Social Interaction and Support in a Type 2 Diabetes Computer-Mediated Environment

by

Allison Ann Lewinski

Nursing
Duke University

Date:__________________________

Approved:

Allison A. Vorderstrasse, Supervisor

Constance M. Johnson, Supervisor

Ruth A. Anderson

Edwin B. Fisher

Wei Pan

Proposal submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing in the Graduate School of Duke University

2017
ABSTRACT

Social Interaction and Support in a Type 2 Diabetes Computer-Mediated Environment

by

Allison Ann Lewinski

Nursing
Duke University

Date:_______________________

Approved:

Allison A. Vorderstrasse, Supervisor

Constance M. Johnson, Supervisor

Ruth A. Anderson

Edwin B. Fisher

Wei Pan

An abstract of a proposal submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing in the Graduate School of Duke University

2017
Abstract

Problem:

Type 2 diabetes (T2D) is increasing in incidence and prevalence in the United States, and T2D remains the 7th leading cause of death. Consistent T2D self-management delays the onset of co-morbidities associated with this disease; however rates of self-management in adults living with T2D remain sub-optimal. The literature indicates that frequent and sustained social interaction between an individual living with T2D, and other peers living with T2D and a healthcare provider, helps sustain critical self-management behaviors. Yet, an individual living with T2D may experience challenges in obtaining this helpful interaction and support due to temporal, geographical, or physical limitations.

Computer mediated environments (CMEs; programs via the Internet) facilitate the exchange of T2D-specific information and support, and may ameliorate limitations to obtaining support and information. CMEs facilitate the creation of an online community in which individuals can choose their participation and the amount of personal information they reveal to other individuals. These personal narratives facilitate the exchange of support and reinforcement as individuals reveal personal challenges and successes encountered during daily T2D self-management. Yet, interventions via CMEs aimed at increasing self-management in individuals living with T2D, have shown mixed results for sustained behavior change. One way to improve disease-specific CMEs is to understand how individuals interact with others in these CMEs.

This study used Strong/Weak Ties Theory and Social Penetration Theory to describe the frequency and content of social interaction and support in a CME. In Strong/Weak Ties Theory, tie strength is defined as time in which the relationship can develop and occur, the intensity of
emotions within that relationship, the breadth and depth of intimacy, and whether the relationship is reciprocal and mutual. Social Penetration Theory purports that the perceived value of a relationship influences the breadth (number of topics discussed) and depth (degree of intimacy and personalization of discussed topics) of a relationship. This study defined social support using the four types of support commonly identified in the literature: emotional, instrumental, appraisal, and informational. Therefore, the overall purpose of this study was to develop knowledge to advance the science of social relationships in CMEs, with a focus on characterizing social interaction and social support as they relate to self-management in a chronic disease. In particular, knowledge was developed about how social interaction and social support among adults living with T2D was exchanged in a CME.

**Materials:**

This study was a secondary analysis of qualitative data collected from the *Second Life Impacts Diabetes Education & Self-Management (SLIDES)* study. The SLIDES study provided self-management knowledge and support via a CME to individuals living with T2D. These data included recorded synchronous (i.e., real-time) and asynchronous (i.e., delay present) conversations among study participants (n = 20) and diabetes educators and study investigators (n = 4). Diabetes educators offered two education sessions and one support session per week, and these sessions were opportunities for participants to ask questions, learn about T2D, and interact with other participants who had T2D. During the study, all conversational data (i.e., synchronous conversations and text-chat; asynchronous emails and discussion board posts) among study participants, diabetes educators, and study staff within the CME were recorded to MP3 files and stored on a secure server at the University.
The conversational data used in the analysis was prepared over a period of several months; this attention to detail enabled a rich description of social interaction and support in a CME. The researcher listened to the MP3 files and then transcribed several files \( (n = 164) \) in order to gain knowledge of the SLIDES CME. A professional transcription service transcribed the remaining MP3 files \( (n = 697) \). The researcher cleaned all transcribed conversations by simultaneously listening to the MP3 files \( (n = 861) \) and reading the transcribed text to verify accuracy. Then, a systematic approach was used to link each spoken word to a SLIDES participant by voice recognition or reference to names to determine which participants contributed to, and how much each participant engaged in, a conversation. Once the researcher reviewed all MP3 files and transcribed text for accuracy, the Microsoft Word document \( (n = 1,537 \text{ pages}) \) was imported into Atlas.ti to support coding and analysis.

**Methods:**

The primary study used a qualitative study design to comprehensively describe conversational data from participants who engaged in a CME that focused on T2D. Qualitative content analysis guided the description of social interaction and social support. The researcher developed inductive and deductive codes to describe social interaction and social support based upon the guiding framework. A research team comprised of a PhD candidate and two research experts reviewed all emergent codes and themes during first and second level coding.

**Results:**

Findings from the primary study describe social interaction and social support among individuals who interacted in a CME. Four characteristics of a social interaction in a CME developed: (1) *communication techniques*, or how participants interact in real-time communication in a CME; (2) *expressions of self-management*, or the content of participants’
self-management discussions; (3) depth of conversation, or intensity of personal information shared; and (4) breadth of conversation, or the number of topics discussed among participants in a conversation. The findings illustrate that the four types of social support are present in a CME: (1) instrumental support, or the exchange T2D-specific tangible goods in the CME; (2) appraisal support, or the exchange of affirmational support for T2D self-management behaviors; (3) informational support, or the exchange of T2D-specific information; and (4) emotional support, or the exchange of empathy among participants in a conversation. Additionally, the findings illustrate the elicitation behaviors (i.e., prompts that individuals used to obtain support) and the support responses (i.e., the support provided) to further describe social support.

A social interaction in a CME is a multidimensional construct because the communication medium (i.e., the CME) influences the communication techniques individuals’ use when talking amongst themselves to exchange information and support. The findings indicated that participants will reveal personal information about themselves in a CME, and most of the topics discussed are salient to T2D. The primary study indicated that strong/weak ties between individuals exist in CME relationships, and these ties develop over time with the sharing of personal information. The ties developed among (1) diabetes educators and individuals living with T2D, and (2) individuals living with T2D. The findings from this study indicate that social interaction and social support are exchanged among peers and providers in a CME.

**Conclusion:**

Computer-mediated environments enable persons living with T2D to obtain valuable interaction and support at times and locations that are convenient. Type 2 diabetes self-management is person-specific and dynamic, which highlights the need for social support that is personalized and timely. One way participants received personalized support and information was
through interactions with the diabetes educators and other participants. The interactions in a CME mirrored those in a face-to-face environment as participants asked questions of each other, responded to other participants, talked about personal challenges, and provided information. This study began to characterize the social interactions among persons living with T2D who interacted in a CME. Future research on the characterization of social interactions in a CME should focus on analyzing social interactions in a larger, more diverse sample that includes men and women of diverse ages, races, ethnicities, education levels, and income levels.
Dedication

Voici mon secret.

Il est très simple: on ne voit bien qu'avec le cœur.

L'essentiel est invisible pour les yeux.

Antoine de Saint Exupéry.
# Table of Contents

Abstract ................................................................................................................................. iv

List of Tables .......................................................................................................................... xviii

List of Figures .......................................................................................................................... xix

List of Abbreviations and Terms ........................................................................................... xx

Acknowledgements .................................................................................................................. xxi

1. Introduction ......................................................................................................................... 1

1.1 Self-management behaviors help individuals live with T2D ........................................... 1

1.1.1 Description .................................................................................................................... 1

1.1.2 The barriers to T2D self-management ........................................................................ 2

1.2 Self-management education, training and support ......................................................... 3

1.2.1 Current methods to address self-management education, training and support .......... 3

1.2.1.1 The importance of social relationships as a tool in self-management ................. 4

1.2.1.2 Social support positively influences T2D self-management ................................... 5

1.2.2 Barriers to receiving self-management education, training and support ................. 7

1.2.3 Internet support is a means to provide self-management education and support ....... 7

1.3 Current state of Internet-based type 2 diabetes self-management research and interventions ................................................................................................................................. 8

1.4 Theoretical framework ...................................................................................................... 9

1.5 Purpose of the study ......................................................................................................... 11

1.6 Chapters ............................................................................................................................ 12

1.6.1 Chapter 1 ....................................................................................................................... 12

1.6.2 Chapter 2 ....................................................................................................................... 12
1.6.3 Chapter 3 .............................................................................................................. 12
1.6.4 Chapter 4 .............................................................................................................. 12
1.6.5 Chapter 5 .............................................................................................................. 13
1.6.6 Chapter 6 .............................................................................................................. 13
1.7 Summary of the introduction and the topic of the study ..................................... 13

2. Social interaction in type 2 diabetes computer-mediated environments: How inherent features of the channels influence peer-to-peer interaction ......................................................... 14

2.1 Introduction .............................................................................................................. 14

2.1.1 Social interaction definition and applications ................................................. 15
2.1.2 Social interaction and self-management ............................................................ 16

2.2 Search procedures and methods ........................................................................... 18

2.3 Findings .................................................................................................................. 21

2.3.1 The presence of synchronous and asynchronous communication ................ 27

2.3.1.1 Description ..................................................................................................... 27
2.3.1.2 Advantages ................................................................................................... 27
2.3.1.3 Critical considerations .................................................................................. 28

2.3.2 The ability to connect with similar peers ......................................................... 29

2.3.2.1 Description ..................................................................................................... 29
2.3.2.2 Advantages ................................................................................................... 30
2.3.2.3 Critical considerations .................................................................................. 30

2.3.3 The presence or absence of a moderator ......................................................... 31

2.3.3.1 Description ..................................................................................................... 31
2.3.3.2 Advantages ................................................................................................... 32
2.3.3.3 Critical considerations .................................................................................. 32
3.4.4 Data Preparation ........................................................................................................51
3.4.5 Measures .....................................................................................................................51
  3.4.5.1 Qualitative Data ....................................................................................................51
  3.4.5.2 Quantitative Data ..................................................................................................52
3.5 Data Analysis Plan ........................................................................................................53
  3.5.1 Overview ..................................................................................................................53
    3.5.1.1 Validity and rigor ...............................................................................................54
  3.5.2 Qualitative Aims: First Level Coding ....................................................................55
  3.5.3 Qualitative Aims: Second Level Coding .................................................................55
  3.5.4 Mixed Methods Aim ...............................................................................................55
3.6 Discussion ......................................................................................................................57
  3.6.1 Limitations ...............................................................................................................58
3.7 Conclusions ....................................................................................................................59

  4.1 Purpose .........................................................................................................................60
  4.2 Computer-mediated environments facilitate social interaction ..................................61
  4.3 Guiding Framework ......................................................................................................62
  4.4 Parent Study and Sample .............................................................................................63
    4.4.1 Parent study ..........................................................................................................63
    4.4.2 Sample ..................................................................................................................64
  4.5 Methods .......................................................................................................................64
    4.5.1 Qualitative Data Available for this Study ...............................................................65
      4.5.1.1 Data description ...............................................................................................65
4.5.1.2 Preparation and cleaning of the data .............................................. 65
4.5.2 Research design .................................................................................. 66
4.5.3 Analysis ............................................................................................... 66
4.6 Results and discussion ........................................................................... 67
4.6.1 Communication Techniques ................................................................. 67
  4.6.1.1 Indicators of listening ...................................................................... 72
  4.6.1.2 Being in the CME ........................................................................... 74
  4.6.1.3 Attributes of bidirectional information exchange ....................... 75
  4.6.1.4 Connecting actions ........................................................................ 77
4.6.2 Expressions of self-management behaviors ......................................... 78
  4.6.2.1 Challenging aspects of living with T2D ....................................... 81
  4.6.2.2 Self-managing in the real world .................................................. 82
4.6.3 Depth .................................................................................................. 83
  4.6.3.1 Level 1: Making small talk .......................................................... 84
  4.6.3.2 Level 2: Opening up ...................................................................... 84
  4.6.3.3 Level 3: Informing ......................................................................... 85
  4.6.3.4 Level 4: Disclosing ....................................................................... 85
4.6.4 Breadth ............................................................................................... 86
4.7 Discussion ............................................................................................... 86
  4.7.1 Participation in a bidirectional social interaction in a CME ............. 86
  4.7.2 Weak and strong ties in a CME ......................................................... 88
  4.7.3 Depth and breadth of the topics discussed in the CME ................ 91
  4.7.4 Interaction in a CME: Regularly scheduled and synchronous ....... 92
Appendix E: Definition of Terms ................................................................. 142
Appendix F: Apriori Codes ........................................................................ 143
Appendix G: Apriori coding methods for social interaction and social support ........................................ 144
Appendix H: Social support examples in a CME ........................................ 146
References ..................................................................................................... 147
Biography ....................................................................................................... 171
List of Tables

Table 1. Descriptions and types of synchronous and asynchronous channels employed in CMEs, their operationalized definitions, and the necessary items for use. ......................................................... 17

Table 2. Search terms and concatenation of terms utilized to obtain articles for this integrative review. ......................................................................................................................... 19

Table 3. The five characteristics of peer-to-peer interaction in a computer-mediated environment as identified through the synthesis of the selected articles. ................................................................. 22

Table 4. Guidelines to assist in the identification of credible, accurate, and reliable health information on the internet and examples of T2D-specific websites. ......................................................... 40

Table 5. Terms used in this study. ......................................................................................................................... 43

Table 6. Operationalization of social interaction and social support for this study. ........................................ 52

Table 7. Data analysis plan for the qualitative aims. .......................................................................................... 53

Table 8. Data analysis plan for the mixed method aim. ....................................................................................... 54

Table 9. The attributes, interaction behaviors, definitions, and exemplar quotes or instances for the social interaction characteristic communication techniques. ..................................................... 69

Table 10. Description of characteristic expressions of self-management. ...................................................... 79

Table 11. Description of characteristic depth with exemplar quotes. ............................................................... 84

Table 12. Social support in asynchronous and synchronous interactions. ......................................................... 97

Table 13. Total number of social support exchanges exchanged in the CME. .................................................... 100

Table 14. Instrumental support elicitation behaviors and support responses. .................................................. 101

Table 15. Appraisal support elicitation behaviors and support responses. ....................................................... 103

Table 16. Informational support elicitation behaviors and support responses. ................................................ 107

Table 17. Emotional support elicitation behaviors and support responses. ..................................................... 112

Table 18. Guiding framework concepts addressed in this study. ................................................................. 123
List of Figures

Figure 1. Guiding framework ................................................................. 11
Figure 2. PRISMA search diagram. .......................................................... 21
Figure 3. Guiding framework. ................................................................. 47
Figure 4. A sample of graphs for Aim 3, the mixed methods aim for BMI and time............. 56
Figure 5. Frequency of each type of social support as exchanged in the education and social support sessions. ........................................................................ 101
Figure 6. Occurrence of the two types of appraisal support as exchanged in the education and social support sessions in the CME. ................................................................. 105
Figure 7. Providers of the two types of appraisal support as exchanged in the CME........... 105
Figure 8. Occurrence of the types of informational support as exchanged in the education and social support sessions in the CME. ................................................................. 110
Figure 9. Source of the informational support in lecture or participant initiated question. .... 110
Figure 10. Types of emotional support present in the education and support sessions. ......... 115
## List of Abbreviations and Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CME</td>
<td>Computer-mediated environment</td>
</tr>
<tr>
<td>T2D</td>
<td>Type 2 diabetes</td>
</tr>
<tr>
<td>SLIDES</td>
<td>Second Life Impacts Diabetes Education and Self-Management (1R21-LM010727-01)</td>
</tr>
</tbody>
</table>
Acknowledgements

My presence in the PhD program and the completion of this dissertation is the result of many hours of attention, work, mentoring, love, and support from countless people in my life. The road to the PhD has been circuitous and eventful, and I am thankful my path has led me to this experience, with these individuals, at this time in my life. I have been helped by many people during this endeavor, and my goal is to repay this kindness and effort during my career.

My deepest thanks go to the chair of my dissertation committee, Dr. Constance Johnson, who served as my primary mentor since day one in the PhD program. She provided me with invaluable support, guidance, and feedback during our conversations about research, nursing, and life. Dr. Johnson exemplifies a respected scholar and mentor, who is as kind as she is bright.

My dissertation committee willingly shared their expertise and knowledge so that I could grow and learn. I am thankful for the mentoring and guidance from: Drs. Ruth Anderson, Edwin Fisher, Wei Pan, and Allison Vorderstrasse. Their invaluable assistance, support, and guidance helped me to develop new perspectives and gain new insight on this dissertation.

I am thankful for the PhD program at the Duke University School of Nursing because of the program’s dedication to producing nurse scholars. I appreciate the conversations I have had with faculty in the classroom, the hallways, and at conferences. Additionally, I am thankful for the support and friendship of Drs. Anne Derouin, Marilyn Oermann, and Leigh Ann Simmons. These women shared their expertise and knowledge about nursing and research. I would also like to thank Revonda Huppert who has been a helpful constant in my life since I started this program.

I am grateful for my friends near and far who have encouraged me on this journey. My PhD cohort and colleagues provided me with invaluable support and friendship during my years at Duke. My friends outside of the PhD program provided valuable support, friendship and conversation when all I could talk about was my research or PhD-life.

My biggest thank you goes to my family. Growing up, my parents gave me tremendous amounts of love and support, as well as the push to pursue new opportunities. This support enabled me to seek new experiences, think creatively, travel worldwide, and learn from others. My mom provided me with unending guidance, support, and inspiration throughout my life, and she continues to inspire me today. My brother Adam, step-dad Tom, and my Aunt Ann provided support and love in the form of ears to talk to, people to bounce ideas off of, shoulders to cry on, and encouragement. I am also thankful for Brutus because he pushed me to go outside, get some exercise, meet people, and sit on the floor and play. Overall, my family provided me with support and the ‘kick in the pants’ needed to keep going on those days that I wanted to quit. Thank you to all and I will pass this love, encouragement, and support on to the next generation.
1. Introduction

The number of individuals living with chronic illness in the United States (U.S.) increases each year. Notably, 9.3% of adults in the U.S. are diagnosed with type 2 diabetes (T2D) and an estimated 8.1 million people are living with T2D, yet remain undiagnosed (Centers for Disease Control and Prevention, 2014). Despite programs aimed at increasing self-management and improving health outcomes, T2D remains the 7th leading cause of death in the U.S. (Centers for Disease Control and Prevention, 2014). This is because individuals living with T2D are at increased risk for comorbidities such as heart disease, lower limb amputations, stroke, and renal failure. Furthermore, the possibility of adverse outcomes increases for individuals living with uncontrolled T2D; therefore, addressing the management of T2D and the related complications is imperative (Vigersky, 2011).

