[69] Lower values denote a negative response towards the survey item. High values indicate a supportive belief towards the survey item. For each behavioral belief, the belief score on the strongly disagree-strongly agree scale were multiplied by the corresponding evaluation score. An overall attitude score was calculated through summation of the products of each behavioral belief and its relevant outcome evaluation.

An example of the formula that that was used to calculate the overall attitude score is as follows: (1a x 1b) + (2a x 2b) + (3a x 3b) + (4a x 4b) + (5a x 5b) + (6a x 6b) + (7a x 7b) + (8a x 8b) + (9a x 9b) = Attitudes.[69] Where 'a' represents a behavioral belief and 'b' represents the beliefs' corresponding outcome evaluation. Subjective norm was calculated in the same manner with 'a' representing normative beliefs and 'b' representing the physicians' motivation to comply. While attitudes and subjective norm

were measured indirectly, perceived behavioral control and intent were measured directly in this study. Composite perceived behavioral control and intent scores were calculated using the mean of all item scores. Cronbach's alpha was also calculated for each TPB composite scale to determine how strong the items in the survey correlated with each other.

Linear regression analysis was used to determine whether demographic factors, attitudes, subjective norm, and perceived behavioral control together predict intention of physician referral to DSME. Lastly, One-way ANOVA with post hoc analysis was conducted to assess if there was a difference in intent to refer among provider types (general/family medicine, internal medicine, endocrinology, and "other") and practice settings (hospital, medical group, private practice, and "other").

Chapter 4

Results

This chapter is divided into the following sections:

- Data Collection
- Reliability
- Validity
- Response rate
- Demographic characteristics
- Responses for each section of the survey (descriptives)
- Progression of physician likelihood to refer to DSME
- Correlations of Predictor Variables with Intention
- Regression Analysis Predicting Intention
- One-way ANOVA with Post Hoc Analysis

4.1 Data Collection

Upon completion of data collection there were 551 total responses obtained. Physicians were surveyed online from February 23rd to March 30th of 2018. There were 22 participants who declined to take the survey after reading the informed consent.

Incomplete surveys were not included for analysis; thus, 120 physicians who did not complete the survey were excluded. After exclusion, there were 409 usable responses.

Table 6: Response description

Total collected surveys	**551**
Declined survey	22
Did not complete survey	120
Total Responses for Analysis	**409**

4.2 Reliability

Rasch analyses were used to determine instrument reliability in terms of measuring physicians' likelihood to refer patients with type 2 diabetes to DSME. All data outputs can be found in Appendix E. The instrument was analyzed using the Rasch rating scale model[70] with WINSTEPS software.[71] The summary statistics and rating scale of the initial uploaded data text file can be seen in Figures 3 and 4, respectively. The rating scaled appeared to be functioning appropriately. Physician reliability ($r = .90$) and item reliability ($r = 1.0$) coefficients were acceptable upon the initial upload. Chronbach's alpha ($\alpha = .95$) was high indicating excellent internal consistency. Physician separation (2.93) and item separation (17.22) were acceptable. These separation values indicated that items were separated into eighteen significant groups of difficulty, and physicians were separated into three significant groups based on likelihood to refer to DSME. Higher separation suggests that the measurement tool is more accurate. Additionally, the standard error decreases as the degree of separation increases.[68]

After evaluating the item-fit statistics two items were removed (32 and 33). Table 7 shows the item-fit statistics in order of most misfitting to least misfitting items. Items with a Z-statistic of > 2.0 and a point measure correlation < 0.3 should be removed as this indicates the item is not measuring what it was intended to measure. The data output for item-fit statistics can be found in Appendix E, Figure 5. The final version of the instrument consists of 34 items using a 4-item Likert-type scale in addition to a 'prefer not to answer' response option.

Table 7. Item-fit statistics of two removed items

Item Number	Infit Mean Square	Z-statistic	Point Measure Correlation
33	1.55	6.9	-0.03
32	1.32	4.5	.19

Table 8 describes the items that required removal from the instrument. This table highlights which construct of the TPB each item was categorized into. It progresses from most misfitting items at the top and least misfitting at the bottom.

Table 8. Items removed from the survey instrument base on fit statistics

Item	Description	Subconstruct (Construct)
33	The decision to refer a patient to DSME is beyond my control.	Controllability (PBC)
32	Whether I refer to DSME or not is mostly up to me.	Controllability (PBC)

After all analyses and subsequent calibrations (i.e., the exclusion of two items based on fit), the instrument was functioning well. The model physician reliability correlation increased, however, the model item reliability remained constant. Although there was no change in item reliability, a model is considered improved when reliability remains constant after elimination of an item or participant. The final model summary statistics can be found in Appendix E, Figure 6. The final model demonstrated a physician reliability of 0.91 (up from 0.90), while the final model item reliability remained the same at 1.0. Chronbach's Alpha remained high at 0.95 after calibration. There was also an increase in separation after calibration. The model physician separation increased to 3.10 (up from 2.93). This level of separation resulted in four distinct groups of physicians (up from three). The number of distinct groups represents the instrument's ability to distinguish between levels of intent among physicians. The model item separation slightly decreased to 17.11 (down from 17.22); however, this level of separation still resulted in the same number of groups of items. This indicated that the presence of eighteen significant groups of items remained constant after calibration. These groups represented the instrument's improved ability to categorize items based on the degree to which they are easy or difficult to affirm. Error was decreased in the calibration process and the statistical improvements made suggest that the instrument is functioning in an acceptable manner.

4.3 Validity

Rasch analysis provides information about an instrument's items, the participants, and the tool. It also provides information about rating scale functionality. Rating scale functionality assesses if individuals are appropriately distinguishing between item response options.[68] This is important to validity when measuring subjective responses on a rating scale (strongly disagree to strongly agree). The rating scale functionality also indicates that based on an individual's measure, the individual's responses to specific item responses on the rating scale can be predicted. With a properly functioning instrument, individuals are able to differentiate between responses appropriately. The final rating scale (Appendix E, Figure 7) demonstrated a desirable monotonic progression between the Andrich's Threshold values for each Likert-type scale response category. It also satisfied the interval separation of more than 1.4 logits. This is interpreted as meaning that physicians were able to differentiate between the instrument's item responses. Additionally, the observed average progresses upward from negative to positive, which is desirable. The differences between item responses according to Andrich's Threshold values increased to -2.30 logits between item responses 1 (Strongly Disagree) and 2 (Disagree), 0.14 logits between item responses 2 (Disagree) and 3 (Agree), and 2.16 logits between item responses 3 (Agree) and 4 (Strongly Agree). These values increased slightly from the initial rating scale (-2.23, 0.15, 2.08, respectively). Although the increase was small, it may suggest potential for an unrepresented item response. Participants may be capable of making finer distinctions than those provided in response rating scale used for this study.[68] Coherence is indicated by the participant

measure-to-category percent values. When examining the coherence, the measure-to-category values and category-to-measure values are comparable. This indicates that based on an individual physician's measure, the physician's responses to specific item responses on the rating scale can be predicted. These values demonstrated an adequate level of predictability between 56 and 77 percent. In addition, the *category probabilities* graph (Appendix E, Figure 7) showed a normal distribution pattern, thus no item-response categories were collapsed. Overall, these results indicate an adequately functional rating scale.

The instrument functioned to measure physician likelihood to refer patients with type 2 diabetes to DSME. Figure 8 in Appendix E shows the raw variance explained by the measures is above the required threshold of 60% (at 78.4%). Additionally, the raw unexplained variance is below the required threshold of 40% (at 21.6%). These results suggest the survey instrument is unidimensional. This variance indicates whether or not physicians' answers are being driven by intention to refer. Since a higher amount of the variance is explained by the measures (78.4%), it is thought that physicians' responses are based on the degree to which they intend to refer rather than due to random chance.

4.4 Response Rate

A link to the survey was sent out to all 11,249 physicians identified by the Ohio Board of Medicine. Of these, 413 email addresses were invalid and 307 were duplicate email addresses. After accounting for those who were unreachable the total sampling frame used to calculate the response rate was 10,529. The ideal sample size for correct

power of the study is 371 based on a 5% margin of error and 95% confidence interval. Overall there were 409 usable responses yielding a response rate of 3.9%.

4.5 Demographic Characteristics

Table 9 depicts the demographic characteristics of the study sample. A majority of physicians who participated were under the age of 55 (58.4%). However, there were more responses obtained from physicians ages 55-64 (23.5%), than in any other age group. There was a small number of physicians age 65 or older (15.9%) who participated, and 9 participants did not indicate their age (2.2%). The study sample consisted of a slightly higher number of males (53.8%). Most physicians were general or family practitioners (52.8%) followed by those who practice internal medicine (32.0%). Endocrinologists comprised only 5.1% of the study sample. Many physicians reported working in a medical group (37.9%). Approximately 23.0% of physicians practiced in a hospital setting, and 20.3% worked in a private practice. Lastly, 18.8% of physicians surveyed reported working in a different practice setting than the previous three settings discussed. A majority of physicians (55.0%) estimated that 25% of their patients seen each month has type 2 diabetes. A moderate number of physicians (28.9%) reported that 50% of their patients seen monthly has type 2 diabetes. Lastly, 13.9% of physicians responded that 75% of their patients seen each month have type 2 diabetes. Only 2 physicians (0.5%) reported that all of their patients seen monthly had diabetes and 7 physicians (1.7%) did not see any patients with diabetes.

Table 9. Demographic factors

Age	Number of Responses (%)
25-34	83 (20.3)
35-44	81 (19.8)
45-54	75 (18.3)
55-64	96 (23.5)
≥ 65	65 (15.9)
Prefer Not to Answer	9 (2.2)
Sex	**Number of Responses (%)**
Male	220 (53.8)
Female	183 (44.7)
Prefer Not to Answer	6 (1.5)
Type of Provider	**Number of Responses (%)**
Gen/Family Practitioner	216 (52.8)
Internal Medicine	131 (32.0)
Endocrinologist	21 (5.1)
Other	41 (10.0)
Practice Setting	**Number of Responses (%)**
Hospital	94 (23.0)
Medical Group	155 (37.9)
Private Practice	83 (20.3)
Other	77 (18.8)
Patients with Diabetes Seen Monthly	**Number of Responses (%)**
0%	7 (1.7)
25%	225 (55.0)
50%	118 (28.9)
75%	57 (13.9)
100%	2 (0.5)

4.6 Responses for Each Section of the Survey

Table 10 summarizes responses to survey items by construct comparing provider type. Responses indicate that as physicians' attitude scores increased so did their intention to refer patients with type 2 diabetes to DSME. For the total sample, attitudes

were positive and the composite attitude score was 45.5 (range -72 to 72). Those who practiced internal medicine were close to the study average with an attitude score of 44.6. General/family medicine physicians had a comparable attitude score of 46.7, slightly above the average. Endocrinologists held the highest attitudes about the benefits of referring a patient to DSME (47.2). On the other hand, physicians who selected "other" still had positive, but significantly lower attitudes regarding the benefits of DSME and did not intent to refer patients (40.9). All other provider types (family/general physicians, internal medicine physicians, and endocrinologists) intended to refer patients to DSME.

The average subjective norm scores among provider types were higher in those who indented to refer patients to DSME. A negative subjective norm score was observed in the "other" group of physicians who did not intent to refer. Endocrinologists had the highest subjective norm (2.81) and highest intent to refer to DSME. This indicates that endocrinologists perceived the most social pressure to refer patients to DSME compared to all other provider types. Physicians in the "other" group did not perceived any social pressure to refer patients to DSME. This may be due to the group's representation of physicians who do not primarily treat type 2 diabetes. Physicians who practiced internal medicine had an average subjective norm of 1.91, higher than the sample average of 1.13. Thus, physicians who practice internal medicine perceive more social pressure to refer to DSME than do general/family physicians (1.02).

The average scores of perceived behavioral control were higher among those providers who had a greater intention to refer patients with type 2 diabetes to DSME. Self-efficacy appeared to be the largest contributing factor to perceived behavioral control scores across provider types with one exception. Endocrinologists were the only

providers who reported controllability to be a stronger contributor to perceived behavioral control than self-efficacy. Endocrinologists (2.87) and internal medicine physicians (2.89) had perceived behavioral control scores comparable to the study sample (2.86). This indicates a similar perceived level of ability of to refer patients to DSME. General/family physicians had the highest perceived behavioral control score (2.91), suggesting that they perceived their ability to follow guidelines and refer patients to be stronger than other provider types. It also indicates that general/family physicians may have more autonomy in decision-making regarding following guidelines compared to other provider types. Physicians in the "other" category had the lowest perceived behavioral control score (2.46), suggesting a perceived lack of ability in following guidelines and referring patients.

Overall, intention to refer patients with type 2 diabetes to DSME was highest among endocrinologists (3.54). General/family physicians (3.13) and internal medicine physicians (3.05) had an intention score comparable to the study sample mean (3.08). Physicians in the "other" category had the lowest intention score (2.58) indicating they did not intend to refer patients to DSME. After assessment of responses by provider type, it was determined that a comparison of groups was necessary and that one-way ANOVA with post hoc analysis should be conducted.