Treatment and management of T2D is costly at both the individual and system levels. For example, at the individual level, medical care costs are 2.3 times higher for individuals living with T2D than for those who do not have the disease (Centers for Disease Control and Prevention, 2014). Additionally, at the system level, the U.S. spends $245 billion annually on treatment and management for those living with T2D (Centers for Disease Control and Prevention, 2014). This financial burden highlights the importance of maintaining optimal health following diagnosis of T2D. Thus, identifying methods to sustain T2D-specific behaviors is imperative if costs are to be controlled.

1.1 Self-management behaviors help individuals live with T2D

1.1.1 Description

One way to sustain these behaviors is to understand how each individual living with T2D integrates self-management behaviors in daily life. In particular, T2D self-management is
conceptualized as disease-specific, distinct, and necessary actions, completed by individuals living with T2D, that are crucial to maintaining optimal health following diagnosis. These behaviors are person-specific, ever-present, and dynamic in nature because individuals with T2D provide 99% of their own care (Funnell & Anderson, 2003). Consistent and sustained self-management decreases comorbidity development, positively influences quality of life, and has a positive impact on psychosocial outcomes (Boren, Gunlock, Schaefer, & Albright, 2007; Norris, Lau, Smith, Schmid, & Engelgau, 2002; Strom & Egede, 2012). Examples of self-management behaviors include the initiation of preventative care (e.g., foot exams, eye exams), monitoring of one’s blood glucose levels (e.g., daily, and routine glycosylated hemoglobin level (HbA1c)), maintaining healthy practices (e.g., healthy diet, exercise), and the early identification and treatment of comorbidities as they arise. However, inconsistent or poor self-management behaviors increase the chances of poor health outcomes as this disengagement may result in microvascular problems (e.g., renal disease, vision problems), macrovascular problems (e.g., coronary heart disease, cerebrovascular disease), neuropathies (e.g., peripheral, autonomic), and psychosocial (e.g., depression, anxiety) complications (Beaser & Johnstone, 2010; Cavallerano & Stanton, 2010; M. Clark, 2008; Cooppan, Beaser, & Shetty, 2010; Norris, Nichols, et al., 2002). Of note, engagement in self-management behaviors requires an individual’s time, knowledge, and skill.

1.1.2 The barriers to T2D self-management

An individual may experience challenges in engaging in self-management despite knowing the importance of these behaviors. For example, barriers include temporal (e.g., lack of time to go shopping for healthy food), geographical (e.g., living far from a healthcare provider), familial (e.g., unsupportive family member), and physical (e.g., difficulty walking) situations (Brundisini et al., 2013; Glasgow, McCaul, & Schafer, 1986; Laranjo et al., 2015; Stiffler, Cullen,
& Luna, 2014). In addition, there are psychosocial barriers (e.g., depression, diabetes distress) which negatively influence an individual’s ability to consistently engage in self-management (Stiffler et al., 2014; Stuckey et al., 2014). In the presence of these barriers, the amount and frequency of self-management behaviors may overwhelm the individual, thus leading to frustration, isolation, or inattention to these critical behaviors (Ahola & Groop, 2013; Laranjo et al., 2015). Therefore, a need exists to identify methods to support T2D self-management behaviors while simultaneously addressing any barriers that are present.

1.2 Self-management education, training and support

1.2.1 Current methods to address self-management education, training and support

One way to support an individual’s self-management behavior is via an educational class. Type 2 diabetes educational classes reinforce and support consistent engagement in self-management behaviors and the maintenance of proper technique for T2D skills. Self-management education and training that teaches and empowers individuals to engage in successful self-management behaviors decreases treatment costs and improves health outcomes (Boren, Fitzner, Panhalkar, & Specker, 2009). Self-management education and training should be patient-specific and include medical management of the disease, lifestyle modifications, support and follow-up, involve an interdisciplinary team, occur yearly, and be dynamic to accommodate changes in the disease over time (American Diabetes Association, 2013b; M. Clark, 2008). Specifically, this content should support and address an individual’s engagement in self-management behaviors in their own physical and social environment so that any personal challenges are addressed (Fisher et al., 2005; Sallis, Owen, & Fisher, 2008). Therefore, educational classes that focus on illness specific, context-dependent behaviors may improve rates of self-management.
1.2.1.1 The importance of social relationships as a tool in self-management

Interactions with healthcare providers and peers living with T2D can reinforce T2D self-management behaviors. These social interactions are defined as an exchange between two or more individuals on a mutually shared, central topic, which has the potential to influence health (Bloomberg, Meyers, & Braverman, 1994; Bretz & Schmidbauer, 1983); during this social interaction, social support may be provided and received (Broadhead et al., 1983; Holt-Lunstad, Smith, & Layton, 2010; Seeman, 1996). Specifically, social interactions within these peer-to-peer relationships serve to connect individuals, exchange support, increase feelings of social integration, and potentially serve to enmesh an individual into a social network (Berkman, Glass, Brissette, & Seeman, 2000; Heaney & Israel, 2008; Seeman, 1996). Additionally, interactions with healthcare providers are also important as these interactions assist an individual living become familiar with, and integrated in, the larger healthcare system (R. M. Anderson & Funnell, 2008; Brundisini, Vanstone, Hulan, DeJean, & Giacomini, 2015; S. A. Fox & Chesla, 2008). The structure (e.g., social ties and social interactions among individuals) and function (e.g. the support provided or received within these relationships) of a social relationship influences a person’s health; these components can either be provided separately or in combination with each other (Cohen, Underwood, & Gottlieb, 2000; Holt-Lunstad et al., 2010; Lakey & Cohen, 2000). Therefore, social interactions serve as a vehicle to exchange knowledge and support within a social relationship.

The frequency of social interactions among individuals matters for T2D self-management. Research shows that increased frequency of social interaction and follow-up improves sustained self-management of T2D (Fisher, Brownson, O'Toole, & Anwuri, 2007; Norris, Engelgau, & Narayan, 2001; Norris, Lau, et al., 2002). Previous research, with face-to-face interventions ranging from six months to two years, suggests that individuals need sustained,
high frequency interaction, over an extended period of time, by healthcare professionals or peers in order to impact and change self-management strategies and blood glucose levels in T2D interventions (Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012). One way to provide this interaction is via educational classes that facilitate the routine interaction with healthcare providers and peers; this interaction helps to support and maintain self-management behaviors, prevent comorbidities from becoming more serious, and assists the individual with accessing the resources needed to maintain self-management practices (Dale, Williams, & Bowyer, 2012; Heisler, Vijan, Makki, & Piette, 2010). For instance, classes in face-to-face group settings improve health outcomes (e.g., decrease in blood glucose), diabetes knowledge, and self-management skills in addition to positively influencing psychosocial outcomes (Steinsbekk et al., 2012; Strom & Egede, 2012). These frequent and consistent interactions with providers and peers may help an individual address self-management barriers and these interactions may reinforce good behaviors.

1.2.1.2 Social support positively influences T2D self-management

One way to understand how interactions reinforce good self-management behaviors is to examine the content of the interaction. Principally, the support exchanged in an interaction is associated positively with chronic disease self-management (Reblin & Uchino, 2008; Uchino, 2006; van Dam et al., 2005), health maintenance (Holt-Lunstad et al., 2010), and less vulnerability to acute illnesses such as the common cold (Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997). These positive benefits may occur because social support provides personal, informal advice and knowledge that helps individuals initiate and sustain T2D self-management behaviors, thus increasing adherence to these behaviors (Baksi, 2010; C. Clark, 2010; Glasgow, Boles, McKay, Feil, & Barrera, 2003; Jennings, Powell, Armstrong, Sturt, & Dale, 2009; Jernigan & Lorig, 2011). While the research literature classifies and defines social support in many ways,
one of the most commonly used classification types and definitions arises from the seminal work completed by Sheldon Cohen (Cohen & McKay, 1984). Individuals living with T2D exchange four types of social support: *emotional*—providing empathy (e.g., trust, love), *instrumental*—providing concrete and tangible aid (e.g., money), *informational*—providing information (e.g., carbohydrate counts of food items), and *appraisal*—providing affirmation comments (e.g., praise for weight loss) (Cohen, 2004; House, 1981; Lakey & Cohen, 2000). Due to the shared experience of living with T2D, peers can provide knowledgeable assistance in daily management, social and emotional support, linkage to clinical care, and the provision of ongoing support (Fisher et al., 2012). This first-hand experience of living with T2D enables the exchange of content on daily self-management practices such as food choices or how to integrate self-management behaviors into daily routines (Brownson & Heisler, 2009; Fisher et al., 2012).

Infrequent or negative interaction with providers and peers may result in ineffective self-management. Individuals with inadequate support lack the social relationships that provide the emotional resources, support, and valuable assistance in applying self-management behaviors to their daily lives (Fisher, Thorpe, DeVellis, & DeVellis, 2007). Notably, the lack of social interaction, or an unsupportive environment, may cause the individual to feel that he or she is self-managing their diabetes in isolation or without assistance (Case et al., 2009; Lorig et al., 2010). These negative instances may exacerbate any psychosocial issues such as depression, worry, and anxiety which negatively influence a person’s self-management and overall ability to cope with T2D (Bond, Burr, Wolf, & Feldt, 2010; Ciechanowski, Katon, & Russo, 2000; Nicolucci et al., 2013). Therefore, a need exists to facilitate the exchange of positive support that ameliorates the negative instances which undermine the efforts of an individual trying to engage in necessary T2D self-management behaviors.
1.2.2 Barriers to receiving self-management education, training and support

While face-to-face interaction is valuable, there are barriers to this type of education and support. For instance, sustained high frequency interaction with healthcare providers and peers increases cost and resource utilization; this level of interaction is generally not feasible in traditional healthcare settings due to the burden on the patient and healthcare provider (Steinsbekk et al., 2012; Williams, Lynch, & Glasgow, 2007; Yarnall, Pollak, Ostbye, Krause, & Michener, 2003). Many individuals do not receive adequate self-management education and support following the official diagnosis of T2D (American Diabetes Association, 2013b; Funnell et al., 2009; Haas et al., 2014). A paucity of interaction with providers or peers who provide education and support is concerning because many individuals living with T2D report a lack of self-management educational opportunities outside of scheduled programs (Funnell, 2013). Therefore, individuals who receive insufficient education and support at diagnosis may not have opportunities to learn about, and sustain, the self-management behaviors necessary to manage T2D and prevent complications during the course of the disease.

1.2.3 Internet support is a means to provide self-management education and support

Education and support via the Internet is one way to overcome the barriers inherent in face-to-face environments. Internet environments, or computer-mediated environments (CMEs) are interactive, dynamic computer networks that facilitate personalized social interaction, either synchronously or asynchronously, via various types of multi-media (Chang & Wang, 2008; Hoffman & Novak, 1996). Types of CMEs include programs via the Internet such as e-mail, discussion boards, text-chat, and virtual environments, and are a novel way to address social and environmental barriers to self-management by increasing the frequency of interaction among
peers and providers. CMEs use asynchronous (i.e., delayed response interactions) or synchronous (i.e., real-time interactions) methods to facilitate interaction among providers and peers (Burkow et al., 2013; Pal et al., 2013; Stefanone, Kwon, & Lackaff, 2012). Internet based, chronic illness educational environments allow patients to access information at their leisure while providing patients with an online community of support (Pal et al., 2013; Stefanone et al., 2012).

Computer-mediated environments facilitate disease-specific social interaction. The support exchanged in a CME is similar to that in a face-to-face environment because individuals form interpersonal relationship networks with similar others (Heisler, 2007; Strozier, 2012; Turner, Grube, & Meyers, 2001; Wright & Muhtaseb, 2011). In a CME, individuals can initiate, continue, and maintain relationships similar to face-to-face environments (Robinson, Turner, Levine, & Tian, 2011; Walther, 1996, 2012; Yzer & Southwell, 2008). The CME enables individuals to form relationships of varying intensity with peers, which are based upon and rely upon shared experiences and social support (Johnson, Feinglos, et al., 2014; Mantovani, Castelnuovo, Gaggioli, & Riva, 2003). Therefore, CMEs are one platform to provide frequent, disease-specific interaction among individuals living with chronic illness.

1.3 Current state of Internet-based type 2 diabetes self-management research and interventions

Interventions via CMEs appear to have some benefits over interventions via face-to-face environments. Current CME interventions to improve T2D self-management behaviors and skills include Internet based education and support via expressly designed webpages, mobile apps, or virtual environments (Dale et al., 2012; Ershow, Peterson, Riley, Rizzo, & Wansink, 2011; Fisher et al., 2012; Heisler & Piette, 2005; Jackson, Bolen, Brancati, Batts-Turner, & Gary, 2006; Johnson, Feinglos, et al., 2014; McKay, Feil, Glasgow, & Brown, 1998; Norris et al., 2006; Pal et al., 2014). Computer-mediated environments facilitate peer to peer interaction and the exchange
of social support by the technical attributes of the specific medium utilized (e.g., postings on a disease-specific discussion board) (Stefanone et al., 2012). Nonetheless, one commonality of all CME interventions is that they facilitate individual choice and enable the individual living with T2D to access information. Yet, the characteristics of interaction among individuals in a CME remain unknown, therefore hindering the ability to create supportive and effective self-management CME interventions.

One benefit of CMEs is that they facilitate the creation of an online support community. Information gleaned through these online interactions supplements real world knowledge, processes, and experiences (Mantovani, 2001; Mantovani et al., 2003; Yu, Parsons, et al., 2012). Unfortunately, the outcomes are inconsistent in both short- and long-term effectiveness and sustainability across CME studies that aim to improve self-management (M. Clark, 2008; Funnell, 2011; Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003; Norris, Lau, et al., 2002; Pal et al., 2014). These mixed results may stem from not having synchronous, conversational, interaction in which to obtain support or the ability to obtain this type of support at convenient times. Therefore, a need exists to identify the characteristics of purposive social interactions, among providers and peers living with T2D, which provide real-world, and real-time assistance to those with T2D.

1.4 Theoretical framework

Two theories will be used to guide this study and the analysis of social relationships over time: Strong/Weak Ties Theory (Granovetter, 1973, 1983) and Social Penetration Theory (Altman & Taylor, 1973). These theories provide guidance on the characterization of social interaction and social support among peers and providers who are interacting in a T2D self-management CME that is intermittently moderated by healthcare providers.
In Strong/Weak Ties Theory, tie strength is defined as time in which the relationship can develop and occur, the intensity of emotions within that relationship, the breadth and depth of intimacy, and whether the relationship is reciprocal and mutual. Strong and weak ties each serve a purpose; strong ties provide support and intimacy, and weak ties provide linkages to information and resources outside of one’s circle of intimate relationships (Ballard-Reisch, Rozzell, Heldman, & Kamerer, 2011; Granovetter, 1973, 1983). The amount and type of topics discussed within these ties, such as the exchange of content about social support, has the potential to influence tie strength. A strong tie is defined by closeness of contact, duration of contact, frequency of contact, and a direct link between two individuals; in sum, strong ties are densely connected (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983) and the amount of social/peer support is high. Weak ties are not densely connected, the relationships do not require large amounts of time or investment and can be formed more rapidly (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983); the amount and type of social support is lower than with strong ties. Weak ties are essential to a social group; new information is diffused and shared between individuals (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). An important aspect to characterizing social interaction and social support is identifying the ties among individuals and how those ties influence self-management and subsequently health outcomes.

Social Penetration Theory purports that the perceived value of a relationship influences the perceived rewards of initiating and maintaining participation, which subsequently influences the breadth (number of topics discussed) and depth (degree of intimacy and personalization of discussed topics) (Altman & Taylor, 1973; Ballard-Reisch et al., 2011). Thus, increased breadth and depth will occur in a high reward relationship; low breadth and depth will occur in relationships that are considered low reward (Altman & Taylor, 1973; Ballard-Reisch et al., 2011). Tie strength is determined by how each individual values the relationship.
Figure 1 is a conceptualization of the guiding framework used in this study, and is based upon Strong/Weak Ties Theory and Social Penetration Theory. The bolded lines indicate the focus of this study. Social interaction is operationalized as: topic (e.g., the content of the discussion such as self-management or social support), ties (e.g., strong/weak, the amount and duration of contact), depth (e.g., degree of intimacy and personalization of discussed topics), breadth (e.g., number of topics discussed), and participation (e.g., active - present and talking; passive – present and not talking). Social support is operationalized as the four characterizations currently identified in the literature: emotional, instrumental, appraisal, and informational. Self-management is operationalized as: self-management behaviors (e.g., foot care), self-efficacy (e.g., belief in ability to practice self-management behaviors), diabetes knowledge (e.g., knowledge of T2D skills), and perceived support for T2D (e.g., perceived support from family and friends for self-management).

1.5 Purpose of the study

The overall purpose of this study is to develop knowledge to advance the science of social relationships in internet environments, with a focus on characterizing social interaction and social support over time as they relate to self-management in a chronic disease such as T2D. In particular, knowledge will be developed on how social interaction and social support among
adults living with T2D influence self-management. This study consists of six chapters with Chapters 4 and 5 specially addressing the following two research aims, respectively:

**Aim 1:** To describe the characteristics of social interaction in a CME over six months using six *a priori* categories: (1) topics discussed; (2) strong/weak ties; (3) depth; (4) breadth; (5) participation; (6) general engagement in the CME; and emergent codes that arise in a CME about self-management.

**Aim 2:** To describe the characteristics of social support in a CME over six months using the four *a priori* categories of social support: (1) emotional; (2) instrumental; (3) informational; (4) appraisal; and emergent codes as they arise in a CME about self-management.

1.6 **Chapters**

1.6.1 **Chapter 1**

The primary purpose of this chapter is to introduce the problem, background, and significance of T2D, the importance of diabetes self-management education and support, and theory to support use of computer-mediated environments in T2D self-management interventions.

1.6.2 **Chapter 2**

Chapter 2 is an integrative review of the literature on peer-to-peer social interaction via the Internet specific to T2D. This chapter describes the current research literature on social interaction among peers living with T2D and particularly how the medium promotes or inhibits social interaction.

1.6.3 **Chapter 3**

Chapter 3 is the study protocol. This chapter describes the background, theoretical framework, research strategy, and analysis plan for the study.

1.6.4 **Chapter 4**

Chapter 4 addresses research Aim 1 of the study and describes the characteristics of social interaction in a CME over six months. The characteristics of social interaction will be
described using six *a priori* categories: (1) topics discussed; (2) strong/weak ties; (3) depth; (4) breadth; (5) participation; (6) general engagement in the CME; and emergent codes that arise in a CME about self-management.

### 1.6.5 Chapter 5

Chapter 5 addresses research Aim 2 of the study and describes the characteristics of social support in a CME over six months. The characteristics of social support will be described using the four *a priori* categories of social support: (1) emotional; (2) instrumental; (3) informational; (4) appraisal; and emergent codes as they arise in a CME about self-management.