Table 10. Item responses by provider type (N = 409)

	Total (N = 409)	General/ Family Practice (N = 216)	Internal Medicine (N= 131)	Endocrinology (N = 21)	Other (N = 77)
Attitude*	**45.5**	**46.7**	**44.6**	**47.2**	**40.9**
*Behavioral Beliefs***	3.05	3.10	3.01	3.14	2.84
*Outcome Evaluation****	1.54	1.58	1.51	1.54	1.47
Subjective Norm***	**1.13**	**1.02**	**1.91**	**2.81**	**-1.77**
*Normative Beliefs****	0.08	0.06	0.15	0.39	-0.23
*Motivation to Comply***	1.87	1.86	1.99	1.67	1.61
Perceived Behavioral Control**	**2.86**	**2.91**	**2.89**	**2.87**	**2.46**
*Self-Efficacy***	2.88	2.94	2.91	2.83	2.46
*Controllability***	2.78	2.80	2.81	3.00	2.44
Intent**	**3.08**	**3.13**	**3.05**	**3.54**	**2.58**

* Range: -72 to 72
**Range: 1 to 4
***Range: -2 to 2
****Range: -32 to 32

Table 11 summarizes responses to survey items by construct comparing practice setting. Responses indicate that as attitude scores in each practice group increased so did their intention to refer patients with type 2 diabetes to DSME. For the total sample, attitudes were positive and the composite attitude score was 45.5 (range -72 to 72). Those who selected "other" were close to the study average with an attitude score of 44.8. Physicians who practiced in a medical group had the highest attitude score (48.4), above the average. Physicians who worked in a hospital or private practice had below average attitude scores of 42.7 and 43.9, respectively.

There was no clear trend between subjective norms and intent across practice settings. The average subjective norm scores were the approximately the same for physicians who practiced in hospitals (1.62) and in medical groups (1.61); however, those who practiced in medical groups intended to refer patients to DSME while those in hospitals did not. This may be due to the type of treatment each provides. Hospital physicians provide acute care and may not make specialty referrals for patients. Whereas physicians who work in a medical group often provide more routine care, including referrals. Those who practiced in hospitals and in medical groups perceived the most social pressure to refer patients to DSME compared to all other provider types. Physicians who worked in "other" settings had an average subjective norm of 1.32, above average (1.13), and intended to refer. Negative subjective norm scores were observed for physicians working in private practice (-0.48). These physicians did not perceive any social pressure and had the lowest intention to refer to DSME.

The average perceived behavioral control score was highest among physicians working in a medical group (2.94). These physicians had the highest intent to refer patients to DSME across all practice settings. Physicians who worked in a private practice or "other" setting had comparable perceived behavioral control scores of 2.77 and 2.78, respectively. However, physicians in the "other" group intended to refer patients to DSME, while physicians working in a private practice did not. This reflects current literature documenting lower referral rates in private practice. The average study sample score (2.86) was similar to that of physicians who work in hospitals (2.87); however, hospital physicians did not intend to refer patients to DSME while the overall study sample did. It is noteworthy that all physicians' perceived behavioral control scores

are less than desirable and lean toward a negative sense of controllability and self-efficacy. Suggesting a perceived lack of ability to follow guidelines on when to refer patients to DSME and how to refer patients to DSME.

Overall, intention to refer patients with type 2 diabetes to DSME was highest among physicians who practiced in a medical group (3.54) and lowest in those who worked in a private practice (2.92). Both physicians in private practices (2.92) and in hospitals (2.95) did not intend to refer patients to DSME. Physicians in "other" practice (3.05) settings were close to the study sample mean (3.07) and both intended to refer. After assessment of responses by practice setting, it was determined that a comparison of groups was necessary and that one-way ANOVA with post hoc analysis should be conducted.

Table 11. Item responses by practice setting (N = 409)

	Total (N = 409)	**Hospital (N = 216)**	**Medical Group (N= 131)**	**Private Practice (N = 21)**	**Other (N = 77)**
Attitude*	**45.5**	**42.7**	**48.4**	**43.9**	**44.8**
*Behavioral Beliefs***	3.05	3.01	3.11	2.99	3.04
*Outcome Evaluation****	1.54	1.46	1.63	1.51	1.51
Subjective Norm***	**1.13**	**1.62**	**1.61**	**-0.48**	**1.32**
*Normative Beliefs****	0.08	0.10	0.13	-0.10	0.13
*Motivation to Comply***	1.87	1.89	1.91	1.81	1.82
Perceived Behavioral Control**	**2.86**	**2.87**	**2.94**	**2.77**	**2.78**
*Self-Efficacy***	2.88	2.91	2.95	2.12	2.81
*Controllability***	2.78	2.73	2.86	2.76	2.69
Intent**	**3.07**	**2.95**	**3.25**	**2.92**	**3.05**

* Range: -72 to 72
**Range: 1 to 4
***Range: -2 to 2
****Range: -32 to 32

4.7 Progression of Physician Likelihood to Refer to DSME

The item separation value of 17.11 signified that eighteen statistically different groups of items were anticipated. Groups of items were assembled into conceptually distinct categories allowing for the definition of the constructs in terms of a developmental progression. The WINSTEPS *keyform* table (appendix E, Figure 9) was assessed in an attempt to conceptually distinguish item groupings to understand how physician likelihood to refer patients to DSME develops. Eighteen groups of items were determined and can be explained through the following TPB subconstructs: behavioral beliefs, outcome evaluations, normative beliefs, motivation to comply, self-efficacy, and controllability. Items that were easier to respond affirmatively to were clustered in spatially lower categories, while the more difficult items to agree or strongly agree with were clustered in spatially higher categories.

Items that were easiest for physicians to agree with were the majority of outcome evaluations followed by behavioral beliefs relating to patients. These items were clustered and may have been easiest to answer due to the current state of healthcare and its focus on quality metrics, such as the HEDIS measures. Two of the outcome evaluations are directly related to these HEDIS measures while others are indirectly related. These results suggest that certain attitudes are an important antecedent to intention to refer patients with type 2 diabetes to DSME. After these outcome evaluations and behavioral beliefs regarding patients, there was no clear pattern of progression among the remaining attitude items. There was one intention item ("I want to refer patients to DSME") clustered among attitude items. This may have occurred due to the

phrasing of the question not adequately measuring intent (i.e. ‘want’ may measure desire to a greater degree than it does intent).

The next cluster of items had no clear pattern of progression and consisted mainly of items regarding self-efficacy, controllability, and intent. However, there were also a few behavioral belief items and one outcome evaluation item in the cluster. The behavioral beliefs and outcome evaluation had to do with physicians’ practice benefits. In regard to self-efficacy, physicians agreed that they were confident in following the guidelines on when to refer a patient to DSME and confident in how to refer a patient to DSME. Followed by this they agreed that they intended and expected to refer, suggesting that self-efficacy is an important antecedent to intention. However, physicians disagreed that following the guidelines and the process of referring were easy. This suggests a need for supportive services for physicians, including more education on guidelines and referral resources. With regard to controllability, physicians disagreed that following the guidelines on when to refer a patient to DSME was entirely up to them. This may be true depending on the practice setting a physician works at or if there is a patient preference in the matter.

The last cluster of items mainly consisted of subjective norms, which physicians disagreed with. Physicians most strongly disagreed with all motivation to comply items. This was followed by the behavioral belief that referring a patient to DSME can increase a physicians’ practice revenue. Physicians should be educated on how DSME can increase their practice revenue, as this was the behavioral belief physicians most strongly disagreed with. Lastly, physicians also disagreed with all normative belief items. No items from other constructs were found in this cluster.

According to the TPB, the constructs (attitude, subjective norm, and perceived behavioral control) interact with one another in addition to contributing to intention. It is apparent based off of the interspersion of subconstructs among clusters that physician likelihood to refer to DSME cannot be described using stages. Thus, attitudes and perceived behavioral control develop alongside and interact with one another when considering to refer a patient to DSME.

4.8 Correlations of Predictor Variables with Intention

Pearson's correlation was used to assess the direction and strength of relationships among TPB constructs and physician intent to refer patients with type 2 diabetes to DSME. All constructs were significantly correlated with each other as is to be expected with the TPB model. Physician intent to refer patients to DSME demonstrated a moderately positive relationship with attitude, subjective norm, and perceived behavioral control (Table 12). Perceived behavioral control had the strongest, moderate positive correlation with intent ($r = 0.478$, $p < 0.001$). Attitudes were moderately and positively associated with intent to refer patients to DSME ($r = 0.369$, $p < 0.001$). Although subjective norm had a moderate positive relationship, it had the weakest relationship with intent to refer ($r = 0.339$, $p < 0.001$).

Table 12. Pearson's correlation coefficients among main study variables: Attitude (ATT), subjective norm (SN), perceived behavioral control (PBC), and intent (INT)

	ATT	SN	PBC	INT
ATT	1	-	-	-
SN	0.260**	1	-	-
PBC	0.285**	0.270**	1	-
INT	0.369**	0.339**	0.478**	1

** Correlation is significant at the 0.01 level (2-tailed).

Regarding demographic factors, provider type and percent of patients with diabetes seen monthly were both correlated with physician intent (Table 13). Provider type was found to have a weak negative relationship with intent ($r = -.123$, $p = 0.013$) and perceived behavioral control ($r = -.153$, $p = 0.002$). This may be due to the unequal number of physicians in each group, with general/family physicians largely dominating the study sample. Percentage of patients with diabetes had a weak a positive relationship with intent to refer ($r = .117$, $p = 0.018$) and perceived behavioral control ($r = .101$, $p = 0.041$). Additionally, age had a weak negative relationship with perceived behavioral control ($r = -.133$, $p = 0.007$), and sex had a weak positive relationship with attitudes ($r = .162$, $p = 0.001$).

Table 13. Pearson's correlation coefficients among demographic factors and main study variables

	ATT	SN	PBC	INT
Age	-.047	-.025	**-.133****	-.023
Sex	**.162****	-.046	-.008	.037
Provider Type	-.096	-.056	**-.153****	**-.123***
Practice Setting	.004	-.044	-.066	-.013
% Patients with Diabetes Seen Monthly	-.035	.064	**.101***	**.117***

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

4.9 Regression Analysis Predicting Intention

A linear regression was used to examine the simultaneous effects of demographic factors and TPB constructs on the prediction of intent. The model explained 31.9% of variance in intention to refer to DSME. Table 14 depicts the results of the linear regression used to assess what factors predict physician likelihood to refer patients to DSME. After controlling for interactions, percent of patients seen monthly with diabetes along with attitudes and perceived behavioral control were all significant predictors of physician intent to refer patients to DSME. Percent of patients seen monthly with diabetes contributed a small amount to the overall model ($\beta = 0.104$, $p = 0.018$). No other demographic factors were found to be statistically significant. Attitudes ($\beta = .341$, $p = 0.013$) and perceived behavioral control ($\beta = .447$, $p < 0.001$) also significantly contributed to the model, with perceived behavioral control having a higher standardized beta coefficient. Subjective norms were not found to be a significant predictor of physician intent. Interactions were examined between attitudes and subjective norms, attitudes and perceived behavioral control, and subjective norms and perceived behavioral control. No interactions were found to be statistically significant.

Table 14. Linear regression of all predictors of physician intent

Constant	β	P
Age	0.074	0.109
Sex	0.014	0.755
Provider type	-0.051	0.233
Practice setting	0.006	0.890
Percent patients with diabetes seen monthly	**0.104**	**0.018**
Attitude (ATT)	**0.341**	**0.013**
Subjective Norm (SN)	0.411	0.054
Perceived Behavioral Control (PBC)	**0.447**	**0.000**
ATT-SN Interaction	-0.233	0.206
ATT-PBC Interaction	-0.171	0.368
PBC-SN Interaction	-0.003	0.988

4.10 One-way ANOVA with Post Hoc Analysis

One-way ANOVA was conducted to determine differences in intent among general/family physicians, internal medicine physicians, and endocrinologists. Levene's test was conducted and the assumption of homogeneity of variance was not violated ($p = 0.084$). Thus, equal variances was assumed. One-way ANOVA was statistically significant ($F = 4.998$, $p = 0.001$). A difference in means across provider types was detected. The supplemental Welch and Brown-Forsythe analyses confirmed the statistical significance across groups of physicians ($p = 0.037$ and 0.003, respectively). Bonferroni post hoc analysis was performed to identify variation in intention by provider type (Table 15). Physicians who selected "other" for provider type had a statistically significant difference in intention to refer than the provider types of interest to the study (general/family physicians, internal medicine physicians, or endocrinologists). No difference was found in intention to refer among any other provider types.

Table 15. Bonferroni post hoc analysis for provider type

Provider Type	4 (other)	p
1 (general/family)	**-0.547***	0.003
2 (internal)	**-0.472***	0.030
3 (endocrinology)	**-0.958***	0.001

*The mean difference is significant at the 0.05 level.