### 1.6.6 Chapter 6

Chapter 6 summarizes the findings from this study on the characteristics of social interaction and social support in adults living with T2D who interacted in a CME. This chapter will discuss the findings of this study in the context of the broader literature on self-management education and support interventions via the Internet.

### 1.7 Summary of the introduction and the topic of the study

Despite numerous attempts to improve self-management among individuals living with T2D, the incidence and prevalence of T2D remains high (Centers for Disease Control and Prevention, 2011, 2012, 2014; Dale et al., 2012; Steinsbekk et al., 2012). Computer-mediated environments can facilitate the frequent social interaction and exchange of support needed in self-management. However, a gap exists in the current literature about synchronous, peer-to-peer social interaction and support provided in a CME. Specifically, this study will address that gap by characterizing social interaction and social support in a CME among peers over time.
2. Social interaction in type 2 diabetes computer-mediated environments: How inherent features of the channels influence peer-to-peer interaction

*Lewinski and Fisher (2016)*

2.1 Introduction

Type-2 diabetes (T2D) is the seventh leading cause of death in the United States (Centers for Disease Control and Prevention, 2014). Individuals with T2D are at increased risk for comorbidities such as heart disease, lower limb amputations, stroke, and renal failure (Centers for Disease Control and Prevention, 2014). The management and complications of T2D depend largely on a patient’s own self-management behaviors (M. Clark, 2008; Funnell & Anderson, 2002; The Diabetes Control and Complications Trial Research Group, 1993). The individual behaviors include monitoring blood glucose levels, daily foot care, medication adherence, eating a healthy diet, and more. Preventative care, initiated by the individual (e.g., scheduling, attending medical appointments) but provided by the healthcare system, includes foot exams, vaccinations, at least annual glycosylated hemoglobin level (HbA1c), as well as discussion and review of self-management skills (Centers for Disease Control and Prevention, 2012). As individuals provide 99% of their own care (Funnell & Anderson, 2003), the burden of self-management rests on the individual’s skills, knowledge, and the continued engagement in self-management behaviors. Regular preventative care is essential to preventing comorbidities and maintaining a baseline level of health (Herrejon, Hartke, Scherer, & Chapman-Novakofski, 2009). Improving self-management of T2D is imperative with 9.3% of U.S. adults diagnosed and an estimated 8.1 million people who have T2D but remain undiagnosed (American Diabetes Association, 2013a; Centers for Disease Control and Prevention, 2014; Funnell & Anderson, 2002). As the incidence and prevalence of T2D increase each year, research continues to explore methods to improve
individuals’ self-management skills and behaviors such as increasing social interaction with peers (Dale et al., 2012; Steinsbekk et al., 2012).

2.1.1 Social interaction definition and applications

A social interaction is broadly defined as a symbolic, mutual exchange between two or more individuals, who possess a common or shared history, in which information is communicated both verbally and non-verbally (Berger, 2002; Rummel, 1975). Social interaction consists of sequential and interdependent occurrences among individuals (Bretz & Schmidbauer, 1983; Henri, 1992; Southwell, 2013); a simple one direction provision of information does not suffice in encouraging dialogue among individuals involved and is not considered a social interaction.

Social interaction with others is an ever-present occurrence that has the potential to influence one’s behavior and health (Berger, 2002; Southwell, 2013). Individuals interact to share knowledge, communicate ideas and goals, and create and maintain relationships (Berger, 2002; Southwell, 2013). A purposive social interaction requires interactivity and multiple responses from both parties to be effective and sufficient in order to exchange ideas and change behavior (Rummel, 1975; Southwell, 2013). Lack of social interaction, termed social isolation, increases susceptibility to illness, stress, morbidity, and mortality (Holt-Lunstad et al., 2010; Umberson & Montez, 2010). Social isolation is a risk factor for mortality comparable to that of cigarette smoking (House, Landis, & Umberson, 1988), thus reinforcing the assertion that social interaction is important for maintaining health.

Programs over the Internet, or computer-mediated environments (CMEs), provide an avenue for social interaction. Individuals use channels in CMEs to interact with family and peers; email, video-chat, and texting are common channels people use to stay in touch and obtain information. The context and environment in which the social interaction occurs is dictated by the
inherent features of each channel. Similar to face-to-face environments, information exchanges in topic-specific CMEs are bidirectional on a mutually shared and understood topic. During the exchange of information, an individual’s behavior is influenced by the behavior of other individuals throughout the encounter as all parties involved in the interaction are influenced (Chartrand & Bargh, 1999; Christakis & Fowler, 2007; Gallant, 2003; Southwell, 2013). For instance, in the case of chronic illness, the exchange of information includes sharing knowledge about a behavior that facilitates self-management, such as diet restrictions (Greenhalgh, Collard, et al., 2011). Interactions in a CME provide individuals the connection to peers to exchange social support and knowledge about self-management practices (Bond et al., 2010; Marziali, 2009). In these social interactions, individuals in CMEs obtain “illness-specific support” (Heisler, 2007) and subsequent friendship-building between peers (Gallant, 2003; Heisler, 2007; Shaya et al., 2013; Turner et al., 2001; Wright & Muhtaseb, 2011).

2.1.2 Social interaction and self-management

Social interaction and behavioral self-management are important to patients with chronic illnesses. Research indicates that individuals living with T2D need sustained self-management support (Funnell et al., 2009) over an extended period of time to maintain self-management strategies (Steinsbekk et al., 2012). Social interaction facilitates the exchange of support as well as obtaining information from others. Personal narratives within social interaction influence one’s behavior by providing opportunities to verbalize real-life application of acquired knowledge (Hinyard & Kreuter, 2007; Shaffer & Zikmund-Fisher, 2013). These exchanges of personal stories, via voice or text, may influence the way individuals self-manage their chronic illness. Self-management behaviors are reinforced in social interactions that are bidirectional, conversational, and that provide guidance, rather than a one-way directional teaching from the provider (Funnell & Anderson, 2002; Glasgow et al., 1999). Current face-to-face and internet
modes of intervention to improve T2D self-management include: support groups (Deakin, McShane, Cade, & Williams, 2005), m-health (Pal et al., 2013), programs over the Internet (Pal et al., 2013), telephones (Graziano & Gross, 2009), interactive voice response systems (Graziano & Gross, 2009; Piette, Weinberger, Kraemer, & McPhee, 2001), and tele-monitors (P. C. Tang et al., 2013). These interventions aim to improve T2D self-management, as well as facilitate the exchange of knowledge and skills. Table 1 describes communication channels employed in CMEs. Of note is that a positive trend is seen in blood glucose levels with increased social support (Strom & Egede, 2012) and an ability to easily obtain T2D self-management information (e.g., with mobile telephones) (Pal et al., 2014). In one study, the outcome results of T2D self-management knowledge, skills, and behaviors provided in a T2D self-management education face-to-face or CME were similar (Pacaud, Kelley, Downey, & Chiasson, 2012). However, due to the increased burden of time and money on both the patient and provider, this high level of interaction is not always feasible in traditional, face-to-face healthcare settings. CMEs can provide frequent interaction with peers and providers that helps to support self-management behaviors for individuals living with chronic illness. The influence of the CME channels on social interaction needs to be determined so that optimal interaction and support can take place.

Table 1. Descriptions and types of synchronous and asynchronous channels employed in CMEs, their operationalized definitions, and the necessary items for use.

<table>
<thead>
<tr>
<th>Channel</th>
<th>Operationalized definition</th>
<th>Necessary items for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forum</td>
<td>• An online community area where individuals post asynchronous messages in different subject areas called threads.</td>
<td>• Computer, keyboard, and internet access.</td>
</tr>
<tr>
<td>Videoconferencing</td>
<td>• A system in which individuals synchronously interact with others via their personal computer. Individuals share what is on their screen and see individuals in real time during their interactions.</td>
<td>• Television or computer screen, internet access, videoconferencing software, and hardware (e.g. headset with microphone).</td>
</tr>
<tr>
<td>E-mail</td>
<td>• A text-based message from a sender to a recipient through an intervention created software environment or through a separate e-mail provider (e.g. Gmail).</td>
<td>• Computer, keyboard, and Internet access.</td>
</tr>
</tbody>
</table>

Of note is that a positive trend is seen in blood glucose levels with increased social support (Strom & Egede, 2012) and an ability to easily obtain T2D self-management information (e.g., with mobile telephones) (Pal et al., 2014). In one study, the outcome results of T2D self-management knowledge, skills, and behaviors provided in a T2D self-management education face-to-face or CME were similar (Pacaud, Kelley, Downey, & Chiasson, 2012). However, due to the increased burden of time and money on both the patient and provider, this high level of interaction is not always feasible in traditional, face-to-face healthcare settings. CMEs can provide frequent interaction with peers and providers that helps to support self-management behaviors for individuals living with chronic illness. The influence of the CME channels on social interaction needs to be determined so that optimal interaction and support can take place.

Table 1. Descriptions and types of synchronous and asynchronous channels employed in CMEs, their operationalized definitions, and the necessary items for use.

<table>
<thead>
<tr>
<th>Channel</th>
<th>Operationalized definition</th>
<th>Necessary items for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forum</td>
<td>• An online community area where individuals post asynchronous messages in different subject areas called threads.</td>
<td>• Computer, keyboard, and internet access.</td>
</tr>
<tr>
<td>Videoconferencing</td>
<td>• A system in which individuals synchronously interact with others via their personal computer. Individuals share what is on their screen and see individuals in real time during their interactions.</td>
<td>• Television or computer screen, internet access, videoconferencing software, and hardware (e.g. headset with microphone).</td>
</tr>
<tr>
<td>E-mail</td>
<td>• A text-based message from a sender to a recipient through an intervention created software environment or through a separate e-mail provider (e.g. Gmail).</td>
<td>• Computer, keyboard, and Internet access.</td>
</tr>
</tbody>
</table>
**Text Chat**

*Same as: instant messaging*

- A synchronous or asynchronous text conversation within a CME or an intervention created software environment with another person or group of people, occurring in real time.

- Computer, keyboard, and Internet access.

- Personal password if secure environment is desired.

- Set time and date for interactions.

T2D is a prime example of a lifelong chronic illness context in which to study social interaction because of its high prevalence. As individuals provide the majority of their own self-care, CMEs can facilitate continued support and follow-up that helps to sustain complex self-management behaviors. Individuals can utilize CMEs to obtain knowledge and support from peers and providers; however, individuals need to learn how to use the features of CMEs to their benefit. While the application and use of the knowledge and support gained in CMEs rests on the individuals living with T2D, healthcare providers retain the responsibility to create, design, implement, and monitor CMEs to ensure optimal use. Therefore, the purpose of this review is to identify features that influence peer-to-peer social interaction in a CME. These findings will provide information to consider when creating, designing, and using CMEs to support self-management in individuals living with T2D.

### 2.2 Search procedures and methods

Individuals interact with each other via the Internet in a variety of ways when learning and seeking information about T2D self-management. This review was designed to provide an appraisal of the literature concerning social interaction via a CME among peers living with T2D. The authors used a systematic approach to identify terms that guided the search and selection of relevant articles regarding social interaction, CMEs, and the self-management of T2D. A literature search was completed using the PubMed, Cumulative Index to Nursing and Allied Health Literature, Sociology Research Database, and PsychInfo databases.

Table 2 lists the search terms and concatenation of the terms when searching databases.
Table 2. Search terms and concatenation of terms utilized to obtain articles for this integrative review.

<table>
<thead>
<tr>
<th>Search Database</th>
<th>Search Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>CINAHL</td>
<td>(MM “Peer Group”) OR (MM “Support Groups”) OR (MH &quot;Self Care&quot;) OR TI self-care OR AB self-care OR TI self-help OR AB self-help OR TI self-management OR AB self-management AND (MH &quot;Internet&quot;) OR (MH &quot;Wireless Communications&quot;) OR (MH &quot;Telephone&quot;) OR (MH &quot;Telehealth&quot;) OR (MH &quot;Social Media&quot;) AND (MH &quot;Internet&quot;) OR (MH &quot;Wireless Communications&quot;) OR (MH &quot;Telephone&quot;) OR (MH &quot;Telehealth&quot;) OR (MH &quot;Social Media&quot;) OR TI Internet OR AB internet OR TI online OR AB online OR TI telephone OR AB telephone OR TI phone OR AB phone OR TI telemedicine OR AB telemedicine OR TI telehealth OR AB telehealth OR TI virtual reality OR AB virtual reality OR TI social media OR AB social media OR (MH &quot;Remote Consultation&quot;) AND (MH &quot;Diabetes Mellitus, Type 2&quot;) OR (MH &quot;Diabetes Mellitus, Type 1&quot;) OR (MH &quot;Chronic Disease&quot;) OR TI diabetes OR TI chronic disease</td>
</tr>
<tr>
<td>SocIndex</td>
<td>(DE “INTERPERSONAL communication” OR DE “PEER communication” OR DE “PEER relations” OR DE “FRIENDSHIP” OR DE “SOCIAL support” OR DE “SOCIAL networks” OR DE “SUPPORT groups” OR DE “HEALTH self-care” OR TI self-care OR AB self-care OR TI self-help OR AB self-help OR TI self-management OR AB self-management OR DE “Social Interaction” OR DE “social interaction”) AND (DE “TELEMATICS” OR DE “INTERNET” OR DE “SOCIAL media” OR DE “TELEPHONE” OR DE “TELECOMMUNICATION systems” OR DE “TELECOMMUNICATION” OR DE “CELL phones” OR TI Internet OR AB internet OR TI online OR AB online OR TI telephone OR AB telephone OR TI phone OR AB phone OR TI telemedicine OR AB telemedicine OR TI telehealth OR AB telehealth OR TI virtual reality OR AB virtual reality OR TI social media OR AB social media OR TI “remote consultation” OR AB “remote consultation”) AND (DE “DIABETES”) OR (DE “CHRONIC diseases”) OR (TI diabetes) OR (TI chronic disease) )</td>
</tr>
</tbody>
</table>

Note: Keywords and MeSH are specific to each database. ab/AB: abstract; DE = subjects (descriptors); MeSH: medical subject headings; MH: exact subject heading; MM: exact major subject heading; NoExp: no explode; ti/Ti: title; tiab: title and abstract.

To identify articles, we used the cognates of the following three broad groupings: (1) **social interaction**- social interaction, OR social support, OR peer support; AND (2) **CMEs**- m-health, OR telephone, OR Internet, OR virtual reality; AND (3) **chronic illness** - chronic disease OR T2D. The inclusion of chronic illness did not increase the number of articles as it was combined with the other search terms. The dates for this search ranged from January 1990 to January 2014. Limits were: adults 18 years old or greater, English language, and scholarly peer-reviewed literature. A total of 1087 articles were obtained; 756 articles remained after duplicates were removed. Inclusion criteria were: (1) article focused on T2D, (2) group peer-to-peer
interaction occurred, and (3) all social interaction was via a CME (e.g. forum, videoconference, text chat, or email). The authors reviewed articles together and discussed for relevance. Nine articles out of 756 met the inclusion criteria and two articles were added from a citation search. In total, eleven articles were systematically organized with headings that allowed for the detailed analysis and comparison of social interaction within a CME. Figure 2 illustrates the search strategy and results. The five most common reasons for exclusion were: (1) focus of article was not T2D (n = 215); (2) focus of article was a survey only (n = 91); (3) focus of article was not computer-mediated communication (n = 75); (4) focus of article was interaction between patient and provider only (n = 54); and (5) focus of article was methods, review of measures, or did not discuss T2D interventions with group peer-to-peer interaction (n = 40).
2.3 Findings

Five characteristics of CMEs emerged as influential in creating opportunities for socially supportive interactions: the presence of synchronous and asynchronous communication, the ability to connect with peers, the presence or absence of a moderator, personalization of feedback regarding individual progress and self-management, and the ability of individuals to maintain choice during participation. Evidence for these findings arose from the original authors’ interpretations/observations and participant statements in the selected articles. Participant statements were directly reported in two out of the 11 articles (Burkow et al., 2013; Jernigan & Lorig, 2011). All 11 articles stated authors’ interpretations of their own data and observations in the “Discussion” section. Table 3 provides an overview the 11 articles as they apply to the five influences identified.
Table 3. The five characteristics of peer-to-peer interaction in a computer-mediated environment as identified through the synthesis of the selected articles.