One-way ANOVA was also conducted to determine differences in intent among practice settings of interest (hospitals, medical groups, and private practices). Levene's test was conducted and the assumption of homogeneity of variance was not violated ($p = 0.611$). Thus, equal variances was assumed. One-way ANOVA was statistically significant ($F = 3.461$, $p = 0.016$). A difference in means across practice settings was detected. The supplemental Welch and Brown-Forsythe analyses confirmed the statistical significance ($p = 0.010$ and 0.023, respectively). Bonferroni post hoc analysis was performed to identify the variation in intention by practice setting (Table 16). Physicians who practiced in a medical group or private practice differed significantly in their intention to refer patients to DSME. Overall, physicians practicing in a medical group are significantly more likely to refer patients to DSME than are physicians who work in private practices. There was no statistically significant difference in intention to refer among those who practice in a hospital, medical group, or any "other" type of setting.

Table 16. Bonferroni post hoc analysis for practice setting

Practice Setting	2 (Medical Group)	p
1 (hospital)	0.295	0.063
3 (private practice)	**0.325***	0.040
4 (other)	0.193	0.690

*The mean difference is significant at the 0.05 level.

Chapter 5

Discussion

5.1 Demographic Characteristics of Respondents

The study sample was representative of physicians' age according to the AAMC. In regard to age and endocrinology, 58% of physicians are under the age of 55.[72] A majority of general/family practitioners were under the age of 55 (55.5%) as were those who practiced internal medicine (57.5%).[72] The study sample is comparable as 58.4% of physicians who participated were under the age of 55.

Approximately 44.7% of physicians in this study were female. The characteristics of study respondents were not representative of the Ohio Physician Workforce Profile of physicians.[73] In Ohio, the average number of females across all specialties is 32.5%.[73] This is true of the entire US physician population according to the Association of American Medical Colleges (AAMC), as only 33% of individuals who practice medicine are female.[74] Though the majority of physicians were male, there was an overrepresentation of females according to the AAMC practitioner statistics. The US population consists of roughly 50% males and females. The data gathered in this study

more closely represent the general population and not necessarily physician characteristics only.

General/family practitioners account for 12.6% of all physicians practicing in the US, however the sampling frame was slightly higher at 14.0% yet still comparable to the national average. It is important to note that most physicians who participated were general/family practitioners, which may have been an effect of Ohio's larger population of these providers. Those who practice internal medicine comprise 18.3% of all physicians practicing in the US. Practitioners of internal medicine in this study appear to be slightly underrepresented in Ohio (15.5%). This was reflected in the study as well as there were fewer internal medicine practitioners that participated than there were general/family practitioners. In the US, endocrinologists or diabetes specialists only compose 0.74% of all provider types (only 7,047 individuals).[74] The small size of this specialty practice group was reflected in the current study, as only 0.64% of all practitioners in Ohio are endocrinologists. The lower number of endocrinologists in the study sample was expected as there are only 240 endocrinologists in the state of Ohio compared to over 10,000 physicians who practice general, family, or internal medicine. Not all patient with type 2 diabetes see an endocrinologist. Patients with type 2 diabetes more commonly see a general/family physician or an internal medicine physician. Elicitation interviews from this study highlight that most physicians reserve referral to an endocrinologist for very severe or complex cases. Endocrinologists are specialists comprising a small sector of the medical field, thus the smaller sample size in this study is representative enough of the practice to meet the study objectives.

Overall, the total responses from each practice specialty were representative of US physicians. On average, few providers work in a hospital setting while a majority work in an office based practice.[74] This aligns with the distribution of survey respondents for this study. Approximately 58.1% of physicians worked in an office based practice while 23.0% reported working in a hospital.

5.2 Attitudes

There was a moderate relationship between physicians' attitudes and their intention to refer patients with type 2 diabetes to DSME. Study findings indicated that as physicians' attitudes about benefits of referring patients to DSME became more positive, their likelihood of referral increased. This aligns with Azjen's theory that there is a relationship between attitudes and behavioral intention.[37] Physicians who selected "other" as a provider type had lower attitudes regarding the benefits of referring to DSME and did not intend to refer patients. This may reflect that they do not primarily treat patients with type 2 diabetes. All other provider types (family/general physicians, internal medicine physicians, and endocrinologists) indicated intent to refer patients with type 2 diabetes to DSME, as expected. Additionally, attitudes had a weak yet positive relationship with gender. This suggests that women held higher attitudes toward the benefits of referring patients to DSME. Although one study found that gender played no significant role on referral decision making,[28] the relationship identified in this study may have been the result of women bringing a nurturing element to patient care. Women may believe that diabetes should be managed more proactively and tailored to each individual's needs; this is the cornerstone of DSME.

Attitudes were also found to be a statistically significant predictor of physician likelihood to refer patients with type 2 diabetes to DSME. Previous studies have shown this trend observing physicians' behaviors. For example, when examining physicians adherence to statin prescribing guidelines, attitude was found to be a significant predictor of the variance in physician intent.[25] Kortteisto et al[75] looked at physicians' use of clinical practice guidelines and found attitudes to be an important factor in intention. Similarly, Limbert and Lamb[76] found that the strongest indicator of intent to use antibiotic guidelines was attitude. Study findings regarding attitude in general align with current literature.[26,38]

Outcome evaluations followed by behavioral beliefs were the easiest survey items to agree with, followed by the first intent item "I want to refer patients to DSME." This may indicate that the formation of attitudes is the first step in developing intention to refer patients to DSME. Physicians agreed on more outcome evaluation items than they did behavioral belief items. This indicates that physicians agreed almost all of the positive outcomes of referring a patient to DSME are important to them as a physician. However, it also suggests that physicians may not be aware of all the benefits of referring a patient. The behavioral beliefs physicians disagreed with were the benefits relating to physician practice (increased revenue, decreased workload, and improved HEDIS measures). These benefits may be unknown to physicians who have not experienced having patients participate in a DSME program. The only patient related behavioral belief that physicians disagreed with was that referring to DSME could reduce patients' long-term expenses. This benefit may be unknown to physicians without having seen or heard about the cost-effectiveness of DSME. Additionally, DSME increases short-term medical

expenses, which may impact what physicians would anticipate long-term expenses to be.[9] Unfortunately, the increased short-term cost with less awareness of long-term cost reduction could dis-incentivize physicians to refer patients to DSME. Efforts should be made to educate physicians about all benefits of referring patients to DSME to improve attitudes and increase referral rates.

5.3 Subjective Norm

The results suggest that subjective norms played a moderate role in physician likelihood to refer patients with type 2 diabetes to DSME. A relationship is expected as the TPB posits that subjective norm contributes to behavioral intention.[37] Although subjective norm had a positive relationship with physician intent, it had the weakest relationship compared to attitudes or perceived behavioral control. When examining subjective norms, normative belief scores were lowest for patients and other physicians. There is a possibility that physicians are unaware of patient and physician knowledge regarding DSME services. This would explain the lower normative belief score regarding whether or not physicians should refer to DSME. However, when looking at motivation to comply, adhering to patients' and physicians' expectations had the highest scores. The importance placed on patients' and physicians' expectations may be linked to patient satisfaction, as this is a HEDIS measure that impacts physician practices.

After controlling for interactions, subjective norm was not found to be a significant predictor of physician intent to refer patients to DSME. This aligns with a study that examined physician statin prescribing behaviors, which found that subjective norms did not play a significant role in predicting prescribing patterns.[25] This is

applicable as prescribing is as commonplace as referring a patient. On the other hand, one study investigated referrals to support services for cancer patients and found subjective norms to be statistically significant.[26] Similarly, Millstein[38] found subjective norms to be significant in predicting intent to educate adolescent patients about HIV and other sexually transmitted diseases. Though the last two studies found subjective norms significant, they suggest subjective norms may play a larger role in preventative services.[38] The significance of subjective norm appears to depend on the nature of the behavior in question when examining health care professionals behaviors.

Physicians disagreed most with motivation to comply items. This indicates that adhering to others expectations was least important to physicians in their consideration of intent to refer patients to DSME. Physicians also disagreed with normative belief items. This suggests that what significant others think may not be a consideration for referral to DSME either. It is possible the subjective norm items included in this study were not as relevant to physicians as they were hypothesized to be based off the literature search conducted. This may also have been due to the nature of the questions asking about expectations of physicians and other healthcare professionals (HCPs). It may be beneficial to ask questions regarding other physicians' behaviors in addition to asking how important it is to mimic their behavior. Additionally, asking subjective norm questions about managers or medical directors may also be of use. While subjective norm may play some role in physician intent to refer, the findings imply that it is a not a critical antecedent to intentions of physician referral to DSME.

5.4 Perceived Behavioral Control

Study findings indicate that as physicians' level of perceived behavioral control increased, so did their intention to refer patients with type 2 diabetes to DSME. This was to be expected as an individuals capability of performing a task has a relationship with behavioral intent.[37] Perceived behavioral control also had a weak positive correlation with percentage of patients with diabetes seen monthly. With a larger number of patients and more opportunities to refer to DSME, this would likely improve physicians' self-efficacy and sense of controllability regarding referral. This suggests that as the number of patients treated by a physician increases, so does the physicians' likelihood of referring.

Age had a weak negative correlation with perceived behavioral control. All age groups had a comparable composite perceived behavioral control score with the exception of those age 65 and older. There were significantly fewer physicians in the 65 and over age group, which may have contributed to the relationship as they also had the lowest perceived behavioral control score. Those between the ages of 45-54 had the only positive perceived behavioral control score. This suggests that physicians who have been in practice longer may have had more experience or feel more confident in referring patients than physicians who are younger. Provider type also had a weak negative relationship with perceived behavioral control. This indicates that physicians had varying levels of perceived behavioral control. General/family physicians had the greatest level of perceived behavioral control followed by internal medicine physicians, endocrinologists, and other physicians, respectively. This would be reasonable given general/family physicians' greater experience as being primary care physicians for patients with type 2

diabetes. General/family physicians' treat a very large volume of patients with this condition. For example, in 2002, general/family physicians accounted for 62.7% of all office visits in the US, with diabetes ranking the third reason for visiting.[77]

Findings indicate that perceived behavioral control was the largest statistically significant predictor of physician intent to refer patients with type 2 diabetes to DSME. These results are similar to those of other studies. For instance, one study looked at physicians' intention to use clinical guidelines in their decision-making on patient care and found that perceived behavioral control was associated most strongly with intention.[75] Significant relationships between perceived behavioral control and physician intent were found in another study that was conducted about predicting physicians' intentions to educate adolescent patients about HIV.[38] Another study that examined physician behavior in following statin prescribing recommendations found that perceived behavioral control significantly explained variation of intent.[25] Limbert and Lamb[76] used the TPB for predicting physicians' intentions to use clinical guidelines. They found that the intention to use guidelines among junior physicians was influenced to a greater extent by perceived behavioral control.[76]

This study also found that perceived behavioral control items differed in the amount that physicians agreed or disagreed on them. Physicians agreed with two self-efficacy items, (1) "I am confident I could follow the guideline recommendations on when to refer a patient to DSME" and (2) "I am confident I could refer my patients to DSME." This is expected as following guidelines and making referrals is an everyday practice for physicians. These were followed by intent items, with "intending" to refer patients to DSME being easier to agree with than "expecting" to refer patients to DSME.

"Expecting" to refer may have been more difficult to agree with due to differences in the percentage of patients with diabetes seen monthly, provider type, or practice setting. Physicians disagreed with two perceived behavioral control items, one self-efficacy item and one controllability item. The first item was self-efficacy ("following guideline recommendations on when to refer a patient to DSME is easy"). The recommended practice guidelines for referral to DSME are not necessarily complex, but they do require physicians to evaluate patient education needs at each visit. With physicians' limited visit time, this assessment may be difficult to fit in. This is a possible explanation for the physicians' difficulty in agreeing with ease of following DSME referral guidelines. The second item was controllability ("following guideline recommendations for referral to DSME is entirely up to me"). Other factors may facilitate or impede physicians' decision-making in DSME referrals, such as practice or patient preferences. Thus, following the guidelines may not be entirely up to individual physicians.

5.5 Intent Among Provider Types and Practice Settings

Literature indicates that different factors affect different healthcare professionals' behaviors.[75] This may apply across practice specialties in medicine as well. Though not statistically significant, endocrinologists had the highest intention to refer patients with type 2 diabetes to DSME (3.54). This is consistent with the literature, which indicates that physicians with more knowledge in a specialty also have higher referral rates to specialists practicing in their area of expertise.[27] General/family physicians' (3.13) and internal medicine physicians' (3.05) intention scores were comparable to the sample mean (3.08). Physicians in the "other" group were statistically different from the

providers of interest (general/family physicians, internal medicine physicians, or endocrinologists) and had the lowest intention score (2.58) indicating they did not intend to refer patients to DSME. This may suggest these physicians do not primarily treat patients with type 2 diabetes, thus they do not intend to refer patients. There appeared to be no difference in intention to refer among general/family medicine physicians, internal medicine physicians, or endocrinologists.

One of the factors that may affect different healthcare professionals' behaviors is practice setting. This study found that physicians working in a medical group (3.25) are significantly more likely to refer patients to DSME than are physicians who work in private practices (2.92). This is consistent with the literature, which indicates that physicians in solo or small group practices are less likely to make referrals than physicians in larger practices.[28] Physicians working in "other" practice settings (3.05) were close to the sample mean (3.07) and intended to refer patients to DSME, while hospital physicians did not (2.95). Physicians who worked in private practices (2.92) had the lowest intent score and did not intend to refer patients to DSME. There was no statistically significant difference in intention to refer among those who practice in a hospital, medical group, or any "other" type of setting.

5.6 Limitations of the Study

There are several limitations to consider in this study. A pilot study of the survey instrument was not conducted, but elicitation interviews along with Rasch analysis were used to improve both the face and content validity. There were missing values for some of the respondents, which may cause non-response bias and issues with interpretation of

the results. However, respondents were analyzed and none were found to be extreme outliers in regard to missing values.

Additionally, this study may not be generalizable due to the sampling of only Ohio physicians, a low response rate (n = 409), and differences in demographic characteristics. According to the AAMC, there are nearly twice as many males in medical practice as there are females; however, females comprised 44.7% of physicians in this study. A disproportionate number of physicians among provider types existed, with general/family physicians being the largest group and endocrinologists the smallest. A similar trend emerged among practice settings, with hospital physicians dominating the study. Those in private practice only comprised a small subsection of the study sample. A larger sample size may help to capture a more representative population of physicians and increase the power of the analysis. It may also help confirm or refute the findings of this study in regard to intent across provider types and practice settings.

Other limitations involve a lack of comparisons. For example, elicitation interviews were conducted with physicians at a single University Medical Center. Thus, the interviewees may not have unearthed some themes other physicians in different practice settings may have discussed. Also, there was no data collected on whether physicians had referred patients in the past nor did the study inquire about a percentage of patients referred. Thus, there was no examination of difference in intent among those who did versus those who did not refer to DSME. This study did not compare responses among early, late, or non-responders. As a result, no inferences can be made about the differences in characteristics among these three groups and the physicians who responded.

A cross-sectional design was used, which does not allow for measuring any changes in physicians' intention to refer to DSME. This study looked at intention, rather than intention and the association of actual behavior (referring). A limitation to consider with this is the influence of social desirability, which can threaten internal and external validity. Physicians may have answered survey items in order to mirror the behavior they believed others wanted to see. However, in order to mitigate this threat, the survey was anonymous and physicians were informed that their responses would be kept confidential. All physicians were provided with a definition and brief description of what DSME is prior to survey administration. However, an additional subject effect that may have been a limitation was a lack of differentiation between DSME and diabetes education when completing the survey. This would decrease the degree to which the results reflected physicians' intent to refer to DSME. Selection bias may have also been a threat to external validity, because volunteers, such as the physicians in this study, do not always have the same characteristics as the general population. Lastly, this survey was administered on the Internet. Prior research has shown that Internet use is uneven across various demographic groups, with younger, highly educated, affluent, and White adults more likely to use it than others.[78]

5.7 Practice Implications of the Study

Overall, physicians' attitudes towards the benefits of referring a patient with type 2 diabetes to DSME were positive. Physicians agreed that many patient benefits were important to them such as increased medication adherence, improved A1c, and increased annual exam adherence (i.e. comprehensive eye exam, renal function, A1c,

comprehensive foot exam, etc.). Other patient benefits that were important to physicians included improved self-care skills (i.e. monitoring blood sugar and problem solving when out of range), individualized comprehensive education, and decreased long-term medical expenses. The knowledge of which patient benefits physicians' agreed were important can help pharmacists create or adjust DSME programs to compliment physicians' treatment of patients and to improve health outcomes.

The practice benefits physicians disagreed with highlight how pharmacists might promote their DSME programs and partner with physicians in the community. Pharmacists should outline how their program can decrease physician workload and how communication will occur. It is also important to engage physicians in a conversation about how DSME can help improve patient health outcomes along with HEDIS measures and CMS star ratings. Pharmacists should educate physicians about the benefits their practice may see with patient referrals to DSME, specifically about how DSME can increase revenue through collaborative practice agreements (CPAs) and billing upon referral. Involvement of physicians in planning a DSME program may help form a collaborative relationship between community pharmacists and physicians. It may also help pharmacists network with other community physicians or market their programs more effectively to increase referral rates.

This study suggests that when searching for physicians to partner with it is wise to find those who treat a large percentage of patients with diabetes. Being between the ages of 45-54 and being female also appeared to have a positive relationship with intention to refer, possibly do to greater practice experience and a nurturing nature, respectively. This study found that physicians working in a medical group are significantly more likely to

refer patients to DSME than are physicians who work in private practices. Generally, physicians who worked in private practiced did not intend to refer patients to DSME. Additionally, study findings indicate that in looking for a physician to form a collaborative relationship with for DSME services, the intention of referral is the same among general/family physicians, internal medicine physicians, and endocrinologists. Either of these three provider types is a good option to promote a DSME program to; however, prior research suggests that specialists are more likely to refer to specialists in their field. Thus, endocrinologists who have been in practice longer, are female, and are part of a medical group may be most likely to refer patients with type 2 diabetes to DSME.

5.8 Future Research

This study aimed to identify factors that influence physician referral to diabetes self-management programs in an effort to better understand how we might increase referral rates. Attitudes and perceived behavioral control had a moderate, positive effect on the variation in physician intent to refer patients with type 2 diabetes to DSME. Perceived behavioral control had the largest impact on physician intent. Percent of patients had a small positive impact. A larger sample size that is more representative of US physicians in regard to gender, provider type, and practice setting is needed to confirm or refute the findings of this study.

Although attitudes were positive toward DSME, current referral rates suggest discrepancies in following current guidelines on when to refer patients. Awareness of current guidelines may be the cause of this issue or there may be barriers to referral

present. In future studies, it may be worthwhile to examine physicians' awareness of referral guidelines and their perceived adherence to said guidelines. Similarly, it may be of interest to study physician awareness of referral materials and local DSME programs available. Additionally, barriers to physician referral should be explored. Subjective norm was not found to be a statistically significant predictor of intent in this study. It may be beneficial to conduct a qualitative analysis on individuals who might contribute to the prediction of physician referral to DSME.

Future studies should think about including demographic information on whether or not the physician has referred a patient to DSME in the past. Another demographic factor to consider for inclusion is the percentage of patients with diabetes physicians' refer to DSME, as this may add vital information to a study. Doing so would help to compare and contrast the attitudes, subjective norms, perceived behavioral control, and intent among those who refer to DSME and those who do not. It is advisable for future researchers to perform comparisons among early, late, and nonresponders to identify any important differences in characteristics among these groups of individuals. This study only examined the prediction of intent; future studies should consider examining the association between intention to refer to DSME and actual referral, as well as the predictors of this behavior.

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Appendix A

Elicitation Interview Correspondence and Responses

Hello Dr. <<last_name>>,

My name is Rebekah Panak and I am a master's student studying health outcomes at the University of Toledo. I am very interested in researching diabetes management for my thesis and want to learn more about the referral process to other health care professionals upon diagnosis. I would love to schedule a time we could speak about the referral process. I anticipate this will take about 5-10 minutes of your time. Please let me know if you are interested and I will send you my availability.

I look forward to hearing from you soon.

Respectfully,

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Physician Referral Elicitation Interview
Physician #1

1. What does the process of communication look like from a referring physician standpoint?
    a. EMR is shared via Athena Health

2. What does the process of communication look like from a receiving physician standpoint?
    a. Order and assessment received from referring physician in list in EMR → Physicians office contacts patient for appointment → appointment → physician sends new assessment and plan to referring physician

3. What might inhibit the referral process?
    a. Insurance in the past – not as much of an issue now

4. When a patient is newly diagnosed with diabetes, what referrals do you make initially?
    a. Ophthalmologist
    b. Diabetes education – more likely if on insulin or getting ready to start insulin, will refer if not at goal after 3 months
    c. Endocrinologist/educator – with patients who have pumps, basal bolus insulin

5. What referrals do you make most often for your patients with diabetes?
    a. Ophthalmologist

6. What referrals are necessary for patients with diabetes throughout the course of the disease?
    a. Depends on the patient

7. If you had to prioritize those referrals from most to least important, where would they rank?
    a. Ophthalmologist → then DSME if needed

8. How do you decide when to refer your patients to DSME?
    a. When the patient requests a referral – not common
    b. When the symptoms of patients' complications are progressing
    c. When the patient is not meeting target goals for clinical measures (A1c, LDL, BP, etc)

9. What factors affect your decision of who to refer your patients to?
    a. Patient motivation → diabetes educator
    b. If they need a push/more info on diabetes → endocrinologist
    c. What the patient's need is
    d. What patients have said about that physician - sometimes

10. What do you feel are the benefits of DSME?
    a. Patient understands diabetes better
    b. Gives in depth education about diabetes
    c. Improved blood glucose levels
    d. Increased adherence to labs and exams (i.e. A1c, lipid panel, kidney function labs, dilated eye exam)

Physician Referral Elicitation Interview
Physician #2

1. What does the process of communication look like from a referring physician standpoint?
    a. Referrals sent through EMR with attached diagnosis code

2. What does the process of communication look like from a receiving physician standpoint?
    a. Division chief goes through referrals & decides if it is appropriate → if yes, tells medical assistant → assistant schedules patient in appropriate clinic
    b. Or physician will email then staff member contacts the medical assistant

3. What might inhibit the referral process?
    a. Time (booked out 2-3 months), if urgent will try to get them in sooner

4. When a patient is newly diagnosed with diabetes, what referrals do you make initially? (She is an endocrinologist)
    a. Ophthalmologist
    b. Podiatrist
    c. Dietician with background in clinical DM education

5. What referrals do you make most often for your patients with diabetes?
    a. Dietician or education

6. What referrals are necessary for patients with diabetes throughout the course of the disease?
    a. Ophthalmologist
    b. Podiatrist
    c. Diabetes education
    d. Cardiologist
    e. Nephrologist
    f. Dietician
    g. Potentially neurosurgeon – pituitary mass
    h. Gen surgeon – masses/ adrenal-pituitary
    i. Pulmonary – sleep apnea

7. If you had to prioritize those referrals from most to least important, where would they rank?
    a. Diabetes education → ophthalmologist → podiatrist

8. How do you decide when to refer your patients to DSME?
    a. When the patient requests a referral
    b. When the patient is developing diabetes-related complications
    c. When the symptoms of patients' complications are progressing
    d. When there is a decline in patient functional status
    e. When the patient is not meeting target goals for clinical measures (A1c, LDL, BP, etc)
    f. If they haven't been seen by ophthalmologist or podiatrist
    g. New diagnosis

9. What factors affect your decision of who to refer your patients to?
    a. If the patient asks to be referred to a specific physician
    b. What the patient's need is
    c. If the physician is taking on new patients
    d. If the physician is in the patients insurance network
    e. Whoever is provided through the university
    f. Medical assistants help find where to send referral
    g. Promedica affiliation – starting to make referrals to surgeons there
    h. Credentials of the physician (where they trained, years in practice)

10. What do you feel are the benefits of DSME?
    a. Improves blood glucose levels
    b. Increases patient knowledge of diabetes and appropriate management

Physician Referral Elicitation Interview
Physician #3

1. What does the process of communication look like from a referring physician standpoint?
    a. EMR

2. What does the process of communication look like from a receiving physician standpoint?
    a. EMR

3. What might inhibit the referral process?
    a. Insurance

4. When a patient is newly diagnosed with diabetes, what referrals do you make initially?
    a. Endocrinologist – if it is a complex patient
    b. Ophthalmologist
    c. Diabetes education

5. What referral for patients with diabetes do you make most often?
    a. Ophthalmologist
    b. Diabetes education – *if insurance will cover it
    c. Refers patients with pre-diabetes to diabetes education – *if insurance will cover it

6. What referrals are necessary for patients with diabetes throughout the course of the disease?
    a. Endocrinologist – maybe
    b. Ophthalmologist
    c. Diabetes education

7. If you had to prioritize those referrals from most to least important, where would they rank?
    a. Ophthalmologist → diabetes education → endocrinologist

8. How do you decide when to refer your patients to DSME?
    a. If it is a complex case
    b. When the patient is not meeting target goals for clinical measures after being on a few medications (A1c)

9. What factors affect your decision of who to refer your patients to?
    a. If I am comfortable with the physician already

b. What patients have said about that physician – patient feedback
c. If they need further education
d. If another physician recommends them – somewhat taken into account

10. What do you feel are the benefits of DSME?
    a. Improves A1c
    b. Patients are more adherent to medications, labs, exams, and appointments
    c. Patients understand diabetes

Physician Referral Elicitation Interview
Physician #4

1. What does the process of communication look like from a referring physician standpoint?
    a. Patient need identified
    b. EMR – Athena (automatically faxes when referral sent/entered & notes are closed)
    c. Staff will check for referrals (print out and hand to patient & fax the office)
    d. Sometimes staff will call the office to let them know

2. What does the process of communication look like from a receiving physician standpoint?
    a. Fax comes through → staff will put in inbox → physician receives and says ok to schedule → staff calls to schedule patient.