<table>
<thead>
<tr>
<th>TI &amp; AU</th>
<th>Characteristic</th>
<th>Exchange</th>
<th>Moderator</th>
<th>Personalized Feedback</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interaction-specific technological features of the channel</td>
<td>Ability to interact with similar peers via the channel provided</td>
<td>Facilitation of social interaction by healthcare providers or peers</td>
<td>Feedback regarding individual progress and self-management behaviors</td>
<td>Patient choice regarding individual participation in the CME</td>
</tr>
<tr>
<td>Feasibility and use of an internet support service for diabetes self-management. McKay et al. (1998)</td>
<td>• Synchronous: n/a • Asynchronous: Social support group forum where participants could interact with each other by posting messages about living with DM.</td>
<td>Interactions occurred among peers worldwide via the forums.</td>
<td>No moderator present; conversations were monitored by intervention staff.</td>
<td>• Posting personal messages helped daily SM. • Social support area was the most utilized section of the website. • Patients tracked their BG and received graphic feedback. • Personalized feedback used minimally by participants but considered helpful.</td>
<td>• Three components: information, social support, and BG monitoring. • Provided a wide amount of DM-specific information and recipes. • No minimum requirements for interaction; site accessible 24/7. • People participated at home and work; and in the morning and evening. • Lurkers benefitted from reading posts.</td>
</tr>
<tr>
<td>The diabetes network internet-based physical activity intervention McKay, King, Eakin, Seeley, and Glasgow (2001)</td>
<td>• Synchronous: n/a • Asynchronous: Forum-facilitated public discussion among peers. Email for private contact with personal HC.</td>
<td>Interactions occurred among peers. Individuals interacted with a personal HC.</td>
<td>No mention in the article of a moderator-type individual in the intervention.</td>
<td>Forum for participants. • Private emails to HC up to four times. HC emailed participant at their first logon to plan goals for the intervention. • Tailored to personal needs and goals of participants. Assessments of PA and feedback on PA. Action process completed to identify barriers to increasing PA. • Participant’s weekly goals available on the website at all times; tips for overcoming barriers on website.</td>
<td>No minimum requirements for interaction. Participants encouraged to: log on 1x/week, set goals, post messages, interact with the HC and peers, and use resources available. Interactions with the HC were encouraged and responses were sent within 48 h. • Decline in usage over time. • Avg session duration 13 min; avg 2.1 messages per participant to HC and 1.1 messages per participant in peer support area.</td>
</tr>
<tr>
<td>Internet-based diabetes self-management and support: initial outcomes from the diabetes network project McKay, Glasgow, Feil, Boles, and Barrera (2002)</td>
<td>• Synchronous: Text-chat. • Asynchronous: Email and forums facilitated contact among peers and personalized HC.</td>
<td>Interactions occurred among peers. Individuals interacted with HC. Sample did not have computer or Internet access at home prior to study.</td>
<td>Peer-managed forum and intervention staff monitored forums. Personalized HC encouraged participants to post messages.</td>
<td>Participants interacted to exchange information about T2D; support, and coping strategies. • Personalized HC provided tailored information to the participant at the first login and then up to four times during the intervention.</td>
<td>Could interact with the HC up to 2x/week during the intervention. • Participants with peer support logged on the most during intervention. • The group that had the peer support and personalized HC logged on the most times per week. • Interactive web resources were available for the participants to peruse.</td>
</tr>
<tr>
<td>The D-Net diabetes self-management program: long-term implementation, outcomes, and generalization results</td>
<td>Interactions occurred among peers. Individuals interacted with personalized HC.</td>
<td>Forum was peer managed, intervention staff monitored forums. Researchers intervened twice to enforce the rules. Personalized HC encouraged participants to post messages.</td>
<td>HC provided advice.</td>
<td>HC provided advice. Participants talked to peers while participated in T2D activities and obtained information, coping strategies, support. Forum-facilitated emotional support and information sharing. Forums were general and topic specific. Participants received feedback from HC after entering in personal information (i.e., BG) and received graphic feedback of personal info. Participants received real-time feedback to their questions. Dietary goals set.</td>
<td>Electronic newsletters shared information. No links to outside websites. Decline in usage over time. Small sample size of participants to interact with each other.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Glasgow et al. (2003) <em>Same intervention as McKay et al. (2002), however this is the 10 month follow-up</em></td>
<td>Synchronous: text-chat. Asynchronous: forum utilized for public discussion; email used for private contact.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet-enabled pulmonary rehabilitation and diabetes education in group settings at home: a preliminary study of patient acceptability</td>
<td>Interactions occurred among peers during educational session. Maximum of 6 people could videoconference at one time and participants saw each other on TV screen. Individuals interacted with personalized HC. All participants had no self-management education prior to this intervention.</td>
<td>Healthcare professionals were seen only as moderators for the discussion. Prior to the intervention, an in-person occurred to introduce the participants to each other and the healthcare provider.</td>
<td>Peers felt that the video conferencing system was similar to face-to-face contact and allowed for social interactions. This method allowed for and facilitated learning from others. Interaction occurred in group discussions about educational materials. More discussions occurred between the healthcare provider and participants. Very little organic conversations among peers. Some participants found they desired more chances to personally interact with their peers. The video conferencing system collected and transmitted data (oxygen saturation, heart rate, and BG levels) from the patients to the healthcare providers.</td>
<td>Participants had to be present at the video conferencing group sessions and watch the educational video prior to the start of the session. Weekly educational videos based on weekly discussion topic. Videos were of the same healthcare professionals that were leading the educational sessions. Digital health diary could also be used and updated. Participants could watch the videos and participate in the sessions from their home. The video conferencing sessions allowed people to clarify information and ask questions after they watched the videos. Participants reported that the videos were not the best quality still were valid and helpful.</td>
<td></td>
</tr>
<tr>
<td>Burkow et al. (2013)</td>
<td>Synchronous: Videoconferencing with peers and the health-care provider. Asynchronous: Email used to send a health diary to healthcare provider.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The effects of a web-based intervention on psychosocial well-being among adults aged 60 and older with diabetes: a randomized trial. Bond et al. (2010)</td>
<td>• Synchronous: Text chat between nurse and participants during weekly discussion group and classes. • Asynchronous: Email and forums.</td>
<td>Interactions occurred among peers, and to the research nurse and interventionist.</td>
<td>• Interventionist led text chat sessions and initiated social interaction. • No mention in the article of a moderator-type individual in the forum.</td>
<td>• Participants could also submit their digital health diary to the healthcare provider.</td>
<td>• Participants attended weekly discussion groups which were held 2x/week. • Synchronous classes weekly and focused on T2D topics.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Content and frequency of writing on diabetes bulletin boards: does race make a difference? Case et al. (2009) <em>same intervention as Lorig et al. (2010), however this is a content analysis of the bulletin boards</em></td>
<td>• Synchronous: n/a • Asynchronous: forum; email for private contact</td>
<td>Small group setting mimicked so individuals could interact online like they would in person.</td>
<td>Intervention team member (e.g., peer facilitator) moderated the forums and served as a resource to assist individuals in utilizing the educational components of the intervention.</td>
<td>• Participants interacted via the forum; they could start new discussions or join discussions. Participants had similar experiences with DM and self-care. • Private messages sent to the peer facilitator about specific questions. No biological feedback could be entered into the website for feedback from the healthcare providers.</td>
<td>Participants engaged in: weekly educational modules, forums, and emails with peers. • Each week participants responded to question posed on the forum and posted an action plan. • Caucasians spent a greater amount of time in the intervention than American Indians or Alaska Natives. • Results indicated that: African Americans wrote significantly fewer problem solving and action planning responses; Caucasians wrote more messages that African Americans; American Indians/Alaska Natives wrote significantly less action planning messages than Caucasians. • Results indicated that writing in the forums helped all groups improve their self-care practices. • Identified that lurkers were present.</td>
</tr>
<tr>
<td>Online diabetes self-management program: a randomized study Lorig et al. (2010) <em>same intervention as Case et al. (2009), however this is the intervention manuscript</em></td>
<td>• Synchronous: n/a • Asynchronous: email, discussion forum, and then a list-serv discussion group email for 12 months following the completion of the intervention.</td>
<td>Peer to peer; peer to facilitator. Two peer facilitators led the program. Each facilitator received special training and participated in an earlier version of the intervention. Facilitators encouraged participation and posting on the</td>
<td>Participants interacted with each other via the forum; they could start new discussions or join discussions. Participants had similar experiences with DM and self-care. • Private messages could be sent to the peer facilitator about specific questions. No biological feedback could be entered into.</td>
<td>Participants replied to postings in the forums. • Participants engaged in: weekly educational modules, forums, and emails with peers. • Each week participants had to respond to question posed on the forum and post an action plan. • Password protected site. Also included a book about chronic illness and self-management.</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Synchronous:</td>
<td>Asynchronous:</td>
<td>Interaction</td>
<td>Education</td>
<td>Website Use/Interactivity</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Jernigan and Lorig (2011)</td>
<td>n/a</td>
<td>forum and email</td>
<td>Interactions occurred among peers who shared the same culture. Intervention facilitated the interactions among groups of peers who may not normally be able to interact with peers due to work or distance.</td>
<td>Trained peer living with T2D who encouraged interaction with peers on the intervention website and with others (e.g., family and friends not in the intervention) to increase support.</td>
<td>• Weekly sessions were available for one week to view. Weekly educational content was included, and the forum had four topics. • List-serv did not have any significant impact on the outcomes of the intervention.</td>
</tr>
<tr>
<td>Pacaud et al. (2012)</td>
<td>Synchronous:</td>
<td></td>
<td>Interactions occurred among peers, and to the healthcare provider. No mention in the article of a moderator-type individual in the intervention.</td>
<td>Easier access to providers and peers led to increased knowledge, DM self-efficacy, and higher perceived quality of life. Follow-up care was completed virtually through email communication with providers. Participants could login and enter BG.</td>
<td>• No minimum requirements for participation. • Electronic health educational materials and learning tools available. The interactivity of these components varied depending on the arm of the intervention. The most interactive website had the lowest dropout rate; however, this was not statistically significant. This highly interactive website also had the highest number of hits. A group x time x gender interaction for satisfaction of the website occurred. Males preferred the static/flat website. No differences noted in females. Significant correlation between higher total use of the website and increased DM...</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Synchronous</strong>: n/a</td>
<td>Participants exchanged ideas and obtained support on the forum. The participants found the message board useful and liked communicating with peers.</td>
<td>Website had five sections (weekly topic, education, research, fitness tips, and physical activity myths) that were updated weekly and the lessons were based on social cognitive theory.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asynchronous</strong>: A forum that was started in week 2 was available to all participants.</td>
<td>Interactions occurred among peers. Participants encouraged to email the study coordinator weekly.</td>
<td>Each week participants had to complete an activity and email results to coordinator.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weekly post in the forum by the coordinator regarding the topic for that week.</strong></td>
<td><strong>Weekly post in the forum by the coordinator regarding the topic for that week.</strong></td>
<td>Results indicated that all participants logged on at least once a week in answer to the weekly question, but could send more emails if desired. These were interactive and responsive emails that were specific to each individual.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participants exchanged ideas and obtained support on the forum.</strong></td>
<td>Participants could send emails to the health counselors at least once a week in answer to the weekly question, but could send more emails if desired. These were interactive and responsive emails that were specific to each individual.</td>
<td>Results indicated that all participants logged on at least once, however there was a decline in the number of logins over time.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>The participants found the message board useful and liked communicating with peers.</strong></td>
<td>The participants found the message board useful and liked communicating with peers.</td>
<td>Email counseling was found to be more beneficial than the forum.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>The forum contained a variety of postings about different topics.</strong></td>
<td>The forum contained a variety of postings about different topics.</td>
<td>Results indicated an average of 4.4 messages per person to the study counselor occurred during the intervention.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participants could send emails to the health counselors at least once a week in answer to the weekly question, but could send more emails if desired. These were interactive and responsive emails that were specific to each individual.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Information provided in the table is specific to the portions/arms of interventions in which peer-to-peer interaction via a CME occurred. Key: AU: authors of articles; AVG: average; BG: blood glucose; DM: diabetes; dx: diagnosis; HC: health coach; PA: physical activity; SM: self-management; TI: title of article.
2.3.1 The presence of synchronous and asynchronous communication

2.3.1.1. Description

CMEs allow for two types of interactions—synchronous and asynchronous.

Synchronicity involves interacting in real-time via video-conferencing or text-chat and asynchronicity involves interacting with a delay in responses via text-chat, email, or forums. Of the interventions that utilized synchronous channels, one used video conferencing (Burkow et al., 2013) and four used synchronous text-chat (Bond et al., 2010; Glasgow et al., 2003; McKay et al., 2002; Pacaud et al., 2012) to facilitate interaction among peers. Asynchronous interaction in the form of text-chat, email, or forums occurred in all eleven articles.

Both synchronous and asynchronous channels involve anonymity. This inherent feature of the CME enables individuals to interact with peers confidentially. Individuals identified themselves through unique usernames provided by the research team (Jernigan & Lorig, 2011; Liebreich et al., 2009; McKay et al., 2002; McKay et al., 2001; Pacaud et al., 2012) or self-selected usernames (Case et al., 2009; Lorig et al., 2010). Individuals also used a password to enter the T2D research-specific computer-mediated environment (Jernigan & Lorig, 2011; Liebreich et al., 2009; McKay et al., 2001; Pacaud et al., 2012). Confidential interactions in the CME facilitate discussions of sensitive topics that individuals do not feel comfortable discussing with their family and friends in face-to-face interactions (Jernigan & Lorig, 2011).

2.3.1.2 Advantages

The ability to communicate synchronously and asynchronously offers benefits to users. The CME channels facilitate the exchange of support, knowledge, and skills by allowing individuals to connect with peers spontaneously or at scheduled times. Supportive synchronous and asynchronous interactions included question and answer conversations or support sessions in which individuals benefited from advice from a diverse group of peers living with T2D (Bond et al., 2010; Case et al., 2009; Glasgow et al., 2003; Jernigan & Lorig, 2011; Liebreich et al., 2009;
Four articles incorporated synchronous communication by utilizing synchronous text chat. This type of text chat facilitated discussion among peers and the healthcare provider in two ways: (1) the healthcare provider led a discussion based upon educational materials specific to T2D (Bond et al., 2010); and (2) peers could text chat each other for support and information (Glasgow et al., 2003; McKay et al., 2002; Pacaud et al., 2012). Peers benefit from synchronous communication channels by the online presence of their peers and feeling connected while receiving real-time responses to their questions.

Additionally, asynchronous channels such as asynchronous text chat, email, and forums facilitated the exchange of social support and information due to the availability of information on a wide variety of topics (Case et al., 2009; Jernigan & Lorig, 2011; Lorig et al., 2010). With asynchronous interaction, individuals shared problems and solutions and obtained support from peers and healthcare providers on a multitude of topics (Case et al., 2009; Jernigan & Lorig, 2011; Liebreich et al., 2009; Lorig et al., 2010; McKay et al., 1998; McKay et al., 2001). In asynchronous communication channels, individuals do not have to be present online for an infinite amount of time to obtain information. Information on a forum, in email, or by text message can be read hours or days later.

2.3.1.3 Critical considerations

Despite these benefits there are some drawbacks to synchronous and asynchronous communication channels. Videoconferencing technology replicates face-to-face communication as individuals can see, talk, and hear their peers share personal stories (Burkow et al., 2013). However, one article reported that individuals did not feel comfortable discussing sensitive issues with the entire peer group (Burkow et al., 2013). The authors indicated that individuals missed the privacy of a face-to-face, one-on-one interaction that provided the most comfort when asking personal, sensitive questions about living with T2D (Burkow et al., 2013). Providing only one
type of communication channel (e.g., videoconferencing) limits the ability of individuals to connect with peers. Additionally, with asynchronous forums, individuals retain the ability to originate topics and messages which may disperse information, and a concentrated area for thoughts regarding certain topics does not exist. One article reported individuals discussed a wide range of topics regardless of the official topic of the forum (Jernigan & Lorig, 2011). While topic switching also occurs in conversations off-line, this constant shifting may impede individuals in obtaining all the information that is available from peers in a CME.

The benefits of synchronous and asynchronous channels are limited by the activity level, and engagement, of the individuals participating. In both asynchronous and synchronous channels, conversational topics evolve with group discussion, are limited to those individuals present and active, and rely on group dynamics. Individuals who do not participate or engage with peers still obtain information that is relevant to their personal situation. However, if they want an answer to a specific problem or question that has not been addressed, the individual must post or engage with their peers. The overall conversation was dictated by the participating, and active, members in the group (Case et al., 2009; McKay et al., 2001). Participating and active individuals, described as individuals who posted in forums, participated in text chats, sent emails, or talked with others, received information, skills, and advice from similar peers and healthcare providers (Liebreich et al., 2009; McKay et al., 2002; McKay et al., 2001). The CME inherently influenced social interaction by relying on the active and regular participation of participants and healthcare providers that guided the conversations and dictated the topics chosen.

2.3.2 The ability to connect with similar peers

2.3.2.1 Description

The features of the CME facilitate social interaction with similar peers (e.g., culture, chronic illness). A shared understanding of cultural knowledge and disease-state experience increased the relevancy of the intervention, the educational components, and subsequent social
support (Jernigan & Lorig, 2011). This understanding contributed to the feelings that one is not self-managing in isolation when living with T2D (Burkow et al., 2013; Jernigan & Lorig, 2011). Overall, CMEs provide a channel for social interaction on shared personal concerns and relevant topics.

2.3.2.2 Advantages

The CME enables individuals to connect and exchange relevant T2D specific information. Social interaction can occur at any time and potentially involves more than one individual. In a disease specific CME, individuals find a community dedicated to their chronic illness, thus making it easier to find peers. As individuals do not need to be in the same place at the same time, these interactions are not constrained by temporal or geographical limitations. Individuals connect and exchange personalized feedback which in turn, promotes further interaction by encouraging multiple, interactive, and sequential exchanges among peers and providers. One way individuals connected with peers was through weekly emails to the study coordinator (Liebreich et al., 2009) or they obtained internet access and computers which facilitated the sharing of information (McKay et al., 2001). Common discussion and information topics were chosen that supplemented information individuals received from their primary healthcare providers, and were topics crucial to T2D self-management (Jernigan & Lorig, 2011; McKay et al., 1998). The sharing of T2D specific information with similar peers provides all individuals a common basis on which to build interactions and relationships. Thus, the CME promotes purposive social interaction among peers due to the ease of interacting with others, easily identifying peers who share the same chronic illness, and discussing T2D specific information.

2.3.2.3 Critical considerations

The ability to connect with peers, however, is limited by the inherent requirements of a CME. A computer and internet access is a requirement for social interaction among peers in a
CME. Three articles noted that technological tools for communication such as video-conferencing equipment (Burkow et al., 2013), computers (Bond et al., 2010; McKay et al., 2002), and internet access (Bond et al., 2010; McKay et al., 2002) were provided to individuals to enable engagement. Additionally, the functional capability of the channel influences interactions by limiting the number of individuals who can interact at one time. When video-conferencing was used, only six individuals could connect and participate in a session at one time (Burkow et al., 2013). Assistance in the form of support staff was also provided to those individuals prior to and during the study to ensure that individuals knew how to use the equipment (Burkow et al., 2013). Thus, the inherent requirement of social interaction via a CME is that an individual has reliable and consistent access to a computer and internet access.

2.3.3 The presence or absence of a moderator

2.3.3.1 Description

A moderator is a person who assists the initiation and continuation of peer to peer interactions by engaging individuals in the discussion. This person functioned in several roles as they: initiated the discussion and social interaction (Bond et al., 2010; Burkow et al., 2013), moderated the forums (Case et al., 2009; Glasgow et al., 2003; Jernigan & Lorig, 2011; Lorig et al., 2010), or served as a resource to assist individuals in utilizing the educational components of the intervention (Case et al., 2009; McKay et al., 2002). If this person was not a healthcare professional, he or she was a trained peer living with T2D who functioned as the moderator (Jernigan & Lorig, 2011). Information shared in the peer-to-peer interactions in forums was formally monitored by the research team (Glasgow et al., 2003; McKay et al., 2002), or informally monitored by involving the healthcare professional as the discussion leader (Bond et al., 2010; Burkow et al., 2013). Only one study reported that they had to intervene twice to provide reminders of community rules and standards and this same study reported no misinformation provided by study participants (Glasgow et al., 2003). Moderators received
training on participation in the intervention and monitored for inappropriate content (Lorig et al., 2010).

2.3.3.2 Advantages

The presence of a moderator benefits interactions in a CME. A moderator promotes bidirectional, purposive interaction among peers by starting and maintaining discussions, eliciting personal narratives, advice and information. Moderators prompted individuals to set goals and make plans to assist in the utilization of the CME (Case et al., 2009; Lorig et al., 2010). In addition, the moderator encouraged individuals to post messages and engage with peers (Glasgow et al., 2003; Jernigan & Lorig, 2011; McKay et al., 2002). Moderators “break the ice” and stimulate the exchange of personal narratives in the CME. One article stated that the moderators were provided with special training in order to assist peers and who had participated in an earlier version of the intervention (Case et al., 2009; Lorig et al., 2010).