3. What might inhibit the referral process?
    a. Insurance
    b. If the physician is accepting new patients
    c. If the physician's office is slow to respond

4. When a patient is newly diagnosed with diabetes, what referrals do you make initially?
    a. DSME
    b. Dietician – depending on weight
    c. Podiatrist
    d. Ophthalmology
    e. Endocrinologist – if unable to control

5. What referrals do you make most often for your patients with diabetes?
    a. Ophthalmology & podiatry

6. What referrals are necessary for patients with diabetes throughout the course of the disease?
    a. Endocrinologist
    b. Optometrist
    c. Podiatrist
    d. Diabetes education
    e. Cardiologist – CAD, complications
    f. Nephrologist
    g. Dietician

h. Vascular – for ischemic limbs, diabetic ulcers

7. If you had to prioritize those referrals from most to least important, where would they rank?
    a. Education → ophthalmology → podiatry

8. How do you decide when to refer your patients to DSME?
    a. If they are taking insulin
    b. If they are noncompliant
    c. If they are unable to afford medications (referred to social work)
    d. When the patient requests a referral
    e. For continuity of care when the complications are progressing
    f. When the patient is not meeting target goals for clinical measures (A1c, LDL, BP, etc.)

9. What factors affect your decision of who to refer your patients to?
    a. Refer internally
    b. Insurance issues
    c. Distance
    d. Transportation
    e. Outside – who the patient requests

10. What do you feel are the benefits of DSME?
    a. Patient is more knowledgeable about their diabetes
    b. Patient understands more about nutrition and how food impacts blood sugar

Physician Referral Elicitation Interview
Physician #5

1. What does the process of communication look like from a referring physician standpoint?
    a. EMR – within UT
    b. Outpatient – printed out and given to patient and they take it to doctor

2. What does the process of communication look like from a receiving physician standpoint?
    a. Order and assessment received from referring physician → Order will be faxed to the staff or it will be called in → staff schedules patient

3. What might inhibit the referral process?
    a. Insurance problems
    b. Location of physician
    c. If physician is booked out

4. When a patient is newly diagnosed with diabetes, what referrals do you make initially?
    a. Ophthalmologist
    b. Depends
        i. Elderly – no referral
        ii. Endocrinologist – Younger, more complications, high A1c
        iii. Nephrology – If kidney dysfunction (abnormal creatinine)
        iv. No referral for diabetes education – they do it in house

5. What referrals do you make most often for your patients with diabetes?
    a. Ophthalmologist

6. What referrals are necessary for patients with diabetes throughout the course of the disease?
    a. Endocrinologist
    b. Ophthalmologist
    c. Podiatrist – if callouses or ingrown toenails
    d. Diabetes education
    e. Cardiologist
    f. Nephrologist

7. If you had to prioritize those referrals from most to least important, where would they rank?
    a. Ophthalmologist → Endocrinologist

8. How do you decide when to refer your patients to DSME?
    a. When the patient requests a referral
    b. When the patient is developing diabetes-related complications
    c. When the symptoms of patients' complications are progressing
    d. When the patient is not meeting target goals for clinical measures (A1c, LDL, BP, etc.)
    e. High A1c at diagnosis
    f. Overweight/obese
    g. Hard time getting to goal/controlling A1c
    h. Starting insulin
    i. Starting a sliding scale

9. What factors affect your decision of who to refer your patients to?
    a. If the patient asks to be referred to a specific physician
    b. What the patient's need is
    c. If the physician is taking on new patients
    d. The practice the physician works at
    e. If patient asks for specific person
    f. Puts in general referral so whoever has an opening can get the patient
    g. If knowledge of other physician specialties meets patient needs
    h. UT physicians

10. What do you feel are the benefits of DSME?
    a. Patient understands diabetes better and how to manage it
    b. Improved A1c and fasting blood glucose levels

Physician Referral Elicitation Interview
Physician #6

1. What does the process of communication look like from a referring physician standpoint?
    a. Several forms: verbal, email, EMR form or no form
    b. Can refer to specific individual or the department
    c. Outpatient referrals – EMR has physicians in Toledo area, can refer to an individual
    d. Then specialist will call the patient to schedule

2. What does the process of communication look like from a receiving physician standpoint?
    a. Order and assessment received from referring physician → Physicians office contacts patient for appointment → appointment → physician sends new assessment and plan to referring physician
    b. Email, communication from staff members

3. What might inhibit the referral process?
    a. Lack of adequate communication
    b. Delay of scheduling (long wait time)
    c. Inadequate number of physicians or time
    d. Lack of physician acquaintance
        i. Referrals happen better with physician to physician contact
    e. Insurance
    f. Physician referred to is going on vacation

4. When a patient is newly diagnosed with diabetes, what referrals do you make initially?
    a. Endocrinologist
    b. Optometrist
    c. Podiatrist
    d. Diabetes education
    e. Depends on severity of DM, complicating medical problems, on the family physician & their comfort level in dealing with diabetes
    f. Handles diabetics himself

5. What referrals do you make most often for your patients with diabetes?

a. Person he has difficulty with who needs more intervention, person he cant get under control, refers people who need more teaching than he has time for
b. Education
c. Does not refer to dieticians because they make things more complicated
d. No formal referral to ophthalmology

6. What referrals are necessary for patients with diabetes throughout the course of the disease?
    a. Optometrist
    b. Podiatrist
    c. Infectious disease
    d. Physical Therapy – for balance
    e. Diabetes education
    f. Nephrologist
    g. Dietician

7. If you had to prioritize those referrals from most to least important, where would they rank?
    a. The one that's most necessary

8. How do you decide when to refer your patients to DSME?
    a. When the patient is not meeting target goals for clinical measures (A1c, LDL, BP, etc)
    b. When problem is outside of scope of practice
    c. Wound care

9. What factors affect your decision of who to refer your patients to?
    a. If I have a relationship with the physician already
    b. If the physician is well respected in practice
    c. The practice the physician works at
    d. What patients have said about that physician
    e. What other physicians have said about that physician
    f. Word of mouth/reputation

10. What do you feel are the benefits of DSME?
    a. Patient understands diabetes better and how to manage it
    b. Improves blood glucose levels
    c. Better adherence to visits, labs, tests (A1c, eye exams, lipid panels, etc.)
    d. Better adherence to medications
    e. Is an opportunity for comprehensive diabetes patient education

Appendix B

Informed Consent Cover Letter

ADULT RESEARCH SUBJECT - INFORMED CONSENT FORM
Factors that Influence Physician Referral to Diabetes Self-Management Education in Patients with Type 2 Diabetes

Principal Investigator: Sharrel Pinto, PhD, 419-383-1906;
Rebekah L. Panak, PharmD, RPh, MS Candidate 2018, 419-383-1967

Purpose: You are invited to participate in the research project entitled, Factors that Influence Physician Referral to Diabetes Self-Management Education in Patients with Type 2 Diabetes, which is being conducted at the University of Toledo under the direction of Sharrel Pinto and Rebekah L. Panak. The purpose of this study is to identify factors that influence physicians' referral behaviors to diabetes self-management education (DSME) programs for patients with type 2 diabetes.

Description of Procedures: If you decide to participate in this study, you will be asked to complete an online survey. The survey will ask you to rate items on a scale of one to seven that relate to physician referral and DSME. The online survey will take you approximately 10-15 minutes to complete. This research study will take place in the state of Ohio. The data collected from survey responses will be de-identified before being analyzed.

Potential Risks: There are minimal risks to participation in this study, including loss of confidentiality. However, the researchers will take precautions to prevent loss of your confidentiality.

Potential Benefits: By participating in this research study, you will help us gain a better understanding of physician referral practices with regard to DSME. If you choose to participate in this study, a direct benefit to you may be that you learn more about DSME. Others may benefit by

learning about the results of this research. Additionally, there is an opportunity to enter into a raffle to win an Amazon gift card.

Confidentiality: The researchers will make every effort to prevent anyone who is not on the research team from knowing that you provided this information, or what that information is. The consent forms with signatures will be kept separate from responses, which will not include names and which will be presented to others only when combined with other responses. Although we will make every effort to protect your confidentiality, there is a low risk that this might be breached.

Voluntary Participation: Your refusal to participate in this study will involve no penalty or loss of benefits to which you are otherwise entitled and will not affect your relationship with The University of Toledo. In addition, you may discontinue participation at any time without any penalty or loss of benefits.

Contact Information: Before you decide to accept this invitation to take part in this study, you may ask any questions that you might have. If you have any questions at any time before, during or after your participation you should contact a member of the research team, Sharrel Pinto 419-383-1906 or Rebekah L. Panak 419-383-1967.

If you have questions beyond those answered by the research team or your rights as a research subject or research-related injuries, the Chairperson of the SBE Institutional Review Board may be contacted through the Office of Research on the main campus at (419) 530-2844.

Before you continue to the survey, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over.

SIGNATURE SECTION – Please read carefully

You are making a decision whether or not to participate in this research study. By continuing to the online survey you are indicating that you have read the information provided above, you have had all your questions answered, and you have decided to take part in this research.

This Adult Research Informed Consent document has been reviewed and approved by the University of Toledo Social, Behavioral and Educational IRB for the period of time specified in the box below.

Approved Number of Subjects: _____

Appendix C

Survey Instrument

Physician Referral to Diabetes-Self Management Education in Patients with Type 2 Diabetes

The items on this survey will ask your opinion regarding different aspects of diabetes self-management education (DSME) and referral. DSME is the process of facilitating the knowledge, skill, and ability necessary for diabetes self-care. DSME is evidenced-based, delivered by trained healthcare professionals (such as pharmacists, nurses, and dieticians), and focuses on facilitating healthy behavior change. Key self-care behaviors commonly taught in DSME include the following: healthy eating, being active, taking medications, monitoring, problem solving, healthy coping, and reducing risks. DSME provides a foundation that assists people with diabetes in navigating daily self-management decisions and activities. Please answer each item to the best of your abilities.

Please answer each question.

DEMOGRAPHICS

1. What is your age?
   - ☐ 25-34
   - ☐ 35-44
   - ☐ 45-54
   - ☐ 55-64
   - ☐ ≥ 65

2. What sex do you most identify with?
   - ☐ Male
   - ☐ Female
   - ☐ Prefer not to answer

3. What type of provider are you:
   - ☐ General/Family practitioner
   - ☐ Internal medicine
   - ☐ Endocrinologist
   - ☐ Other: _____

4. What is your primary practice setting?
   - ☐ Hospital
   - ☐ Medical Group
   - ☐ Private Practice
   - ☐ Other: _____

5. What percentage of your patients seen monthly has diabetes?
   - ☐ 0%
   - ☐ 25%
   - ☐ 50%
   - ☐ 75%
   - ☐ 100%

Please answer each question that best describes your opinion. The articles in the left most column are meant to complete the sentence below:

"Referring a patient to DSME can _____"

BEHAVIORAL BELIEFS

	Strongly Disagree	Disagree	Agree	Strongly Agree	Prefer Not to Answer
6. Lead to improvements in A1c.	1	2	3	4	o
7. Lead to individualized comprehensive patient education.	1	2	3	4	o
8. Result in improved self-care skills (such as monitoring blood sugar regularly and problem solving when blood sugar is outside of target range).	1	2	3	4	o
9. Lead to increased patient adherence to medications.	1	2	3	4	o
10. Lead to increased patient adherence to annual examinations (i.e. comprehensive eye exam, renal function, A1c, blood pressure, comprehensive foot exam, etc.).	1	2	3	4	o
11. Decrease the patient's long-term medical expenses related to diabetes.	1	2	3	4	o
12. Decrease the workload at my practice.	1	2	3	4	o
13. Increase the revenue of my practice.	1	2	3	4	o
14. Improve HEDIS measures at my practice.	1	2	3	4	o

Please answer each question that best describes your opinion.

OUTCOME EVALUATIONS

	Strongly Disagree	Disagree	Agree	Strongly Agree	Prefer Not to Answer
15. Improvements in A1c are important to me.	1	2	3	4	o
16. Individualized comprehensive patient education is important to me.	1	2	3	4	o
17. Improved self-care skills (such as monitoring blood sugar regularly and problem solving when blood sugar is outside of target range) are important to me.	1	2	3	4	o
18. Increased patient adherence to medications is important to me.	1	2	3	4	o
19. Increased patient adherence to annual examinations (i.e. comprehensive eye exam, renal function, A1c, blood pressure, comprehensive foot exam, etc.) is important to me.	1	2	3	4	o
20. Decreasing patients' long-term medical expenses related to diabetes is important to me.	1	2	3	4	o
21. Decreasing the workload at my practice is important to me	1	2	3	4	o
22. Increasing the revenue of my practice is important to me.	1	2	3	4	o
23. Improving HEDIS measures at my practice is important to me.	1	2	3	4	o

Please answer each question that best describes your opinion.