2.3.3.3 Critical considerations

Moderators are not a requirement for social interaction in a CME. Personal narratives that contain advice, responses to questions, and skills are exchanged over time regardless of a designated topic. Interactions occur, and social relationships will form via CMEs where individuals interact in forums. Studies did not explicitly state how the moderators assisted in maintaining the relevance of information discussed among peers. One article noted that discussion occurred despite the short duration of the intervention and the lack of a moderator (McKay et al., 1998). Of note is that this sample included experienced computer users already engaged in T2D discussion groups (McKay et al., 1998). An absence of a moderator is noticeable in interventions where: (1) individuals rated the support from a health coach more valuable than peers (Liebreich et al., 2009); or (2) a delay in the initiation of social interaction among peers occurred (McKay et al., 2002). Although a moderator may not always be necessary for interaction
to occur, a risk is present with no moderator as individuals may not organically participate in discussions, initiate conversations, and share personal narratives with peers.

### 2.3.4 Personalization of feedback regarding individual progress and self-management

#### 2.3.4.1 Description

The CME enables users to provide medical or behavioral information and receive personal feedback relevant to their current situation. Personalized feedback occurs when an individual receives tailored responses to vocalized problems. When an individual provides medical (e.g., blood glucose levels) or behavioral (e.g., food diaries) data they receive responses from peers or members of the research team regarding their particular progress. Personalized feedback in a CME transpired when individuals obtained relevant information when needed on topics such as physical activity, diet, and daily self-management (Case et al., 2009; Lorig et al., 2010).

#### 2.3.4.2 Advantages

Providing personal feedback supports self-management. All 11 articles discussed features embedded in the design of the CME that promoted continued engagement and subsequent social interaction among peers and providers. In these studies, embedded features provided personalized feedback on current self-management behaviors or answers from peers or health professionals kept individuals engaged in the CME (Glasgow et al., 2003; Liebreich et al., 2009; McKay et al., 2002; McKay et al., 2001; Pacaud et al., 2012). Individuals received feedback via the embedded features such as: forums (McKay et al., 1998), forum and email (Case et al., 2009; Jernigan & Lorig, 2011; Liebreich et al., 2009; Lorig et al., 2010; McKay et al., 2001), or a combination of forum, email, and chat (Bond et al., 2010; Glasgow et al., 2003; McKay et al., 2002; Pacaud et al., 2012). In addition, personalized feedback also occurred when the individual keyed information into embedded features such as online health diaries, exercise and medication logs, or
glucose monitoring logs (Bond et al., 2010; Burkow et al., 2013; Jernigan & Lorig, 2011; Lorig et al., 2010). This personalized feedback was beneficial in the daily disease management of T2D as individuals received support, shared concerns and frustrations, and shared positive actions and information (Jernigan & Lorig, 2011; McKay et al., 1998). Individuals value T2D specific support components as these were the most frequently visited as indicated by the greatest number of log-ins (Glasgow et al., 2003; McKay et al., 2002). Information was available via discussions with peers or individuals could start new discussions in order to obtain needed answers (Lorig et al., 2010). The availability of personalized feedback promoted learning from a community of similar peers; these shared exchanges about life experiences were highly valued (Burkow et al., 2013; Jernigan & Lorig, 2011).

2.3.4.3 Critical considerations

Individual preference determines utilization of the features that provide personal feedback. Personalized feedback from peers and healthcare providers increased goal setting and implementation, and engagement in the components of the intervention (Glasgow et al., 2003; Jernigan & Lorig, 2011). Being able to obtain T2D information and support specific to the point on the trajectory of the disease is valuable—information one needs directly after diagnosis is different from what one needs years after initial diagnosis (McKay et al., 1998). If personalized health information was offered, those individuals who actively participated obtained more tailored advice than individuals who did not participate as much (Case et al., 2009; McKay et al., 2001).

2.3.5 The ability of individuals to maintain choice during participation

2.3.5.1 Description

In a CME, an individual dictates their involvement and the level and amount of social interaction with peers. Specific components in which individuals could choose to participate included: postings in forums (Jernigan & Lorig, 2011; McKay et al., 1998; Pacaud et al., 2012),
providing biological data in order to receive personalized and tailored feedback (Bond et al., 2010; Glasgow et al., 2003; McKay et al., 1998; McKay et al., 2002; Pacaud et al., 2012), reviewing educational material prior to weekly sessions in order to fully participate in discussions (Burkow et al., 2013), submitting health or activity diaries (Burkow et al., 2013), weekly chats to discuss educational materials (Bond et al., 2010; Lorig et al., 2010), and posting weekly goals (Jernigan & Lorig, 2011; McKay et al., 2001).

2.3.5.2 Advantages

Personal choice is intrinsic to a CME. The way an individual engages and participates in CMEs is inherently self-directed. Features used to engage individuals in the CME included: watching educational videos prior to a class session (Burkow et al., 2013), logging on a minimum number of times per week and participating in the weekly activities (Jernigan & Lorig, 2011; Liebreich et al., 2009; McKay et al., 2001), and replying to postings in the forums (Lorig et al., 2010). Through the channels in the CME, individuals learned at their own paces and obtained information that was relevant to their own experience living with T2D (Burkow et al., 2013; Jernigan & Lorig, 2011). Simple design graphics of the CME enhanced personal choice by allowing individuals to access information from a variety of locations (Jernigan & Lorig, 2011).

2.3.5.3 Critical considerations

The usability of the CME influences personal choice. Social interaction among peers in a CME becomes inhibited when the functionality or usability of the CME is poor. Computer technology and internet speed limited the ability to participate from different geographical locations (e.g., work or home), thus limiting personal choice (McKay et al., 1998; McKay et al., 2002). Circumstances that limit social interactions are related to technical and functional limitations which include inherent features of the channels (Burkow et al., 2013; Case et al., 2009; Lorig et al., 2010; McKay et al., 2001; Pacaud et al., 2012), too much information (Bond et al., 2010; Jernigan & Lorig, 2011), individuals unfamiliar or with limited access to computers and
the internet (Case et al., 2009; Glasgow et al., 2003), a confusing design of the CME (Jernigan & Lorig, 2011), or a lack of engagement (Glasgow et al., 2003; McKay et al., 2001; Pacaud et al., 2012). Finally, the lack of privacy in a CME limits choice when an individual wants to discuss personal matters, but is unable to if there is no area for confidential conversations with peers (Burkow et al., 2013).

2.4 Discussion

Evidence from this integrative review of the literature suggests that the design and characteristics included in CMEs influence social interaction among individuals living with T2D by facilitating connections among peers and providers, transcending space and time, and promoting exchange of personalized and disease-specific support. CMEs facilitate the connection among peers and providers as individuals exchange synchronous and asynchronous information via email (Bond et al., 2010; Burkow et al., 2013; Case et al., 2009; Glasgow et al., 2003; Jernigan & Lorig, 2011; Lorig et al., 2010; McKay et al., 2002; McKay et al., 2001; Pacaud et al., 2012), forums (Bond et al., 2010; Case et al., 2009; Glasgow et al., 2003; Jernigan & Lorig, 2011; Lorig et al., 2010; McKay et al., 1998; McKay et al., 2002; McKay et al., 2001; Pacaud et al., 2012), text chat (Bond et al., 2010; Glasgow et al., 2003; McKay et al., 2002; Pacaud et al., 2012), or videoconferencing (Burkow et al., 2013). Synchronous and asynchronous channels support initiation and continued success of peer-to-peer interactions. In both synchronous and asynchronous communication, an individual receives, at the most basic level, the ability to connect with another individual who is living with the same chronic illness (Case et al., 2009; Jernigan & Lorig, 2011; Lorig et al., 2010). Synchronous channels facilitate real-time interaction in which individuals can exchange spontaneous responses via voice and text chat. Conversely, asynchronous channels facilitate interaction by providing individuals time to compose responses and questions about T2D via e-mail or forums. In both channels, individuals retain the ability to ask questions, obtain answers, and exchange social support which promotes social interaction.
among peers (Jernigan & Lorig, 2011; Lorig et al., 2010; McKay et al., 1998; Pacaud et al., 2012).

In addition to facilitating connections, CMEs transcend space and time to enable social interaction and support. These environments connect individuals who are geographically dispersed and allow them to obtain social support from peers. CMEs transcend temporal constraints by facilitating the exchange of support at times that are convenient to individuals and at the point when the individual most needs the support and information. Research shows that ongoing follow-up and support is critical in maintaining self-management behaviors (Fisher, Brownson, et al., 2007); therefore, the flexibility the CME provides in terms of space and time facilitates this exchange.

Furthermore, personalized support and feedback that is timely helps manage the challenges of living with T2D. Forums that are topic specific, CMEs that include information specific to T2D self-management, and the opportunity to pose questions provide individuals with support and information specific to their own disease process. The combination of personalized support that is exchanged in a CME and the feedback the individual receives positively influence self-management and continued engagement (Pacaud et al., 2012). Being able to ask and respond to questions about living with T2D, problem solving, and obtaining information from peers and other medical professionals allow for the direct application of the information being exchanged. The literature shows an individual living with T2D values shared, bidirectional, purposive, and supportive personal interaction while they are learning, refining, and maintaining self-management behaviors (Bond et al., 2010; Jernigan & Lorig, 2011; McKay et al., 1998).

Personalized content, in the form of feedback, and availability of this interaction supports T2D self-management behaviors. The interaction includes social support, problem solving, and practicing of self-management skills. Personalized help, guidance, and support via CME may be more frequent and attainable than in traditional face-to-face environments.
The design of a CME is critical in facilitating peer-to-peer interaction. CMEs should be designed to maintain optimal functionality and usability that encourages initial and sustained engagement while providing a channel to facilitate private conversations among peers. Diabetes-specific social interaction and support helps an individual to maintain self-management behaviors, thus reducing the risk of comorbidities (Dale et al., 2012; Heisler et al., 2010). Social interaction in a CME increases the availability of support, most notably peer support, to those individuals living with T2D.

2.4.1 Limitations of findings

Integrative reviews combine results across experimental and nonexperimental studies to develop understanding, context, and processes about a previously uncharacterized phenomenon (Cooper, 1982; Whittemore & Knafl, 2005). This integrative review attempted to minimize bias and error by having a clear problem statement and research question, an inclusive keyword search in relevant databases, specific inclusion criteria, and identification of codes and themes (Whittemore, 2005; Whittemore & Knafl, 2005). We included in this review only the published literature that currently exists on peer-to-peer interaction in T2D CMEs. Another limitation of this review is that computer technology advances over time; CMEs used 15 years ago may be outdated. Other limitations of the articles included in this review are: sampling from individuals already seeking T2D-specific support from peers via the Internet (McKay et al., 1998; McKay et al., 2001); no theory guiding the intervention (Bond et al., 2010; Burkow et al., 2013; McKay et al., 1998; Pacaud et al., 2012); providing internet access or computers to individuals (Bond et al., 2010; McKay et al., 2002); and small sample sizes in general (Bond et al., 2010; Burkow et al., 2013; Case et al., 2009; Glasgow et al., 2003; Liebreich et al., 2009; McKay et al., 2002; McKay et al., 2001; Pacaud et al., 2012). Therefore, the authors of this review recommend that future studies on peer-to-peer interaction in CMEs be completed with larger, more diverse samples,
taking into account the internet and computer access of the sample, and with all attempts made to decrease attrition.

2.4.2 Clinical implications

CMEs enable individuals to access information when outside of the medical office. Reliable, and accurate, T2D self-management information is located in CMEs and supplements information obtained during medical encounters. However, individuals living with chronic illness can obtain misinformation in CMEs that can affect their ability to self-manage. Of importance is that medical providers are still the primary source for healthcare information, but a growing number of individuals seek information via CMEs (S. Fox & Duggan, 2013). Thus, it is imperative that healthcare professionals know how to guide and direct individuals living with T2D to credible, accurate, and reliable health information on the internet in general or in CMEs. However, readability, access to information, and commercial marketing procedures require healthcare providers to be cognizant of information available to patients on the internet (Fahy, Hardikar, Fox, & Mackay, 2014; Ricciardi, Mostashari, Murphy, Daniel, & Siminerio, 2013; Risoldi Cochrane, Gregory, & Wilson, 2012). Developed guidelines assist individuals in discerning credible and qualified health information on the Internet (Fahy et al., 2014; Health on the Net Foundation, 1996; U.S. National Library of Medicine MedlinePlus). Table 4 provides two guidelines with examples of credible, reliable diabetes websites. When looking at health information on the internet, quality sites are those sponsored by reputable organizations, certified to indicate quality and credibility, transparent in their funding and sponsorship, include information that is updated regularly, specify the target audience, and provide references for included information (Eysenbach, Powell, Kuss, & Sa, 2002; Health on the Net Foundation, 1996; U.S. National Library of Medicine MedlinePlus; Winker, Flanagin, Chi-Lum, & et al., 2000). Reliable information enables patients to become more engaged in their medical treatment and facilitates the acquisition of information to make informed decisions with their providers.
Table 4. Guidelines to assist in the identification of credible, accurate, and reliable health information on the internet and examples of T2D-specific websites.

<table>
<thead>
<tr>
<th>Name of organization</th>
<th>Guidelines</th>
</tr>
</thead>
</table>
| Health on the Net Foundation (1996) (HON) [http://www.hon.ch/home1.html] | • Authoritative (qualifications of authors are listed)  
• Complementarity (information supplements what is learned from the healthcare provider)  
• Privacy (personal data are kept private and confidential)  
• Attribution (source and date of information is included)  
• Justifiability (evidence for information is provided)  
• Transparency (information is jargon free and contact information for the editors of the website and source is provided)  
• Financial disclosure (funding for the website is provided)  
• Advertising policy (details of the advertising policy is included) |
| National Institutes of Health – National Library of Medicine (NIH)  
• Look at who reviews the information  
• The language used is understandable  
• References are included  
• Information is current  
• Funding of website  
• Data collection information |

Examples of credible, reliable, and accurate websites for providers and individuals living with T2D:

- American Heart Association ([www.heart.org](http://www.heart.org))

### 2.4.3 Conclusion

Dynamic learning and support environments that allow individuals various involvement choices tend to engage individuals more and enable greater social interaction. Further research will validate CMEs as tools that facilitate the exchange of support necessary for chronic illness self-management. For instance, this review indicates the presence of a moderator promotes interactions in the CME; however, studies did not discuss how the moderator maintained relevance in the conversations. Relevance may have been achieved by the questions posed and responses provided by the moderators during conversations. Therefore, future research should examine the role of the moderators in facilitating the exchange of support among peers in a CME and how this role evolves over time. This review suggests that the ideal CME includes: (1) a large sample with sufficient diversity, (2) a moderator who promotes interaction, (3) asynchronous and synchronous communication methods, (4) educational information about self-management, and most importantly (5) a dynamic learning environment. Further research in CMEs that continually engage individuals in longitudinal studies regarding T2D self-management will validate the role
of CMEs in self-management. This type of research justifies allocating resources to their integration into the healthcare system. Validation will occur as the number of CME studies increase and longitudinal self-management and support studies are completed on diverse samples. In summary, CMEs facilitate social interaction among peers by offering content that encourages and promotes peer-to-peer interaction at convenient times and places.
3. Analyzing Unstructured Communication in a Computer Mediated Environment for Adults with Type 2 Diabetes (A Research Protocol)

*Lewinski et al. (2017)*

3.1 Introduction

Type 2 diabetes (T2D) affects 9.3% of the adult population in the United States (U.S.) and is the 7th leading cause of death (Centers for Disease Control and Prevention, 2015). The Centers for Disease Control estimates an additional 8.1 million U.S. adults are living with T2D, yet remain undiagnosed (Centers for Disease Control and Prevention, 2015). Complications of T2D include renal failure, lower limb amputations, and heart disease (Centers for Disease Control and Prevention, 2015); such complications are associated with an individual’s self-management behaviors (M. Clark, 2008; Funnell & Anderson, 2002; The Diabetes Control and Complications Trial Research Group, 1993). Regular preventative care also is essential to preventing comorbidities and maintaining a baseline level of health (Herrejon et al., 2009). Yet, no greater than 75% of adults report receiving standard, recommended T2D preventive care, such as vaccinations, annual eye exams, at least an annual glycosylated hemoglobin (HbA1c) test, and regular foot examinations (Centers for Disease Control and Prevention, 2015). Due to the increasing incidence and prevalence of T2D, healthcare providers and researchers need to explore innovative, accessible, and lower cost ways to enhance the self-management skills of those living with T2D (Dale et al., 2012; Steinsbekk et al., 2012).

Self-management of T2D is person-specific, ever-present, and dynamic (Funnell & Anderson, 2002), as individuals with T2D provide 99% of their own self-care (Funnell & Anderson, 2003). Thus, daily disease management of T2D depends on an individual’s self-management behaviors and knowledge (Funnell & Anderson, 2002). In addition to T2D specific skills and knowledge, research indicates that psychosocial support is important in maintaining self-management behaviors (Qi et al., 2015; Strom & Egede, 2012). As such, interventions that
provide additional support to facilitate self-management is essential, as individuals living with T2D report not receiving wanted psychosocial support from close family and peers (Nicolucci et al., 2013).

### 3.2 Background

Individuals living with T2D can become knowledgeable about self-management behaviors and living with a chronic illness through social interactions with peers and providers (Davison, Pennebaker, & Dickerson, 2000). Studies indicate that sustained support from peers and providers for T2D self-management is effective in lowering HbA1c levels because it reinforces critical self-management skills (Dale et al., 2012; Qi et al., 2015; T. S. Tang, Ayala, Cherrington, & Rana, 2011). Table 5 provides definitions for terms utilized in this study.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition for this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-management behaviors</td>
<td>Daily activities completed by the individual living with T2D which may include (American Association of Diabetes Educators, 2008; Johnson, Feinglos, et al., 2014; &quot;Standards of Medical Care in Diabetes—2016,&quot; 2016): Monitoring dietary intake, checking blood glucose values, medication adherence, physical activity, foot care</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>A bidirectional, verbal or written exchange between two or more individuals on a mutually shared, central topic (Bloomberg et al., 1994; Bretz &amp; Schmidbauer, 1983; Lewinski &amp; Fisher, 2016)</td>
</tr>
<tr>
<td>Social Support</td>
<td>Personal, informal advice and knowledge that helps individuals initiate and sustain T2D self-management behaviors, thus increasing adherence (Jennings et al., 2009; Jernigan &amp; Lorig, 2011; World Health Organization Consultative Conference, 2010)</td>
</tr>
<tr>
<td>Computer-mediated environment (CME)</td>
<td>A computer medium that mediates communication among individuals (High &amp; Solomon, 2011; Riva, Davide, &amp; Ijsselsteijn, 2003): Email, discussion forums, text messaging, virtual environments</td>
</tr>
</tbody>
</table>

Self-management of T2D improves with increased frequency of social interaction (Fisher, Brownson, et al., 2007; Norris et al., 2001; Norris, Lau, et al., 2002). Research indicates that high frequency interaction, over an extended period of time, with peers or healthcare professionals can impact and change self-management strategies and blood glucose levels in T2D interventions (Steinsbekk et al., 2012). Social interaction is important in self-management as individuals provide real-world assistance to those with T2D; key to this relationship is the mutual understanding of the shared experience of living with T2D (Boothroyd & Fisher, 2010; Caro & Fisher, 2010; Fisher et al., 2012; World Health Organization Consultative Conference, 2010).
Individuals may exchange support as well as obtain information from others during these synchronous and asynchronous interactions (Greenhalgh, Campbell-Richards, et al., 2011; Jernigan & Lorig, 2011; Southwell, 2013). Social interactions enable individuals to verbalize acquired knowledge; this exchange can potentially influence one’s behavior (Hinyard & Kreuter, 2007; Shaffer & Zikmund-Fisher, 2013).

Of note, an individual’s behavior can be influenced due to a social interaction (Berger, 2002; Southwell, 2013). Verbalizing a personal narrative influences self-management skills, emotional expression, health outcomes, and social support; the language used denotes an individual’s perspective and meaning of these situations (Ames et al., 2005; Graybeal, Sexton, & Pennebaker, 2002; Greenhalgh, Campbell-Richards, et al., 2011; Greenhalgh, Collard, et al., 2011; Pennebaker & Stone, 2003; Ramírez-Esparza & Pennebaker, 2006). However, frequent levels of interaction and support is not always feasible in traditional healthcare settings due to the temporal and financial constraints on both the individuals and provider (Steinsbekk et al., 2012; Williams et al., 2007; Yarnall et al., 2003); thus using the Internet for social interaction is a potential solution and can include interaction among peers as well as between the individuals and provider.

Internet interventions are more widely accessible than other forms of healthcare (Griffiths, Lindenmeyer, Powell, Lowe, & Thorogood, 2006). Individuals access information and interact with an online community of support (Pal et al., 2013; Stefanone et al., 2012) and gain quality information to aid in the self-management of T2D (Burkow et al., 2013; Pal et al., 2013; Stefanone et al., 2012). Therefore, interventions provided via computer-mediated environments (CMEs) are a promising solution to increase self-management practices (Ershow et al., 2011; Johnson, Feenan, et al., 2014). Current CME interventions to improve T2D self-management include m-health (Pal et al., 2014; Pal et al., 2013), programs via the Internet (Pal et al., 2014; Pal et al., 2013), and tele-monitors (P. C. Tang et al., 2013). In CMEs, individuals gain information and benefit from being present with others (McKay et al., 1998); their participation is both active
(present, talking) and passive (present, not talking). Information gleaned through these online interactions supplements and enhances real world knowledge, processes, and experiences (Mantovani, 2001; Mantovani et al., 2003; Yu, Parsons, et al., 2012).

Despite obtaining useful self-management skills and knowledge, attrition in T2D self-management programs remains a concern. Reasons for attrition include barriers such as temporal (e.g., working full- or part-time, scheduling conflicts), geographical (e.g., distance to program), emotional (e.g., apathy, priority of self-management), or technological (e.g., engagement, computer problems) (L. L. Brown, Lustria, & Rankins, 2007; Gucciardi, Demelo, Offenheim, & Stewart, 2008; Norris et al., 2001). Internet interventions can address many of these barriers to attendance, thus potentially decreasing attrition in self-management interventions. Unfortunately, the rates of T2D self-management remain sub-optimal, and internet intervention studies to improve self-management report inconsistent findings in both short- and long-term effectiveness and sustainability (M. Clark, 2008; Funnell, 2011; Gary et al., 2003; Norris, Lau, et al., 2002; Pal et al., 2014). Mixed results may stem from not having synchronous conversations in social interaction which would provide sufficient depth and breadth in social support or not having the ability to obtain this type of support at convenient times (Johnson, Feinglos, et al., 2014).

A virtual environment focusing on T2D specific self-management skills may influence the real-time social interactions among individuals and the support exchanged (Johnson, Feinglos, et al., 2014). Virtual environments mimic real-world environments; the virtual environment is exploratory, interactive, extensive, and users can ultimately determine their own personal involvement and investment (Behm-Morawitz, 2013). This computer generated environment provides an illusion of the real-world through a multisensory, interactive encounter, in which users feel presence and co-presence (Blascovich, 2002a; Schroeder, 2002). Presence, the feeling of being “there” in the environment, makes it feel as if the actions in the CME were occurring in the real world, and the user is completely engaged in the CME (Blascovich, 2002a; Lombard & Ditton, 1997; Schroeder, 2002). Co-presence is the feeling that others are present in the virtual
environment and that one is in an interactive environment in which interpersonal relationships can be initiated, formed, and maintained (Blascovich, 2002a; Schroeder, 2002). While virtual environments can have many different types of representations (e.g., small towns, space crafts) and facilitate a variety of interactions, the proposed study describes a virtual environment as one that re-creates a small town using 3D graphics (Blascovich, 2002a). The replication of real-life environments can foster skills that promote real world application of essential self-management behaviors (Johnson, Feinglos, et al., 2014).

Individuals self-represent as avatars within these environments, a type of CME, to receive both informal and formal learning opportunities, thus reinforcing positive T2D self-management techniques (Blascovich, 2002a; Burkow et al., 2013; Cook, 2012). Avatars, when high in agency (e.g., accurate representation of a person in real life) and behavioral realism (e.g., degree to which objects in the virtual environment act like they do in the real world), increase the involvement and engagement of individuals in the virtual environment (Blascovich, 2002a). This real-time interaction and support may positively influence self-management skills and behaviors. However, a gap in knowledge exists regarding the characteristics of social interaction and social support exchanged among adults living with diabetes that contribute to sustained behavior change and self-management (Fisher, La Greca, Greco, Arfken, & Schneiderman, 1997; Green, Furrer, & McAllister, 2011).

Thus, this current study will provide insight into the depth, breadth, and quality of the social interaction and social support exchanged in a virtual environment through the study of conversations among participants in combination with survey responses, health outcomes (HbA1c, BMI), and activity data. The parent study, Second Life Impacts Diabetes Education and Self-Management (SLIDES, 1R21-LM010727-01), provided self-management support and education in a virtual environment, where all voice, email, and text-chat conversations were recorded in real-time over a six-month period (Johnson, Feinglos, et al., 2014). The knowledge generated from this study will help determine what features are important to include in future
T2D self-management interventions and how to best facilitate high-quality, effective support. Here we describe the theoretical and analytic approaches to this study exploring the characteristics of social interaction and social support exchanged among adults living with T2D who interacted in a virtual environment.

3.3 Theoretical Framework

This study uses Social Penetration Theory (Altman & Taylor, 1973) and Strong/Weak Ties Theory (Granovetter, 1973, 1983) to guide this secondary analysis in order to gain an understanding of T2D specific social interaction among providers and peers within a CME. These theories will assist us in examining the differences in interaction among both active and passive participants, amount and type of interaction, and exchange of social support, specifically centering on self-management of chronic illness. Figure 1 depicts the guiding framework for this study.

![Figure 3. Guiding framework. This framework was utilized for this secondary analysis of qualitative and quantitative data from adults living with type 2 diabetes who interact in a virtual environment.](image)

3.3.1 Social Interaction

Social Penetration Theory purports that the perceived value of a relationship influences the perceived rewards of initiating and maintaining participation, which then influences the breadth (e.g., number of topics discussed) and depth (e.g., degree of intimacy and personalization
of discussed topics). Thus, increased breadth and depth will occur in a high reward (e.g., family member, valued and trusted friend) relationship; low breadth and depth will occur in relationships that are considered low reward (e.g., casual acquaintance) (Altman & Taylor, 1973; Ballard-Reisch et al., 2011). The determination of the value in a relationship influences the tie strength between two individuals.

In Granovetter’s (Granovetter, 1973) Strong/Weak Ties Theory, tie strength is time in which the relationship can develop and occur, intensity of emotions within that relationship, breadth and depth of intimacy, and whether the relationship is reciprocal and mutual. Strong and weak ties each serve a purpose; strong ties provide support and intimacy, and weak ties provide linkages to information and resources outside of an individual’s circle of intimate relationships (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). The amount and type of topics discussed within these ties, such as social support, have the potential to influence tie strength. Strong ties are defined by closeness of contact, duration of contact, frequency of contact, and a direct link between two individuals; in sum, strong ties are densely connected (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983) and the amount of social support is high. For instance, strong ties are an individual’s close family and friends with whom they frequently interact, and the ties are familiar with each other (Granovetter, 1983). Weak ties are not densely connected, the relationships do not require large amounts of time or investment and can be formed more rapidly (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983), and the amount and type of social support is lower than with strong ties. Weak ties are essential to a group; new information is diffused and shared between individuals (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). An individual has weak ties with other people with whom they are not in frequent contact, and there is little familiarity among the individual’s other weak ties (Granovetter, 1983). The characterization of the ties between individuals is important, as well as the identification of when ties are integral and influential in self-management and the exchange of support.
3.3.2 Social Support

We conceptualize social support as: emotional, instrumental, informational, and appraisal support (Heaney & Israel, 2002; House, 1981; Lakey & Cohen, 2000; Langford, Bowsher, Maloney, & Lillis, 1997; Vorderstrasse, Lewinski, Melkus, & Johnson, 2016). Emotional support is the provision of empathy shared among peers and providers when discussing T2D self-management. Instrumental support is the provision of assistance or goods that assist in the self-management of T2D. Informational support is the sharing of knowledge that assists the individual in T2D self-management. Appraisal support includes affirmative comments among individuals regarding self-management actions taken (Heaney & Israel, 2008). Peer support (e.g., support from peers living with T2D) consists of assistance in daily management, linkage to clinical care, and the ongoing availability of support (Fisher et al., 2012).

3.3.3 Self-management and health outcomes

In this study, we utilized the outcome measures from the parent study to conceptualize self-management and health outcomes (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). Data collected included valid and reliable measurement of: (1) self-management behaviors via the Summary of Diabetes Self-Care Activities (Toobert, Hampson, & Glasgow, 2000); (2) diabetes knowledge via true/false items designed to assess diabetes knowledge (Speight & Bradley, 2001); (3) perceived support for T2D management via the Diabetes Support Scale(Barrera, Glasgow, McKay, Boles, & Feil, 2002); (4) self-efficacy via the Diabetes Empowerment Scale- Short Form (R. M. Anderson, Fitzgerald, Gruppen, Funnell, & Oh, 2003); (5) outcome data (HbA1c and BMI) via medical chart reviews by the study coordinator; (6) demographics collected by the study coordinator; and (7) activity data (number of log-ins, time spent online) via participant activity in SLIDES site (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). These data were collected at baseline, three months, and six months and are described fully elsewhere (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014).
3.4 Study Protocol

The overall goal of this study is to gain an understanding of T2D social interaction in a virtual environment, a type of CME, and the social support characteristics that increase and sustain self-management in adults living with this chronic illness. The specific aims for this study are:

- To describe the characteristics of social interaction using the following six *a priori* categories: (1) topics discussed, (2) strong/weak ties, (3) depth, (4) breadth, (5) participation, and (6) general engagement in the CME; and emergent codes that arise in a CME about self-management.
- To describe the characteristics of social support using the following four *a priori* categories: (1) emotional, (2) instrumental, (3) informational, and (4) appraisal; and emergent codes as they arise in a CME about self-management.
- To describe the trends of social interaction and social support over time, and the longitudinal relationship between social support and social interaction with SLIDES outcome data including self-management behaviors, self-efficacy, diabetes knowledge, perceived support for T2D management, health outcomes (HbA1c, BMI), and participation (number of log-ins, time spent online).

3.4.1 Design

A mixed-methods secondary analysis of naturalistic, conversational, and qualitative data (voice and text conversations) will be used to describe the characteristics of social interaction in a CME about self-management and support (Boslaugh, 2007; Heaton, 2008; Vartanian, 2011). This secondary analysis was approved by the University Institutional Review Board (Pro00022132).

3.4.2 Parent Study

The SLIDES study was a virtual 3D diabetes community that promoted knowledge application of self-management behaviors among adults with T2D (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). The SLIDES sample included individuals living with T2D who self-represented as avatars (e.g., representations of themselves) and interacted with peers while learning and practicing self-management skills. Individuals interacted in real-time self-management education and support classes focused on AADE curriculum for self-management education and salient T2D self-management topics.
3.4.3 Participants

All participants (n = 20) and providers (diabetes educators and investigators) (n = 4) of the SLIDES study, and all conversations among participants, will be used; no further recruitment of participants will occur and no additional inclusion or exclusion criteria will be applied. The demographics and primary outcomes of this study have been previously reported elsewhere (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). As we want to analyze the various ways that individuals participated, we will include all 20 participants knowing that some participated more actively than others. Passive and active participation are described in the operationalization of social interaction. This allows us to understand what is happening to those individuals who are more/less active and more/less passive. The qualitative conversation data have not been analyzed in the parent study.

3.4.4 Data Preparation

An IRB approved transcriptionist and the first author transcribed the synchronous voice conversations. The first author verified concordance with the MP3 voice conversation files to ensure the accuracy of spoken words and the communication style of each participant. Each spoken word is linked to a SLIDES participant (de-identified), location of conversation in the SLIDES CME, and calendar date of conversation; and is organized into a Microsoft Word file. Since the participants were provided a study-created screen name, their personal names were de-identified. These data were then organized by study week and uploaded into Atlas.ti for analysis.

3.4.5 Measures

3.4.5.1 Qualitative Data

These data include all synchronous voice conversations and asynchronous conversations (e.g., text chat, discussion forums, and emails) over six months (1535 pages of transcribed text), thus providing secondary data for evaluating social interaction (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). Table 6 provides the Operationalization of social interaction and
social support for this study. Conversations occurred in various contexts: participant to participant, participant to educator, discussion forums, and within group education and support sessions (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014).

Table 6. Operationalization of social interaction and social support for this study.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Operationalization in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social Interaction</strong></td>
<td></td>
</tr>
<tr>
<td>• <strong>Topic</strong> (Holt-Lunstad et al., 2010): the content of the discussion about self-management, type 2 diabetes, or living with chronic illness.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Ties</strong> (strong/weak) (Granovetter, 1973, 1983): amount and duration of contact, intensity of emotions, reciprocity of interaction.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Depth</strong> (Altman &amp; Taylor, 1973; Ballard-Reisch et al., 2011): degree of intimacy and personalization of discussed topics.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Breadth</strong> (Altman &amp; Taylor, 1973; Ballard-Reisch et al., 2011): number of topics discussed.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Participation</strong> (active/passive): present and talking; present, not talking.</td>
<td></td>
</tr>
<tr>
<td><strong>Social support</strong></td>
<td>4 categories as noted in the literature (Heaney &amp; Israel, 2002; House, 1981; Lakey &amp; Cohen, 2000; Langford et al., 1997; Vorderstrasse et al., 2016):</td>
</tr>
<tr>
<td>• <strong>Emotional</strong>: The exchange of feelings of trust, caring, love, belongingness, and warmth when discussing T2D self-management or behaviors.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Instrumental</strong>: The exchange of tangible goods or services related to T2D self-management.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Informational</strong>: The exchange of T2D-specific information among individuals.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Appraisal</strong>: The exchange of praise for a T2D self-management behavior or action.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Emergent codes</strong>: to capture instances in the conversations not covered by the 4 categories of social support.</td>
<td></td>
</tr>
<tr>
<td><strong>Source of support</strong></td>
<td>Providers of support and/or education within the CME:</td>
</tr>
<tr>
<td>• <strong>Provider</strong>: Nurse Practitioners, Certified Diabetes Educator, PI of SLIDES.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Peer</strong>: another individual who had T2D.</td>
<td></td>
</tr>
</tbody>
</table>

3.4.5.2 Quantitative Data

We will be using data that were previously collected and analyzed in the parent study (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). Psychosocial measures and health outcomes data were collected at baseline, three months, and six months and are described fully elsewhere (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). Demographic data was collected upon entry into the SLIDES study, and activity data was collected continuously when the participants entered the SLIDES site. Data collected included valid and reliable measurement of: (1) self-management behaviors via the *Summary of Diabetes Self-Care Activities* (Toobert et al., 2000); (2) diabetes knowledge via true/false items designed to assess diabetes knowledge (Speight & Bradley, 2001); (3) perceived support for T2D management via the *Diabetes Support Scale* (Barrera et al., 2002); (4) self-efficacy via the *Diabetes Empowerment Scale- Short Form* (R. M. Anderson et al., 2003); (5) outcome data (HbA1c and BMI) via medical chart reviews by
the study coordinator; (6) demographics collected by the study coordinator; and (7) activity data (number of log-ins, time spent online) via participant activity in SLIDES site (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014).

3.5 Data Analysis Plan

3.5.1 Overview

Table 7 provides a description of the analysis plan for the qualitative aims. The qualitative aims, characterizing social interaction and characterizing social support, will be first analyzed with content analysis (Krippendorff, 2004; Richards, 2013) using Atlas.ti (Friese, 2014) to manage and support the coding process.

<table>
<thead>
<tr>
<th>Study Aim 1: Characterizing social interaction: To describe the characteristics of social interaction using six a priori categories: (1) topics discussed; (2) strong/weak ties; (3) depth; (4) breadth; (5) participation; (6) general engagement in the CME; and emergent codes that arise in a CME about self-management.</th>
<th>Study Aim 2: Characterizing social support: To describe the characteristics of social support using the four a priori categories of social support: (1) emotional; (2) instrumental; (3) informational; and (4) appraisal and emergent codes as they arise in a CME about self-management.</th>
</tr>
</thead>
</table>
| **Analysis Step 1: First Level Coding Process. Data-near coding process.** | Determine appropriate coding unit for each a priori code Demographic coding (e.g., conversation type, participant ID, participant study time, location in VE, class type, conversation type) Create higher level, more abstract codes based upon the first level codes:  
  - Social Interaction  
  - Social Support  
  - When themes are created, create variables |
| **Analysis Step 2: Second Level Coding Process. Increasing abstraction of codes.** | Code data using the a priori codes:  
  - Social Interaction: Use a priori codes (Table 1)  
  - Social Support: Use a priori codes (Table 1)  
  - Team process: Code independently, gather together and debate definitions and coding, re-code documents following the meeting |

The codes and themes created using content analysis will be quantitized into numerical values in order to create code counts for use in displaying trajectory lines for the mixed method aim (Creswell & Plano Clark, 2011; Sandelowski, Voils, & Knafl, 2009). Table 8 provides the analysis plan for the mixed methods aim. Emergent codes will be identified in relation to observations of social support unique to participants living with T2D interacting in a CME. Codes
will be analyzed consistent with the theoretical framework and in context of social interaction, social support, and self-management of T2D. Thus, the theoretical framework provides the lens to examine the conversations with a more focused and guided analysis (Creswell, 2014).