NORMATIVE BELIEFS

	Strongly Disagree	Disagree	Agree	Strongly Agree	Prefer Not to Answer
24. Most people who are important to me think that I should refer patients with type 2 diabetes to DSME.	1	2	3	4	○
25. My patients with type 2 diabetes think I should refer them to DSME.	1	2	3	4	○
26. Other physicians expect me to refer patients with type 2 diabetes to DSME.	1	2	3	4	○
27. Other healthcare professionals (pharmacists, nurses, dieticians) expect me to refer patients with type 2 diabetes to DSME.	1	2	3	4	○

Please answer each question that best describes your opinion.

MOTIVATION TO COMPLY

	Strongly Disagree	Disagree	Agree	Strongly Agree	Prefer Not to Answer
28. Doing what most people who are important to me think I should do is important to me.	1	2	3	4	○
29. Doing what my patients think I should do is important to me.	1	2	3	4	○
30. Doing what other physicians expect me to do is important to me.	1	2	3	4	○
31. Doing what other healthcare professionals (pharmacists, nurses, dieticians) expect me to do is important to me.	1	2	3	4	○

Please answer each question that best describes your opinion.

SELF-EFFICACY

	Strongly Disagree	Disagree	Agree	Strongly Agree	Prefer Not to Answer
32. I am confident I could follow the guideline recommendations on when to refer a patient to DSME.	1	2	3	4	○
33. Following guideline recommendations on when to refer a patient to DSME is easy.	1	2	3	4	○
34. I am confident I could refer my patients to DSME.	1	2	3	4	○
35. Referring my patients to DSME is easy.	1	2	3	4	○

Please answer each question that best describes your opinion.

CONTROLLABILITY

	Strongly Disagree	Disagree	Agree	Strongly Agree	Prefer Not to Answer
36. Following guideline recommendations for referral to DSME is entirely up to me.	1	2	3	4	○
37. Whether I refer to DSME or not is mostly up to me.	1	2	3	4	○
38. The decision to refer a patient to DSME is beyond my control.	1	2	3	4	○

Please answer each question that best describes your opinion.

INTENTION

	Strongly Disagree	Disagree	Agree	Strongly Agree	Prefer Not to Answer
39. I expect to refer patients with type 2 diabetes to DSME.	1	2	3	4	○
40. I want to refer patients with type 2 diabetes to DSME.	1	2	3	4	○
41. I intend to refer patients with type 2 diabetes to DSME.	1	2	3	4	○

Appendix D

Instrument Scoring

Survey Section	Question Numbers	Response Format*	Score Multiplication	Composite Construct Score	Construct Item Score	Construct Measured
Behavioral Beliefs	1-9	1 to 4	1a x 1b; 2a x 2b; 3a x 3b; 4a x 4b; 5a x 5b; 6a x 6b; 7a x 7b; 8a x 8b; 9a x 9b	-72 to 72	-8 to 8	ATT
Outcome Evaluations	1-9	-2 to 2				
Normative Beliefs	1-4	-2 to 2	1c x 1d; 2c x 2d; 3c x 3d; 4c x 4d	-32 to 32	-8 to 8	SN
Motivation to Comply	1-4	1 to 4				
Self-efficacy	1-4	1 to 4	-	Mean	1 to 4	PBC
Controllability	1	1 to 4	-	Mean	1 to 4	
Intention	3	1 to 4	-	Mean	1 to 4	INT
Demographics	5	-	-	-	-	-

*All survey items also offered a "prefer not to answer" response option
ATT = attitudes
SN = subjective norm
PBC = perceived behavioral control
INT intent

Appendix E

Reliability and Validity: WINSTEPS Outputs

Figure 3. Summary Statistics Table (Initial)

```
TABLE 3.1 Physician Referral to DSME              ZOU207WS.TXT Apr  3 18:43
2018
INPUT: 409 Physicians  36 Items  MEASURED: 408 Physicians  36 Items  4 CATS
3.62.1
-------------------------------------------------------------------------------
-

     SUMMARY OF 407 MEASURED (NON-EXTREME) Physicians
+-----------------------------------------------------------------------------+
|           RAW                           MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN     104.5      34.3        1.41     .29      1.03    -.3    .98    -.4 |
| S.D.      14.7       3.1         .93     .04       .68    2.2    .71    1.9 |
| MAX.     141.0      36.0        5.49     .63      8.60    9.9   9.90    9.9 |
| MIN.      50.0      18.0       -2.66     .26       .21   -5.0    .23   -4.3 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .33  ADJ.SD     .87  SEPARATION  2.62  Physic RELIABILITY  .87 |
|MODEL RMSE    .30  ADJ.SD     .88  SEPARATION  2.99  Physic RELIABILITY  .90 |
| S.E. OF Physician MEAN = .05                                                |
+-----------------------------------------------------------------------------+
  MAXIMUM EXTREME SCORE:      1 Physicians
      LACKING RESPONSES:      1 Physicians
        VALID RESPONSES:  95.3%

     SUMMARY OF 408 MEASURED (EXTREME AND NON-EXTREME) Physicians
+-----------------------------------------------------------------------------+
|           RAW                           MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN     104.4      34.3        1.42     .30                                |
| S.D.      14.8       3.2         .96     .09                                |
| MAX.     141.0      36.0        5.98    1.87                                |
| MIN.      50.0      18.0       -2.66     .26                                |
|-----------------------------------------------------------------------------|
| REAL RMSE    .34  ADJ.SD     .89  SEPARATION  2.59  Physic RELIABILITY  .87 |
|MODEL RMSE    .31  ADJ.SD     .90  SEPARATION  2.93  Physic RELIABILITY  .90 |
| S.E. OF Physician MEAN = .05                                                |
+-----------------------------------------------------------------------------+
```

```
Physician RAW SCORE-TO-MEASURE CORRELATION = .76 (approximate due to missing
data)
CRONBACH ALPHA (KR-20) Physician RAW SCORE RELIABILITY = .95 (approximate due
to missing data)

     SUMMARY OF 36 MEASURED (NON-EXTREME) Items
+-------------------------------------------------------------------------------+
|           RAW                          MODEL         INFIT        OUTFIT     |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD  |
|-------------------------------------------------------------------------------|
| MEAN    1181.2     388.0         .00     .09       .99    -.3    .98    -.2  |
| S.D.     254.4      15.9        1.55     .02       .24    3.4    .27    3.4  |
| MAX.    1555.0     406.0        2.99     .14      1.65    7.8   1.70    8.4  |
| MIN.     697.0     339.0       -2.67     .08       .68   -5.4    .68   -4.4  |
|-------------------------------------------------------------------------------|
| REAL RMSE    .09  ADJ.SD    1.54  SEPARATION 16.58  Item   RELIABILITY 1.00  |
|MODEL RMSE    .09  ADJ.SD    1.55  SEPARATION 17.22  Item   RELIABILITY 1.00  |
| S.E. OF Item MEAN = .26                                                       |
+-------------------------------------------------------------------------------+
UMEAN=.000 USCALE=1.000
Item RAW SCORE-TO-MEASURE CORRELATION = -.99 (approximate due to missing data)
13969 DATA POINTS. APPROXIMATE LOG-LIKELIHOOD CHI-SQUARE: 23473.77
```

This table was generated using WINSTEPS.[71] The summary statistics shown above serve as a baseline reference for individuals interested in examining the improvements made in the measurement tool calibration process. Note that the model physician separation is 2.93, while the model item separation is 17.22. Model physician reliability started at 0.90, while model item reliability started at 1.0; Chronbach's Alpha started at 0.95.

Figure 4. Rating Scale (Initial)

```
TABLE 3.2 Physician Referral to DSME              ZOU207WS.TXT Apr  3 18:43 2018
INPUT: 409 Physicians  36 Items  MEASURED: 408 Physicians  36 Items  4 CATS 3.62.1
--------------------------------------------------------------------------------


SUMMARY OF CATEGORY STRUCTURE.  Model="R"
+-------------------------------------------------------------------+
|CATEGORY   OBSERVED|OBSVD SAMPLE|INFIT OUTFIT||STRUCTURE|CATEGORY|
|LABEL SCORE COUNT %|AVRGE EXPECT|  MNSQ  MNSQ||CALIBRATN| MEASURE|
|-------------------+------------+------------++---------+--------+
|  1   1     759   5| -1.16 -1.48|  1.36  1.36||  NONE   |( -3.39)| 1
|  2   2    3044  21|  -.33  -.13|   .80   .83||   -2.23 |  -1.08 | 2
|  3   3    4987  34|  1.48  1.39|   .80   .76||     .15 |   1.15 | 3
|  4   4    5179  35|  2.85  2.87|  1.17  1.18||    2.08 |(  3.27)| 4
|-------------------+------------+------------++---------+--------+
|MISSING     683   5|   .50      |            ||         |        |
+-------------------------------------------------------------------+
OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

+--------------------------------------------------------------------------+
|CATEGORY    STRUCTURE   |  SCORE-TO-MEASURE   | 50% CUM.| COHERENCE|ESTIM|
| LABEL    MEASURE  S.E. | AT CAT. ----ZONE----|PROBABLTY| M->C C->M|DISCR|
|----------------------+---------------------+---------+----------+-----+
|   1      NONE          |( -3.39) -INF   -2.43|         |  55%  12%|     | 1
|   2       -2.23    .04 |  -1.08  -2.43    .07|   -2.31 |  63%  60%|  .78| 2
|   3         .15    .03 |   1.15    .07   2.36|     .11 |  56%  73%| 1.17| 3
|   4        2.08    .02 |(  3.27)  2.36  +INF |    2.20 |  77%  65%|  .96| 4
+--------------------------------------------------------------------------+
M->C = Does Measure imply Category?
C->M = Does Category imply Measure?

         CATEGORY PROBABILITIES: MODES - Structure measures at intersections
P      ++------+------+------+------+------+------+------+------++
R  1.0 +                                                          +
O      |                                                          |
B      |                                                          |
A      |11                                                    444|
B   .8 +  11                                                 44   +
I      |    11                                             44     |
L      |      11                                         4        |
I      |        1                                      44         |
T   .6 +         1       22222222                    4           +
Y      |          11   22        22      3333333     4           |
    .5 +            122            22  33       33344            +
O      |            221               *3           433            |
F   .4 +           2   11           33 22          4   3          +
       |         22      1         3     2      44     33         |
R      |        22         1      33       2    4         33      |
E      |     22             11   3          22 4            33    |
S   .2 +  22                 1*3            4*2              33   +
P      |22                  33 11          44   22              333|
O      |                 333     111   444       222             |
N      |           333333          44***11           22222       |
S   .0 +**********444444444444444       1111111111111111*********+
E      ++------+------+------+------+------+------+------+------++
       -4     -3     -2     -1      0      1      2      3      4
       Physician [MINUS] Item MEASURE
```

This table was generated using WINSTEPS.[71] The rating scale statistics shown above serve as a baseline reference for individuals interested in examining the

improvements made in the measurement tool calibration process. This figure shows the rating scale output table for all items. Note that Andrich's Threshold shows an appropriate separation interval (>1.4), progressing monotonically from negative to positive, suggesting that participants interacted appropriately with the rating scale; they distinguished between the available item responses. Additionally, the observed average progresses upward from negative to positive, which is desirable. When examining the coherence, the measure-to-category values and category-to-measure values are comparable. This shows that based on an individual physician's measure, the physician's responses to specific item responses on the rating scale can be predicted. Lastly, the distribution of responses in the rating scale was relatively normal indicating that no categories need to be collapsed, as each possible response in the scale is separate.

Figure 5. Item-Fit Statistics Table (Initial)

TABLE 10.1 Physician Referral to DSME ZOU758WS.TXT Apr 4 14:23 2018
INPUT: 409 Physicians 36 Items MEASURED: 408 Physicians 36 Items 4 CATS 3.62.1

Physician: REAL SEP.: 2.62 REL.: .87 ... Item: REAL SEP.: 16.58 REL.: 1.00

Item STATISTICS: MISFIT ORDER

ENTRY NUMBER	RAW SCORE	COUNT	MODEL MEASURE	S.E.	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD	PTMEA CORR.	EXACT MATCH OBS%	EXP%	Item
33	774	398	2.69	.08	1.55	6.9	1.70	8.4	A-.03	55.0	57.3	Refer Beyond Control
24	848	390	2.11	.08	1.65	7.8	1.64	7.6	B .42	59.2	57.1	Patients Important
32	1150	396	.43	.08	1.32	4.5	1.46	6.1	C .19	53.0	53.9	Refer Mostly Me
25	781	389	2.52	.08	1.41	5.2	1.42	5.4	D .46	62.5	57.3	Physicians Important
31	1137	397	.53	.08	1.21	3.1	1.32	4.4	E .31	51.9	53.8	Following Guideline Entirely Me
30	1069	375	.58	.08	1.30	4.1	1.30	4.0	F .43	47.2	53.6	Easy Refer
23	697	382	2.99	.08	1.28	3.8	1.29	3.9	G .48	61.8	57.0	Important People Important
17	1189	378	-.14	.08	1.28	3.9	1.29	3.8	H .36	56.3	55.0	Revenue Important
16	1376	395	-1.05	.09	1.19	2.6	1.14	1.6	I .37	58.5	60.2	Workload Important
26	730	387	2.84	.08	1.07	1.1	1.13	1.9	J .51	68.0	57.2	HCPs Important
18	1207	361	-.62	.09	1.12	1.7	1.11	1.4	K .41	58.4	56.8	HEDIS Important
13	1555	405	-2.67	.14	1.05	.5	.71	-1.8	L .46	86.4	85.1	Medication Important
7	1177	395	.27	.08	1.02	.3	1.01	.1	M .53	52.7	54.2	Decrease Workload
28	1094	367	.29	.08	1.02	.2	1.02	.3	N .46	58.3	54.6	Easy Follow Guidelines
15	1503	406	-1.88	.11	.99	-.1	.88	-1.0	O .42	74.6	73.3	Expenses Important
10	1545	404	-2.56	.13	.98	-.2	.73	-1.8	P .45	84.4	83.7	A1c Important
12	1529	406	-2.20	.12	.93	-.7	.85	-1.1	Q .45	79.8	78.5	Self-Care Important
8	787	361	2.10	.08	.90	-1.5	.91	-1.2	R .48	63.7	57.0	Increase Revenue
29	1262	388	-.39	.08	.90	-1.5	.88	-1.6	r .49	62.1	55.2	Confident Refer
19	1005	369	.89	.08	.86	-2.1	.89	-1.6	q .57	58.0	53.0	Important People Think
14	1523	402	-2.33	.12	.89	-1.1	.68	-2.4	p .48	81.3	80.7	Exam Important
6	1227	397	-.01	.08	.86	-2.2	.89	-1.7	o .52	57.9	54.8	Decrease Expense
11	1506	404	-2.00	.11	.87	-1.5	.81	-1.6	n .48	77.7	75.3	Education Important
5	1322	400	-.54	.08	.83	-2.7	.86	-1.9	m .48	62.3	56.0	Exam Adherence
22	1029	371	.78	.08	.86	-2.1	.86	-2.2	l .53	57.7	53.3	HCPs Expect
3	1426	402	-1.25	.09	.82	-2.7	.86	-1.6	k .47	70.9	63.0	Improved Self-Care
34	1204	388	-.01	.08	.86	-2.2	.85	-2.3	j .57	59.8	55.0	Expect Refer
2	1418	400	-1.24	.09	.85	-2.2	.82	-2.1	i .51	73.3	62.6	Individual Education
21	911	364	1.40	.08	.78	-3.4	.80	-3.0	h .53	58.5	54.0	Physicians Expect
4	1363	402	-.78	.08	.77	-3.7	.78	-3.0	g .53	68.7	57.6	Medication Adherence
9	1051	339	.03	.08	.76	-3.7	.76	-3.5	f .55	66.7	55.0	Improve HEDIS
27	1285	395	-.42	.08	.73	-4.5	.75	-3.8	e .49	67.1	55.5	Confident Follow Guidelines
36	1257	389	-.34	.08	.73	-4.5	.74	-4.0	d .60	62.7	55.3	Intend Refer
20	856	372	1.82	.08	.71	-4.6	.74	-4.0	c .52	63.2	55.9	Patients Think
1	1419	403	-1.18	.09	.73	-4.3	.73	-3.4	b .54	70.2	61.9	Improve A1c
35	1312	392	-.65	.08	.68	-5.4	.70	-4.4	a .59	67.1	56.8	Want Refer
MEAN	1181.2	388.0	.00	.09	.99	-.3	.98	-.2		64.4	60.2	
S.D.	254.4	15.9	1.55	.02	.24	3.4	.27	3.4		9.3	9.1	

This table was generated using WINSTEPS.[71] The initial item fit table shows the item fit for all 36 items in the instrument. Item 33 shows an infit mean square above the 1.4 threshold and a point measure loading below the 0.3 threshold (-0.03). Item 32 has an infit mean square of 1.32, but had a point measure loading below the 0.3 threshold (0.19). Both items 33 and 32 were removed. Items 24 and 25 both had an infit mean square above the 1.4 threshold, but had point measures loading above the 0.3 threshold. Removal of items 24 and 25 did not improve the model and were therefore retained for analysis. Items 16, 17, 23, and 30 all showed a z-standard statistic above the 2.0

threshold; however, their mean square infit statistics are below the threshold of 1.4 and all have a point measure loading above the 0.3 threshold. These items were therefore retained for analysis. Overall, removing two items (33 and 32) improved the model, as seen in the following final summary statistics of the model (Figure 6).

Figure 6. Summary Statistics Table (Final)

```
TABLE 3.1 Physician Referral to DSME              ZOU648WS.TXT Apr  4 14:31
2018
INPUT: 409 Physicians  36 Items  MEASURED: 408 Physicians  34 Items  4 CATS
3.62.1
-------------------------------------------------------------------------------
-

     SUMMARY OF 407 MEASURED (NON-EXTREME) Physicians
+-------------------------------------------------------------------------------+
|           RAW                           MODEL         INFIT        OUTFIT     |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD  |
|-------------------------------------------------------------------------------|
| MEAN      99.8      32.4        1.55     .31      1.03    -.3    .98    -.4  |
| S.D.      14.4       2.9        1.05     .06       .67    2.1    .73    1.8  |
| MAX.     134.0      34.0        6.27    1.05      8.46    9.9   9.90    9.9  |
| MIN.      45.0      18.0       -2.96     .27       .23   -4.6    .25   -4.2  |
|-------------------------------------------------------------------------------|
| REAL RMSE    .36  ADJ.SD     .99  SEPARATION  2.76  Physic RELIABILITY  .88  |
|MODEL RMSE    .32  ADJ.SD    1.00  SEPARATION  3.16  Physic RELIABILITY  .91  |
| S.E. OF Physician MEAN = .05                                                  |
+-------------------------------------------------------------------------------+
  MAXIMUM EXTREME SCORE:      1 Physicians
      LACKING RESPONSES:      1 Physicians
        VALID RESPONSES:  95.2%

     SUMMARY OF 408 MEASURED (EXTREME AND NON-EXTREME) Physicians
+-------------------------------------------------------------------------------+
|           RAW                           MODEL         INFIT        OUTFIT     |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD  |
|-------------------------------------------------------------------------------|
| MEAN      99.7      32.3        1.56     .31                                   |
| S.D.      14.5       3.0        1.08     .10                                   |
| MAX.     134.0      34.0        6.27    1.88                                   |
| MIN.      45.0      18.0       -2.96     .27                                   |
|-------------------------------------------------------------------------------|
| REAL RMSE    .37  ADJ.SD    1.01  SEPARATION  2.73  Physic RELIABILITY  .88  |
|MODEL RMSE    .33  ADJ.SD    1.02  SEPARATION  3.10  Physic RELIABILITY  .91  |
| S.E. OF Physician MEAN = .05                                                  |
+-------------------------------------------------------------------------------+
Physician RAW SCORE-TO-MEASURE CORRELATION = .77 (approximate due to missing
data)
CRONBACH ALPHA (KR-20) Physician RAW SCORE RELIABILITY = .95 (approximate due
to missing data)

     SUMMARY OF 34 MEASURED (NON-EXTREME) Items
+-------------------------------------------------------------------------------+
|           RAW                           MODEL         INFIT        OUTFIT     |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD  |
|-------------------------------------------------------------------------------|
| MEAN    1194.1     387.5         .00     .09       .99    -.3    .99     .0  |
| S.D.     251.9      16.2        1.57     .02       .24    3.2    .27    3.2  |
| MAX.    1555.0     406.0        3.19     .14      1.72    8.5   1.71    8.3  |
| MIN.     697.0     339.0       -2.66     .08       .69   -5.2    .68   -3.7  |
|-------------------------------------------------------------------------------|
| REAL RMSE    .10  ADJ.SD    1.57  SEPARATION 16.51  Item   RELIABILITY 1.00  |
|MODEL RMSE    .09  ADJ.SD    1.57  SEPARATION 17.11  Item   RELIABILITY 1.00  |
| S.E. OF Item MEAN = .27                                                       |
+-------------------------------------------------------------------------------+
                DELETED:      2 Items
```

```
UMEAN=.000 USCALE=1.000
Item RAW SCORE-TO-MEASURE CORRELATION = -.99 (approximate due to missing data)
13175 DATA POINTS. APPROXIMATE LOG-LIKELIHOOD CHI-SQUARE: 21536.25
```

This table was generated using WINSTEPS.[71] The summary statistics above were provided as a final reference for those who are interested in examining the improvements made in the measurement tool during the calibration process. Note that the model physician separation is 3.10 (up from 2.93), while the model item separation is 17.11 (slightly down from 17.22). This increase in physician separation now indicates there are four significant groups of physicians, while the number of groups of items remained the same. Model physician reliability is 0.91 (up from 0.90), while model item reliability was unchanged at 1.0. Chronbach's Alpha remained at 0.95 after calibration.

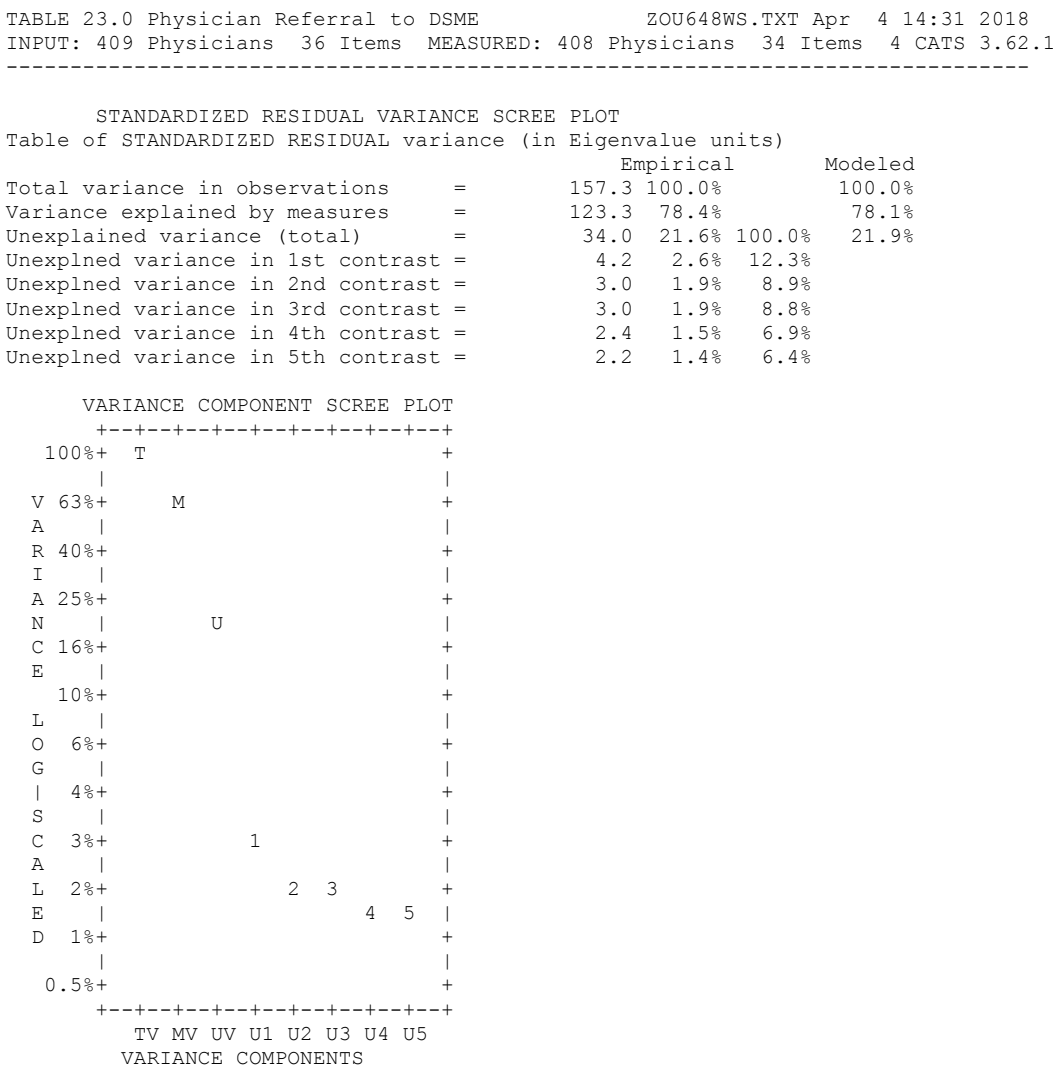
Figure 7. Rating Scale Table (Final)

```
TABLE 3.2 Physician Referral to DSME              ZOU648WS.TXT Apr  4 14:31 2018
INPUT: 409 Physicians  36 Items  MEASURED: 408 Physicians  34 Items  4 CATS 3.62.1
-------------------------------------------------------------------------------


SUMMARY OF CATEGORY STRUCTURE.  Model="R"
+-------------------------------------------------------------------+
|CATEGORY   OBSERVED|OBSVD SAMPLE|INFIT OUTFIT||STRUCTURE|CATEGORY|
|LABEL SCORE COUNT %|AVRGE EXPECT|  MNSQ  MNSQ||CALIBRATN| MEASURE|
|-------------------+------------+------------++---------+--------+
|  1   1     652   5| -1.30 -1.59|  1.32  1.32||  NONE   |( -3.46)| 1
|  2   2    2715  20|  -.31  -.12|   .81   .88||   -2.30 |  -1.12 | 2
|  3   3    4714  34|  1.57  1.47|   .79   .76||     .14 |   1.18 | 3
|  4   4    5094  37|  3.03  3.05|  1.20  1.21||    2.16 |(  3.35)| 4
|-------------------+------------+------------++---------+--------+
|MISSING     663   5|   .54      |            ||         |        |
+-------------------------------------------------------------------+
OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

+-------------------------------------------------------------------------------+
|CATEGORY    STRUCTURE   |  SCORE-TO-MEASURE   | 50% CUM.| COHERENCE|ESTIM|
| LABEL    MEASURE  S.E. | AT CAT. ----ZONE----|PROBABLTY| M->C C->M|DISCR|
|-----------------------+---------------------+---------+----------+-----+
|   1      NONE          |( -3.46) -INF   -2.50|         |  60%  16%|     | 1
|   2       -2.30    .05 |  -1.12  -2.50    .07|   -2.38 |  63%  59%|  .81| 2
|   3         .14    .03 |   1.18    .07   2.43|     .11 |  56%  72%| 1.17| 3
|   4        2.16    .02 |(  3.35)  2.43  +INF |    2.27 |  77%  66%|  .94| 4
+-------------------------------------------------------------------------------+
M->C = Does Measure imply Category?
C->M = Does Category imply Measure?

        CATEGORY PROBABILITIES: MODES - Structure measures at intersections
P      ++------+------+------+------+------+------+------+------++
R  1.0 +                                                        +
O      |                                                        |
B      |                                                        |
A      |1                                                     44|
B   .8 + 111                                                 44  +
I      |    1                                              44    |
L      |     11                                          44      |
I      |       1                                       4         |
T   .6 +        11      222222222                    44         +
Y      |          1   22         22     333333333    4          |
    .5 +           1*2            22 33         33 4            +
O      |           2 1              *             *3            |
F   .4 +         22   1            33 22          44  33         +
       |       22      1          3     2       4      3        |
R      |      2         11      33       2     4        33      |
E      |    22            11  33          22 44           33    |
S   .2 +  22               13             4*2              33   +
P      |22                33311          44   22             333|
O      |               333     111     44       222             |
N      |          33333           *****            22222        |
S   .0 +**********4444444444444444     1111111111111111*********+
E      ++------+------+------+------+------+------+------+------++
       -4     -3     -2     -1      0      1      2      3      4
       Physician [MINUS] Item MEASURE
```