Table 8. Data analysis plan for the mixed method aim.

| Study Aim 3: Mixed Methods aim: To describe the trends of social interaction and social support over time, and the longitudinal relationship between social support and social interaction with SLIDES outcome data including self-management behaviors, self-efficacy, diabetes knowledge, perceived support for T2D management, physiological data (HbA1c, BMI), and activity data (number of log-ins, time spent online). |
| Analysis Step 3: Mixing the Data. Identifying areas of convergence and divergence of these data. |
| Identify patterns that emerge that can be described with sample demographics (e.g., race, duration of diabetes) |

3.5.1.1 Validity and rigor

We will use team coding procedures to ensure validity and reliability of findings and iteratively generate codes based upon the theories (Creswell & Plano Clark, 2011; Harris, 2001; Krefting, 1991; Maxwell, 1992; Richards, 2013). We will ensure validity by providing rich descriptions of all codes with exemplar quotations; triangulating data from quantitative and qualitative sources; presenting any discrepant information identified during the coding process; and discussing all findings as a team (Creswell, 2014). Validity of findings is also strengthened due to the extensive time the first author (AAL) spent cleaning and organizing these data, the involvement of the last author (CMJ) who served as PI of SLIDES, and the participation of the third author (AAV), a co-investigator in SLIDES who led the support sessions (Creswell, 2014). A codebook will be created that details creation of the codes and emerging themes, and that contains an audit trail of actions throughout coding and analysis (Richards, 2013). The coding team (AAL, RAA, CMJ) will meet regularly to ensure accuracy of coding, reliability, categorization, higher level code development, and emerging findings. The coding team will independently read and code 25% of the transcripts during the entire analysis to ensure reliability.
3.5.2 Qualitative Aims: First Level Coding

The coding team will initially independently code the transcripts using the *a priori* codes for 5% of the transcripts, and then meet to discuss codes and coding units. The team will compare examples and findings and discuss results until agreement is reached on coding definitions and application of the definitions to these data. The coding team will look for coding agreement for the remaining 5% cycles of coding. Due to the multidimensional structure that is anticipated to be present in the transcripts, no limit will be placed upon the number of codes to which a coding unit can be assigned. The coding team will repeat this process until we have agreement on the first level coding. Following discussions, the first author will re-code transcripts using any new codes, and the coding team will review work on a biweekly basis.

3.5.3 Qualitative Aims: Second Level Coding

We will use data matrices to identify patterns in these data that emerge relating to social interaction and social support (O'Cathain, Murphy, & Nicholl, 2010). The coding team will meet to identify higher level, and more refined codes inclusive of the codes identified in first level coding. Second level coding will mirror the first level coding in that the coding team will independently code 5% of the transcripts and then meet to discuss emerging patterns in these data. No limit will be placed upon the number of higher level codes a coding unit can be assigned. These data, and the patterns identified, will be quantitized to variables related to social interaction and social support (e.g., levels of depth, active listening) (Sandelowski et al., 2009). Descriptive statistics will be used to summarize differences, determine frequencies, and identify relationships.

3.5.4 Mixed Methods Aim

The SAS program Version 9.4 (SAS Institute Inc., Cary, NC) will be used to address this aim. Due to the small sample size ($n = 20$), we will compute descriptive statistics only to summarize the characteristics of social interaction and social support. This data will then be used to examine the longitudinal relationship between these variables with BMI and HbA1c. The
variables created during analysis of qualitative data for social interaction and social support aims will be used in the analysis of the mixed methods aim. These data will be first plotted on trajectory lines for each person for the social interaction and social support variables (e.g., ties, emotional support, etc.) and two or three subgroups will be identified by visually examining their trends over time (e.g., informational support increased, unchanged, or decreased). Then, we will summarize the average trend for each variable created from qualitative data (e.g., ties, emotional support) and overlay the SLIDES variables (e.g., diabetes knowledge, self-efficacy, etc.) for the subgroups to identify the trajectories at three time points (baseline, 3, 6 months) and relate these to BMI and HbA1c. Figure 4 provides a sample of such graphs to visualize these data.

![Graph of BMI over time with informational support trajectories](image)

**Figure 4.** A sample of graphs for Aim 3, the mixed methods aim for BMI and time.

*Note:* We will first visually categorize the 20 trajectories of informational support into increased, unchanged, and decreased groups. Here shows a plot of the three subgroup’s BMI across the time points to see if the trajectories of BMI are correlated with the informational support: BMI decreased for the group of increased information support (filled line), BMI unchanged for the group of unchanged informational support (dotted line), and BMI increased for the group of decreased informational support (dashed line).

The visual and descriptive trajectory lines will allow us to overlay the average trends from the time points to describe trends over time and how social support and social interaction
evolve. We will determine if there are differences in the trajectory plots described above, based on demographic factors, duration of diabetes, and time spent online.

3.6 Discussion

Research indicates that sustained social support reinforces T2D self-management behaviors (Dale et al., 2012; Fisher et al., 2012; Heisler & Piette, 2005; Norris et al., 2006). Current T2D social support research focuses on face-to-face interactions and CMEs with person-to-person interaction via the Internet (Dale et al., 2012; Ershow et al., 2011; Fisher et al., 2012; Heisler & Piette, 2005; Johnson, Feenan, et al., 2014; Norris et al., 2006; Pal et al., 2014); yet, interventions for T2D over the past fifteen years have not led to significant long-term improvements in self-management (Pal et al., 2014). Therefore, a need exists for sustainable, innovative interventions that increase an individual’s self-management behaviors by providing long-term contact with providers and peers that provide T2D specific support (Holt et al., 2013; Marrero et al., 2013; Vigersky, 2011).

Type 2 diabetes self-management is positively influenced by sustained, continuous support via face-to-face or Internet environments (Norris, Lau, et al., 2002; Pal et al., 2014). Research shows that relationships formed in CMEs augment face-to-face support; however, specifics of these relationships remain unknown (Armstrong, Koteyko, & Powell, 2012; Wright & Muhtaseb, 2011). Thus, we do not have sufficient evidence for how to encourage and support effective interactions in CMEs. Sufficient knowledge about interaction in CMEs is needed as approximately 81% of all U.S. adults use the Internet, and 72% look for health information online (Boase, Horrigan, Wellman, & Rainie, 2006; S. Fox & Duggan, 2013; Pew Internet and American Life Project, 2014). Thus, the analysis of verbatim, naturalistic conversations in a virtual environment, will characterize enacted, supportive interactions among individuals living with a chronic illness who are seeking information and support. Results from this study will provide a
way to measure social support as it is provided in daily conversation and interaction to identify the real-time exchange of support among adults living with chronic illness.

The SLIDES platform allowed participants to have conversations online and exchange support in naturalistic conversations. Interactions in virtual environments are synchronous and include sight (e.g., one can see graphics), sound (e.g., one can hear other individuals talking and other ambient sounds in the environment), voice (e.g., one can talk to others via a headset), text (e.g., text-chatting with another person), and motion (e.g., one can direct their avatar and navigate around the CME (Blascovich, 2002a; Blascovich et al., 2002). This synchronous communication and the feelings of presence and co-presence, mimic the real-time communication that occurs in relationships in the real world. Our belief is that conversational depth and breadth will occur in the virtual environment because individuals will feel like they are in the virtual environment (presence), with others (co-presence), and in a real-life conversation with another person and not an avatar (synchronous communication) (Blascovich, 2002a). Analysis of these naturalistic conversations will determine if the four categories of social support are reflected in social interactions in a CME. To our knowledge, this is the first study to analyze and characterize (1) social interaction among participants interacting in a T2D CME, in order to understand the nature of this kind of social interaction; and (2) social support in naturalistic conversations, in order to understand how to improve the exchange and delivery of social support in T2D specific interventions to populations with high rates of T2D. This data rich sample allows for the identification of the nature of T2D-specific social support and social interaction in a CME using descriptive analysis and trajectory creation.

3.6.1 Limitations

Limitations of this study include the small sample size ($n = 20$), having only one male participant, and the inability to probe individuals to clarify statements. These factors limit the generalizability of the findings and thus findings will be interpreted with caution. However, a
sample of this size will enable us to analyze the conversations among individuals in depth, so that we can fully understand the phenomenon of interaction in a CME (Sandelowski, 1995). The value of analyzing naturalistic conversations will aid in understanding the nature of social support and social interaction in a CME and its benefits for self-management. With these data, we hope to see instances of social support which are rich in personal narratives, descriptions of those living with T2D, and emotional connections with others.

3.7 Conclusions

The current study is unique because in the parent study, all interaction occurred within the virtual environment which mimicked real-life. The proposed study will determine the type of social support being exchanged in natural conversations through social interaction within a virtual environment by participants, and the subsequent changes in self-management. These results could be used to develop sustainable self-management interventions that promote high-frequency support. The proposed study will lead to further research to validate the findings in other populations; subsequent research will aid in the development of effective and scalable self-management interventions that can reach large numbers of individuals, including disadvantaged or diverse groups. The proposed study is a conceptual step in the development of self-management interventions aimed at improving population-level prevention and management of T2D, thus addressing the population burden and disparities seen with this chronic illness.

Frequent social interaction among providers and individuals living with type 2 diabetes (T2D) improves T2D self-management, as these disease-specific interactions may address the challenges inherent in such dynamic and ever-present disease management. Individuals living with T2D interact with providers in face-to-face interactions to share personal experiences and discuss challenges these individuals encounter when they engage in T2D self-management. These face-to-face interactions occur via verbal (i.e., spoken words) and non-verbal (i.e., body language, gaze) channels. Yet, frequent face-to-face contact with providers and similar peers may not be feasible because of temporal, financial, physical, and geographic constraints (Funnell & Anderson, 2003; Henderson, Wilson, Roberts, Munt, & Crotty, 2014; Hinder & Greenhalgh, 2012; Jernigan & Lorig, 2011; Stiffler et al., 2014; Vigersky, 2011).

Programs via computer-mediated environments (CMEs; programs via the Internet) can provide frequent interaction that is similar to an interaction in a face-to-face environment. These CME-interactions are bidirectional and serve to transmit knowledge, communicate thoughts and ideas, and initiate and sustain relationships with others (Berger, 2002; Southwell, 2013). They facilitate the exchange of information via verbal and non-verbal channels (Blascovich, 2002a, 2002b). Therefore, identifying methods to maintain interactions, through the Internet, that reinforce individuals’ implementation of key self-management behaviors is critical, because consistent self-management delays the onset of the co-morbidities associated with T2D (Centers for Disease Control and Prevention, 2015).

4.1 Purpose

The overall purpose of the study was to characterize social interaction and support among adults living with T2D who interacted via a CME in order to achieve a better and more comprehensive understanding of T2D-specific, real-time interaction and support. This chapter
provides the characterization of a social interaction in a CME and the expressions of self-management behaviors exchanged among individuals living with T2D. The results of this study will aid in the development of interventions that support self-management behaviors.

Disease-specific computer-mediated environments (CMEs; e.g., programs via the Internet) are one way to facilitate interactions among healthcare providers and other individuals living with T2D while providing disease-specific knowledge and support. Immersive virtual environments, a type of CME, are 3D computer-generated replications of the real world (Blascovich, 2002a; Blascovich et al., 2002), and are one way to facilitate interaction and provide knowledge and support to those living with chronic illness. Specifically, these types of CMEs are effective tools for helping individuals learn and sustain T2D self-management behaviors (Ershow et al., 2011; Jennings et al., 2009; Johnson, Feinglos, et al., 2014; Mitchell et al., 2014; Powell, Jennings, Armstrong, Sturt, & Dale, 2009; Rosal et al., 2012; Schroeder, 2002).

4.2 Computer-mediated environments facilitate social interaction

Computer-mediated environments can mimic real-world environments because they are exploratory, interactive, extensive, and users can ultimately determine their own personal involvement and investment (Behm-Morawitz, 2013). A virtual environment represents the real world through a multisensory, interactive encounter in which users feel presence and co-presence (Blascovich, 2002a; Schroeder, 2002). Presence occurs when an individual is engaged and feels as if they are “there” in the virtual environment; co-presence is when individuals feel that they are in the virtual environment with other people (Blascovich, 2002a; Lombard & Ditton, 1997; Schroeder, 2002).

The feelings of presence and co-presence in the CME replicate real-world, group interactions among individuals (Bailenson, 2006; Bailenson, Blascovich, & Guadagno, 2008). When in the CME, individuals assume the identity of an avatar, a customized virtual representation of themselves that mimics a human being (Behm-Morawitz, 2013). Interactions
increase in the CME when avatars look and act like people in the real world (Blascovich, 2002a; Lomanowska & Guittton, 2012). Synchronous interactions in the CME mimic interactions in the real world because they involve sight (e.g., one can see others as avatars), sound (e.g., one can hear individuals talking and other ambient sounds in the environment), voice (e.g., one can talk to others via a headset), text (e.g., one can text-chat with another person that is similar to texting on a smartphone), and motion (e.g., one can direct their avatar to navigate around the CME, similar to watching or following another person) (Blascovich, 2002a; Blascovich et al., 2002). Realistic interactions help create and maintain a collaborative community of like-minded individuals, which fosters further interaction among those present (Naughton & Redfern, 2002). The information gleaned through interactions in CMEs augments real-world knowledge, processes, and experiences because individuals can share knowledge, learn new concepts, and exchange support (Mantovani, 2001; Mantovani et al., 2003; Yu, Parsons, et al., 2012). However, little is known about the interaction among individuals living with T2D, and between individuals living with T2D and their providers, via a CME designed for individuals living with chronic illness.

4.3 Guiding Framework

Altman’s Social Penetration Theory (Altman & Taylor, 1973) and Granovetter’s Strong/Weak Tie Theory (Granovetter, 1973, 1983) guided the characterization of social interaction in the study’s CME. The guiding framework for this study is depicted in Chapter 1, Figure 1. The CME that was used in this study, called SLIDES, contained T2D-specific information and facilitated interaction between participants and diabetes educators that helped the participating individual with T2D learn and practice self-management skills (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014; Vorderstrasse, Shaw, Blascovich, & Johnson, 2014). The current study defined social interaction as a bidirectional and sequential exchange among individuals (Lewinski & Fisher, 2016).
Social Penetration Theory hypothesizes that the *breadth* (e.g., variance in topics discussed) and *depth* (e.g., how deeply personal the conversation is between individuals) is influenced by the perception and value of the relationship between two individuals (Altman, 1993; Altman & Taylor, 1973). Conversations in high-value relationships focus on many topics (e.g., high breadth) and may be highly intimate and personal (e.g., high depth). However, conversations in low-value relationships focus on fewer topics (e.g., low breadth) and may not be as personal or intimate (e.g., low depth).

Granovetter’s Strong/Weak Tie Theory hypothesizes that a *tie*, or connection, between two individuals depends on time (e.g., time in which relationships between individuals develops), feelings and emotions present (e.g., intensity of feelings), and closeness (e.g., familiarity of individuals with each other) (Granovetter, 1973, 1983). Strong ties reflect close relationships (e.g., shared history, intimate) between individuals, and weak ties are relationships that are formed more quickly and in which ties do not share deeply personal information (Granovetter, 1973, 1983). Therefore, an understanding of the types of strong and weak ties, and the breadth and depth of relationships, is imperative for conceptualizing and characterizing social interactions via a CME.

**4.4 Parent Study and Sample**

**4.4.1 Parent study**

Data for this secondary analysis came from the *Second Life Impacts Diabetes Education & Self-Management (SLIDES)* (1R21-LM010727-01) study. The SLIDES study provided self-management knowledge and support via a CME, specifically an immersive virtual environment, hosted on the Second Life platform (Linden Labs, Inc.) to adults living with T2D (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014; Vorderstrasse et al., 2014).

In the SLIDES study, participants and diabetes educators interacted in various locations in the CME such as the grocery store, restaurant, pharmacy, bookstore, welcome center, and
community center. Two of the three diabetes educators served as a healthcare provider for some of the participants in the study. The diabetes educators offered two education sessions weekly and one social support session weekly to facilitate participant interaction and knowledge acquisition. The twice weekly education sessions focused on one self-management topic each week; the social support session provided time for further questions on the weekly topic or general participant concerns. In addition to these regularly scheduled synchronous sessions, participants interacted with others asynchronously via emails and discussion boards. As is customary in these types of CMEs, participants customized their avatar to their personal preferences.

4.4.2 Sample

The total sample (N = 24) for this study included study participants, study investigators, and diabetes educators. The individual participant (n = 20) demographics are: women (n = 19), mean age of 54 years old, 65% Caucasian; 35% Black; 55% married; 70% with an annual income of $50,000 or greater; 65% with a Bachelor degree or higher; and 100% were regular users of the Internet (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). This study analyzed all conversations that occurred in the CME, therefore, the researcher also included the study investigators and diabetes educators (n = 4) who interacted in the CME (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). This study defines a participant as any person (i.e., individual living with T2D, diabetes educator, or study investigator) who interacted in the CME via text, email, discussion-board postings, voice (recorded) discussions, and virtual activity.

4.5 Methods

The study design is briefly described below; a complete description appears in Chapter 3 (Lewinski et al., 2017). The Duke University Institutional Review Board (Pro00022132) approved this secondary analysis. The researcher did not collect any new data or re-contact the participants.
4.5.1 Qualitative Data Available for this Study

4.5.1.1 Data description

Qualitative data included real-time conversations, emails, discussion-board postings, and text-chat transcripts among participants and between participants and diabetes educators within the CME over a six-month period. Appendix A describes the raw qualitative data, and Appendix B describes the origins of the raw qualitative data. Real-time conversations and text-chat transcripts were recorded by non-player characters (i.e., computer controlled bots) within the Second Life platform (Johnson, Feenan, et al., 2014). Most these data included synchronous conversations that occurred when participants and diabetes educators interacted and talked with each other while in the CME. Participants did not utilize the text-chat feature or discussion boards frequently to engage with other participants or the diabetes educators. Additional text-chat transcripts sent among the participants and emails sent to the diabetes educators may have been sent among participants, but these were not part of the database. During the study, all conversational data within the CME were recorded to MP3 files and stored on a secure server at the University. All files analyzed for the study (n = 861) included conversations among those affiliated with the SLIDES study (i.e., participants, diabetes educators, and study investigators).