This table was generated using WINSTEPS.[71] The rating scale statistics above were provided as a final reference for those who are interested in examining the

improvements made in the measurement tool during the calibration process. This figure displays the rating scale output table for the final 34 questions remaining in the instrument. Andrich's Threshold demonstrates an appropriate separation interval (>1.4) progressing monotonically from negative to positive. This is suggests that physicians interacted appropriately with the rating scale, meaning they were able to distinguish between the given item response categories. Additionally, the observed average progresses upward from negative to positive, which is desirable. When examining the coherence, the measure-to-category values and category-to-measure values are comparable. This indicates that based on an individual physician's measure, the physician's responses to specific item responses on the rating scale can be predicted. Lastly, the distribution of responses in the rating scale was relatively normal indicating that no categories needed to be collapsed, as each possible response in the scale is separate.

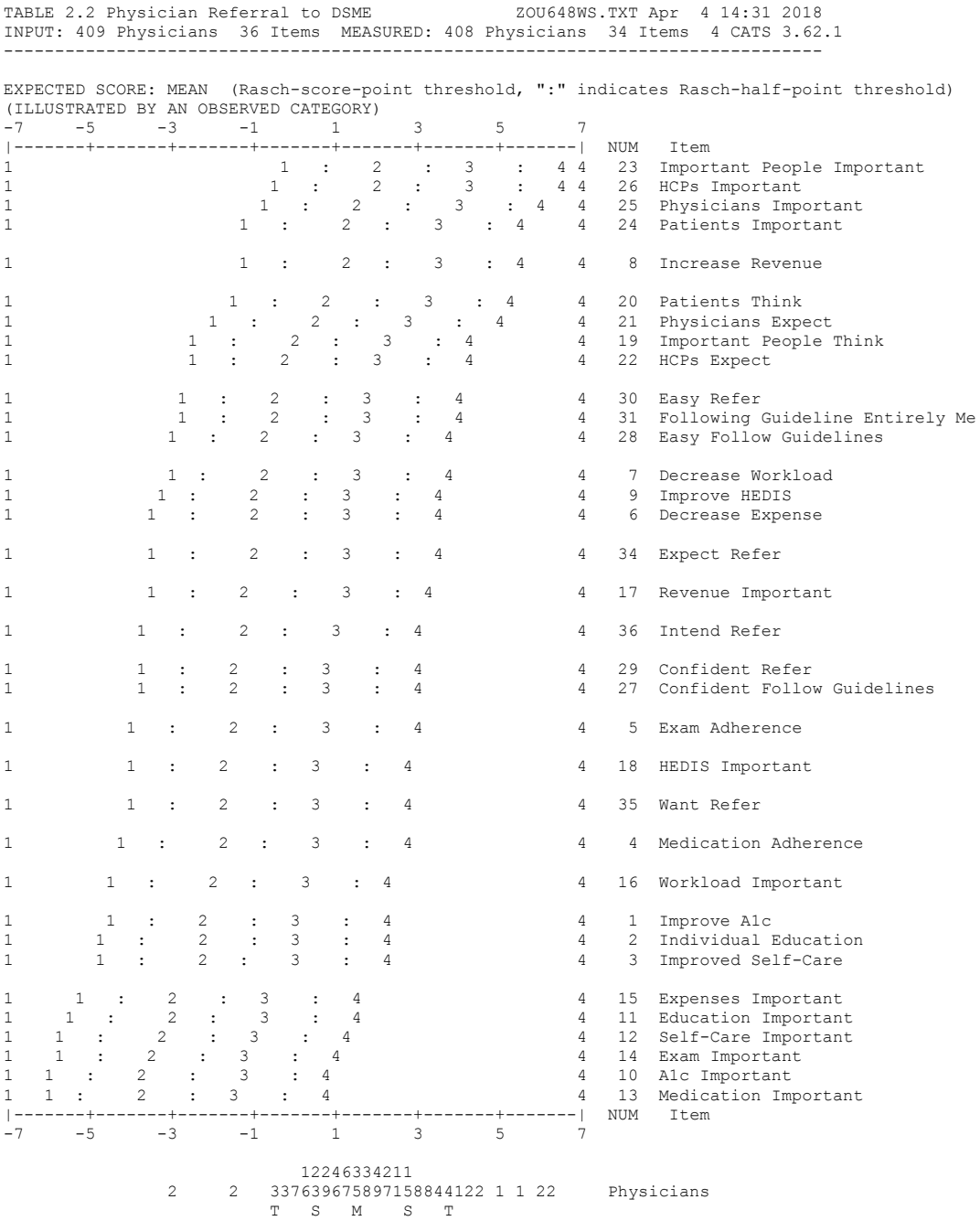
Figure 8. Item Dimensionality (Final)



```
TABLE 23.0 Physician Referral to DSME             ZOU648WS.TXT Apr  4 14:31 2018
INPUT: 409 Physicians  36 Items  MEASURED: 408 Physicians  34 Items  4 CATS 3.62.1
--------------------------------------------------------------------------------

       STANDARDIZED RESIDUAL VARIANCE SCREE PLOT
Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)
                                                 Empirical       Modeled
Total variance in observations     =        157.3 100.0%          100.0%
Variance explained by measures     =        123.3  78.4%           78.1%
Unexplained variance (total)       =         34.0  21.6% 100.0%   21.9%
Unexplned variance in 1st contrast =          4.2   2.6%  12.3%
Unexplned variance in 2nd contrast =          3.0   1.9%   8.9%
Unexplned variance in 3rd contrast =          3.0   1.9%   8.8%
Unexplned variance in 4th contrast =          2.4   1.5%   6.9%
Unexplned variance in 5th contrast =          2.2   1.4%   6.4%

      VARIANCE COMPONENT SCREE PLOT
       +--+--+--+--+--+--+--+--+--+
   100%+  T                       +
       |                          |
  V 63%+     M                    +
  A    |                          |
  R 40%+                          +
  I    |                          |
  A 25%+                          +
  N    |        U                 |
  C 16%+                          +
  E    |                          |
    10%+                          +
  L    |                          |
  O  6%+                          +
  G    |                          |
  |  4%+                          +
  S    |                          |
  C  3%+           1              +
  A    |                          |
  L  2%+              2  3        +
  E    |                    4  5  |
  D  1%+                          +
       |                          |
   0.5%+                          +
       +--+--+--+--+--+--+--+--+--+
          TV MV UV U1 U2 U3 U4 U5
         VARIANCE COMPONENTS
```

This table was generated using WINSTEPS.[71] The raw variance explained by the measures is 78.4% and well above the desired threshold of 60%. The raw unexplained variance is 21.6%, which is below the desired threshold of 40%. This indicates that the instrument is unidimensional and that physician's responses were driven by the constructs (attitude, subjective norm, and perceived behavioral control).

Figure 9. Keyform Table (Final)



```
TABLE 2.2 Physician Referral to DSME              ZOU648WS.TXT Apr  4 14:31 2018
INPUT: 409 Physicians  36 Items  MEASURED: 408 Physicians  34 Items  4 CATS 3.62.1
-------------------------------------------------------------------------------

EXPECTED SCORE: MEAN  (Rasch-score-point threshold, ":" indicates Rasch-half-point threshold)
(ILLUSTRATED BY AN OBSERVED CATEGORY)
-7     -5      -3      -1       1       3       5       7
|-------+-------+-------+-------+-------+-------+-------|  NUM   Item
1                          1   :    2    :   3    :   4 4   23  Important People Important
1                         1   :     2   :    3    :   4 4   26  HCPs Important
1                        1   :    2    :    3    :  4   4   25  Physicians Important
1                      1   :     2   :    3    :  4     4   24  Patients Important

1                      1   :     2   :    3    :  4     4    8  Increase Revenue

1                     1   :    2    :    3    :  4       4   20  Patients Think
1                   1   :     2   :    3    :   4        4   21  Physicians Expect
1                  1   :     2   :    3    :  4          4   19  Important People Think
1                  1   :    2    :   3    :   4          4   22  HCPs Expect

1                 1   :    2    :   3    :   4           4   30  Easy Refer
1                 1   :    2    :   3    :   4           4   31  Following Guideline Entirely Me
1                1   :    2    :   3    :   4            4   28  Easy Follow Guidelines

1                1  :     2    :   3    :   4            4    7  Decrease Workload
1               1  :     2    :   3    :   4             4    9  Improve HEDIS
1              1   :     2    :   3    :   4             4    6  Decrease Expense

1              1   :     2    :   3    :   4             4   34  Expect Refer

1              1   :    2    :    3    :  4             4   17  Revenue Important

1             1   :     2   :    3    :  4              4   36  Intend Refer

1             1   :    2    :   3    :   4              4   29  Confident Refer
1             1   :    2    :   3    :   4              4   27  Confident Follow Guidelines

1            1   :     2   :    3    :   4              4    5  Exam Adherence

1            1   :    2    :   3    :   4              4   18  HEDIS Important

1            1   :    2    :   3    :   4              4   35  Want Refer

1          1   :     2   :    3    :   4               4    4  Medication Adherence

1         1   :     2   :    3    :  4                 4   16  Workload Important

1         1   :    2    :   3    :   4                 4    1  Improve A1c
1        1   :     2    :   3    :   4                 4    2  Individual Education
1        1   :     2   :    3    :   4                 4    3  Improved Self-Care

1      1   :    2    :   3    :   4                    4   15  Expenses Important
1     1   :     2   :    3    :   4                    4   11  Education Important
1    1   :     2    :   3    :   4                     4   12  Self-Care Important
1    1   :    2    :   3    :   4                     4   14  Exam Important
1   1   :    2    :    3    :  4                      4   10  A1c Important
1   1  :     2    :   3    :   4                      4   13  Medication Important
|-------+-------+-------+-------+-------+-------+-------|  NUM   Item
-7     -5      -3      -1       1       3       5       7

                          12246334211
               2     2   337639675897158844122 1 1 22     Physicians
                         T   S   M    S   T
```

This table was generated using WINSTEPS.[71] The keyform table displays the organization of instrument items in order of statistically-determined difficulty (from most difficult to least difficult to affirm).[68] The keyform is used to show how physician

intention to refer patients to DSME develops as a construct. Comprising attitudes is behavioral beliefs (BB) and outcome evaluations (OE). Subjective norm is composed of normative beliefs (NB) and motivation to comply (MC). Perceived behavioral control was measured by self-efficacy (SE) and controllability (CRTL). Questions regarding subjective norm were most difficult for physicians to agree with, while questions about attitudes were the easiest for physicians to agree with. There is no clear progression among the constructs, indicating that physician intent to refer is influenced by interplay of these constructs.