4.5.1.2 Preparation and cleaning of the data

The preparation of the raw conversational data occurred over a period of months; Appendix C provides in-depth description of the preparation and cleaning process. First, the researcher became familiar with the conversational data by listening to the MP3 files, transcribing several files (n = 164), and learning about the SLIDES study. A professional transcription service transcribed the remaining MP3 files (n = 697). The researcher’s simultaneous immersion in these data and corresponding literature enabled her to become knowledgeable about social interactions and identify intriguing patterns over time. Therefore, she made the analytical choice to note as much detail as possible in the transcribed conversations. The researchers cleaned these data by
simultaneously listening to the MP3 files and reading the transcribed text to verify accuracy. Then, she made corrections to the transcribed text as necessary and double-checked any questionable text with Dr. Allison Vorderstrasse (study investigator). Then, the researcher systematically linked each spoken word to a SLIDES participant by voice recognition or reference to names to determine which participants contributed to, and how much each participant participated in, a conversation. The close attention to detail during the data-cleaning process facilitated the ability to closely analyze the characteristics of social interaction among individuals (Davidson, 2009; Poland, 1995).

4.5.2 Research design

This study used a qualitative study design to comprehensively describe social interactions among participants who engaged in a CME that focused on T2D. Content analysis enabled the recognition of patterns related to social interaction and T2D self-management in these conversational data (Hsieh & Shannon, 2005), and the guiding framework (Chapter 1, Figure 1) provided a lens in which to analyze and describe the conversations. This approach, with codes defined a priori, and during analysis, was useful in systematically describing what was said (e.g., topic) and how individuals communicated in an interaction (e.g., verbal techniques). Also, content analysis was useful in describing how the CME mediated the communication among individuals as each conversation was analyzed in the context of the CME (Hsieh & Shannon, 2005).

4.5.3 Analysis

This study analyzed the transcribed textual data, emails, text-chat messages, and discussion board posts to describe verbal and non-verbal characteristics of social interaction among adults in a CME. The use of content analysis enabled the description of the characteristics of social interactions among adults who interact in a CME (Krippendorff, 2004; Richards, 2013) and Atlas.ti version 7.5.17 (Atlas.ti GmBH, Berlin, Germany) to support coding and analysis. Appendix D describes the steps used to import the data into Atlas.ti, Appendix E describes the
definition of terms used during the coding process, Appendix F describes the methods used to develop codes, and Appendix G details the coding process. The researcher worked with Drs. Johnson and Anderson during the coding process to develop inductive and deductive codes based on Strong/Weak Ties Theory and Social Penetration Theory. These individuals coded by consensus; they met biweekly to discuss and review all codes, the codebook, exemplar quotations, and emerging themes. Additionally, they discussed and reviewed the development of the characteristics of social interaction in a CME. Drs. Anderson and Johnson reviewed 25% of the researcher’s coding to ensure reliability and validity of the codes. The coding team discussed the codes and coded segments until consensus was reached among the three researchers.

4.6 Results and discussion

This study uses the transcribed textual data, emails, text-chat messages, and discussion board posts to describe verbal and non-verbal characteristics of social interaction among adults in a CME. The findings are organized by four characteristics: (1) communication techniques, or how participants interact in real-time communication in a CME; (2) expressions of self-management, or the content of participants’ self-management discussions; (3) depth of conversation, or intensity of personal information shared; and (4) breadth of conversation, or the number of topics discussed among participants in a conversation. In the findings, unless otherwise specified, the term participant refers to both an individual living with diabetes and a diabetes educator.

4.6.1 Communication Techniques

Participants engaged in communication techniques when they interacted with other participants and conversed about T2D-specific content. The researcher identified four attributes of communication techniques: indicators of listening, being in the CME, attributes of bidirectional information exchange, and connecting actions. Table 9 details these attributes and provides a definition of the interaction behaviors (i.e., participant actions during an interaction).
for each of the four attributes. Below, each attribute is described with examples of some, but not all of the essential interaction behaviors identified and listed in Table 9.
Table 9. The attributes, interaction behaviors, definitions, and exemplar quotes or instances for the social interaction characteristic communication techniques.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Interaction behaviors and definition</th>
<th>Exemplar quotes or instances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators of listening.佩斯凯拉，Verbal utterances used to indicate that someone was present and listening.</td>
<td>Double-checking, Clarification of a term, idea, or statement.</td>
<td>A participant stated how she felt at certain glycemic values. The educator clarified this value and the participant’s actions.</td>
</tr>
<tr>
<td></td>
<td>Following conversation, Indication a person is listening to the conversation.</td>
<td>“uh huh”</td>
</tr>
<tr>
<td></td>
<td>Reflecting back, Instances in which a person talking reflects back something someone else has stated.</td>
<td>When the diabetes educator heard that some participants do not drink, she stated, “Ok, well that’s good. I’m glad to hear that.”</td>
</tr>
<tr>
<td></td>
<td>Repeating phrase, Repeating a phrase when asked to repeat the phrase.</td>
<td>Participants repeated questions or comments during conversations if they did not receive an answer or response from someone.</td>
</tr>
<tr>
<td></td>
<td>Responsiveness, Instances of positive feedback during interactions.</td>
<td>During a lecture, the diabetes educator heard something and asked, “I heard a squeak. Somebody say something?”</td>
</tr>
<tr>
<td></td>
<td>Non-responsiveness, Dismissing a question or comment in an interaction.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Being busy, Statements of how a participant is busy with life-events.</td>
<td>“I had a real important meeting I had to go to.”</td>
</tr>
<tr>
<td></td>
<td>Interrupting another, Interrupting a conversation with a question or comment, or talking over someone.</td>
<td>A schedule mix-up occurred and prevented an activity.</td>
</tr>
<tr>
<td></td>
<td>Inappropriate comment, Terms or words that might offend others.</td>
<td></td>
</tr>
<tr>
<td>Being in the CME, Indications that participants felt they were “there” and they were not alone.</td>
<td>Feeling presence, The influence of the CME on interaction.</td>
<td>“Wait a minute. Where am I taking off to?”</td>
</tr>
<tr>
<td></td>
<td>Feeling VE co-presence, Statements that indicate a participant is in the CME with others.</td>
<td>“These? Oh I’m pointing on my screen, how handy is that?”</td>
</tr>
<tr>
<td></td>
<td>Practicing self-management skills, Practicing self-management skills in the CME.</td>
<td>“I’m getting tired of standing behind this podium because I never do this in the real world anyway.”</td>
</tr>
<tr>
<td></td>
<td>Stating location, Statements of what is occurring in the CME.</td>
<td>“Here we have a simple label. We can play around with this a little bit. For this particular food, let’s see what we have here. Can anybody read what the serving size is?”</td>
</tr>
<tr>
<td>Attributes of bidirectional information exchange.Statements used when exchanging information.</td>
<td>Posing</td>
<td>Participants asked questions about self-management topics covered in the education and social support sessions.</td>
</tr>
<tr>
<td></td>
<td>Seeking information, Asking a question or wanting more information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Responding</td>
<td>Giving a reminder, Reminding an individual about something.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Remember we said one piece of bread equals one starch serving.”</td>
</tr>
<tr>
<td>Connecting actions. Statements and actions taken by individuals when associating with others.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Personality attributes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Being engaged.</strong> Showing interest in, or expressing an opinion about T2D.</td>
<td>When a participant inquired, “will the topic be the same for the other session during the day if I end up going during the day?”</td>
<td></td>
</tr>
<tr>
<td><strong>Being encouraging.</strong> Encouragement for self-management behaviors.</td>
<td>“Wow! That’s good.”</td>
<td></td>
</tr>
<tr>
<td><strong>Being enthusiastic.</strong> Verbal excitement.</td>
<td>“Oh good!”</td>
<td></td>
</tr>
<tr>
<td><strong>Being friendly.</strong> Being nice, wishing someone well, or responding to another person.</td>
<td>“I hope you are doing well. Thanks for your participation.”</td>
<td></td>
</tr>
<tr>
<td><strong>Being incredulous.</strong> Laughing or having an awkward response.</td>
<td>“Really?!”</td>
<td></td>
</tr>
<tr>
<td><strong>Being polite.</strong> Commonly used phrases that indicate politeness.</td>
<td>“Thank you”</td>
<td></td>
</tr>
<tr>
<td><strong>Collaborating.</strong> Working together to solve a problem.</td>
<td>“Let’s look at this meal together and see if we can make it more diabetes friendly.”</td>
<td></td>
</tr>
<tr>
<td><strong>Commiserating.</strong> Admitting that problems happen to everyone, and people are not alone.</td>
<td>In response to a participant trying to drink more water, a diabetes educator stated, Yeah. That’s really good. It definitely is an adjustment. It takes a lot to get used to it.”</td>
<td></td>
</tr>
<tr>
<td><strong>Expressing concern.</strong> Worry, concern, or nervousness about an aspect of T2D self-management.</td>
<td>“You sound terrible tonight! How are you feeling?”</td>
<td></td>
</tr>
<tr>
<td><strong>Expressing empathy.</strong> Showing concern about another participant.</td>
<td>“Oh, I’m sorry about that.”</td>
<td></td>
</tr>
<tr>
<td><strong>Expressing gratitude.</strong> Expressing that someone is thankful for an effort made in the CME.</td>
<td>“Thank you for participating tonight.”</td>
<td></td>
</tr>
<tr>
<td><strong>Helpfulness.</strong> Instances of helpful actions.</td>
<td>A participant repeated what someone said in response to a third participant stating “I couldn’t hear her clearly.”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of co-presence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calling by name.</strong> Addressing someone by their avatar name.</td>
</tr>
<tr>
<td>**Good question [name]”</td>
</tr>
</tbody>
</table>
| Commenting on appearance, Comments about the avatar’s appearance. | • “Do you have another new outfit on?”  
• “What a lovely shirt you have on”  
• “Did you change your hair?”  |
|---|---|
| Greeting, Saying a variation of “hello” or “good-bye.” | • “Hello” or “Good bye”  
• “Hi! How are you?”  |
| Introducing oneself, Stating their name and role. | • “I am [name] and I am a diabetes educator”  
• “My name is [name] and I have had diabetes for [years]”  |
| Noticing others, Noticing if another participant is present or absent. | • “And [name] was talking, and she stopped with [name] when we started to walk over.”  |
| **Moderating the conversation** |  |
| Checking-in, Seeing if anyone has any questions. | • “Before we go any further, do you have any questions from last week’s session, which was problem solving?”  |
| Connecting outside the CME, When the diabetes educators interact with participants outside the CME. | • “Call me in the office tomorrow”  
• “Let’s talk at your next appointment”  |
| Facilitating interaction, Connecting participants together. | • “I want to just have open dialogue with you and one of the things I wanted to know from each of you, is –what are the most challenging issues for you in terms of diabetes nutrition?”  |
| Referring to shared history, Discussing a shared history or shared knowledge between themselves. | • “How did everything go at the doctor this week?”  
• “We talked about this in the first class that the reason why…”  |
| Sticking to time schedule, Stating that someone is on a time schedule. | • “It’s about five after, so I’ll get started”  
• “I don’t want to keep you guys any longer if you need to go.”  |

*Note: [name] = screen name.*
4.6.1.1 Indicators of listening

While interacting with others, participants verbally indicated they were present and listening, and these verbal utterances were accompanied by technological features of the CME. For example, when a participant spoke into the microphone, their avatar’s mouth moved and green lights appeared over the avatar’s head. Participants used several behaviors that promoted interaction between others present in the CME, including double-checking information stated in a conversation, giving verbal cues that they were engaged in the conversation, responding to questions, reflecting emotions or content back to the speaker, or repeating a phrase to emphasize a point or ensure the speaker was heard during a conversation.

Participants’ actions during bidirectional interactions promoted further conversation and interaction. During interactions, participants shared personal information and obtained feedback about their self-management behaviors. Participants followed the conversation using utterances such as “mmmmhmm” or “uh huh” when others were talking, and engaged in double-checking when they wanted to clarify a comment or information. For example, participants engaged in double-checking to ensure they were looking at the right information during a discussion or when they had a question about a certain object in the CME; these actions further promoted interaction.

Participants exhibited responsiveness, a key behavior that promoted interaction, when they responded to questions or comments, participated in activities, or engaged with others. These specific behaviors promoted subsequent interactions among individuals because participants provided further information, discussed self-management behaviors, or provided self-management support.

Participants also engaged in behaviors that inhibited subsequent interaction among individuals such as verbalizing an inappropriate comment, not responding to questions, indicating one did not have the time to interact, and interrupting another participant. These interaction behaviors discouraged participants from sharing personal information or obtaining desired self-
management information. For example, repeated interruptions made it harder for the participants to converse,

[Participant]: When you are in the hospital, you are going to get insulin if your blood sugar goes up. That’s why they have the sliding scale…

[Diabetes educator]: Do you understand why?
[Participant]: …they put you on a sliding scale…
[Diabetes educator]: Do you understand why?
[Participant]: …it’s on a sliding scale when your blood sugar goes up to a certain amount they automatically give you insulin.

[Diabetes educator]: But do you understand why we give insulin?

In the exemplar above, the diabetes educator routinely interrupted the participant’s story about her experience in the hospital. Although this participant continued to talk, in general, participants varied in their responses to being interrupted during the sessions. Typically, when interrupted, a participant (a) continued and talked over the interrupter; (b) let the interrupter speak and then continued back to their topic after the interrupter finished; or (c) stopped talking completely. However, instances in which one person interrupted another could have indicated that the interrupter was not listening or that the interrupter did not realize another person was talking.

Behaviors that inhibited interactions were used with varying frequency. For instance, *inappropriate comments* were infrequent. When this behavior was used, these instances were accompanied by laughter. On the other hand, the researcher noted that *non-responsiveness* was a frequent behavior that inhibited real-time interaction. Instances of *non-responsiveness* primarily occurred during education sessions when the diabetes educator was speaking and a participant interrupted with a question or comment to which the educator did not respond. In several instances, the diabetes educator talked for extended periods of time and did not engage participants in discussion or interaction. This is in direct contrast to instances of *responsiveness* in which the diabetes educator immediately stopped the lecture to follow-up with a participant. However, *non-responsiveness* may have occurred due to inherent features of the CME, such as
the lack of non-verbal cues (e.g., one cannot visually see when another participant opens their mouth to speak) or dependence on a microphone and headset to engage in interactions (e.g., the microphone or headset may have been powered off and did not transmit sound). Therefore, the diabetes educator may not have heard the participant rather than be ignoring the participant.

4.6.1.2 Being in the CME

Participants’ awareness of presence and co-presence, or being “there,” in the CME promoted and inhibited social interaction. The participants indicated presence when they applied and practiced their self-management skills and stated their location in the CME. The interaction behaviors that indicated co-presence, or the feeling that others are in the CME with you, included conversations with others indicative of co-presence. However, technical issues sometimes prevented participants from feeling presence and co-presence in the CME, which may have inhibited interaction. Overall, the CME mediated the participants’ interactions with each other during the education and support sessions.

Participants indicated feelings of being “there” when they used the embedded components (e.g., grocery items, exercise equipment) of the CME to interact with other participants. For example, the participants indicated they felt they were in the CME with others when they used the menus in the restaurant (located in the CME) in the company of the diabetes educator or other participants living with T2D. The educational components promoted interaction because during sessions, participants referred to a specific educational component when they asked a question about living with T2D. These instances promoted feelings of being “there” because participants living with T2D asked real-time questions and practiced their self-management skills with others in the CME. In general, the embedded components facilitated interaction because they stimulated conversation and extended the interaction between participants. In turn, the extended discussion offered participants the opportunity to share and obtain self-management information and behaviors.
Participants also indicated feelings of presence and co-presence when they referred to their avatars during conversations. Participants’ self-representations as avatars promoted interactions with each other as both appearance and position of the avatar mattered in an interaction. Participants frequently discussed their avatar’s outfits, hairstyles, shoes, and clothing; many participants found joy in “playing dress-up” with their avatar and changed the avatar’s clothing to be seasonally appropriate. Notably, participants noticed when others changed their avatar’s appearance and commented on these changes in sessions.

Not only did appearance matter, but the position of another participant’s avatar during the interaction mattered. For example, the behavior stating location promoted interaction because it enabled participants to co-locate others in the CME. Participants used statements such as, “She’s standing right behind you” or “I’m standing right next to you” when they co-located each other in the CME. Therefore, the position of a participant’s avatar served as a proxy for their inclusion in an interaction.

In several instances, technical issues prevented participants’ inclusion in the interaction. Participants became discouraged when their avatar did not appear in the CME, the embedded components in the CME did not work properly, or the participant could not talk with others due to microphone, computer, or headset problems. The participants expressed frustration at technical issues because they made it harder for participants to interact with each other. For example, the educational components in the CME sparked discussions or questions among the participants, and when no technical issues occurred, participants conversed easily with each other. However, when a technical issue occurred, the interactions were inhibited because participants were focused on the technical problems instead of T2D self-management.

4.6.1.3 Attributes of bidirectional information exchange

Participants used several interaction behaviors when they searched for, or exchanged, information. The behaviors posing (i.e., asking a question or wanting more information) and
responding (i.e., responding to a question or comment) captured the bidirectional nature of a social interaction. In the CME, participants asked questions about discussion topics, posed questions to others about T2D self-management, or expanded on others’ statements with a subsequent question. For example, as in face-to-face conversation, participants sometimes erred when they spoke. Typically, participants corrected their own errors, and in some instances, other participants corrected the speaker. Participants clarified their statements, described their T2D self-management behaviors and experiences to others, provided correct information on a T2D topic, or restated their thoughts.

The interaction behavior *posing* occurred when participants sought information about aspects of living with T2D, or when they asked questions of other participants. Participants posed questions throughout the duration of the education and support sessions. The most frequent method of asking a question occurred via voice (i.e., synchronous conversation); however, participants also used text-chat, email, and posts in the discussion forum to ask questions.

The interaction behavior *responding* occurred when a participant answered a question, gave a reminder, provided information, or corrected someone or themselves. This behavior was frequently used after a participant posed a question. Interestingly, prompt responses promoted further interaction, because the participant who asked the question immediately received relevant information. On the other hand, participant questions did not always get answered promptly, or at all. Instances in which the question was not answered occurred when the conversation continued with no pause or another participant asked a question at the same time and the conversation shifted to that participant’s concern. Notably, both participants living with T2D and the diabetes educators provided information about self-management, shared their self-management experiences in response to questions and comments, or referred to content discussed in prior sessions. In several instances, participant responses segued into new topics, introduced new T2D content, or summarized the topics reviewed in the session.
4.6.1.4 Connecting actions

Participants used several connecting actions when they interacted with others in the CME. The three types of connecting actions are: (1) personality attributes—the participant’s personal characteristics that became evident during social interactions; (2) signs of co-presence—instances in which participants alerted others to their presence in the CME; and (3) moderating the conversation—actions of the diabetes educators during the education and support sessions.

Connecting actions in the CME resembled interaction behaviors in face-to-face environments. Participants were polite, indicated they were engaged in learning about self-management, expressed enthusiasm at appropriate times, commiserated with others, acknowledged the company of others, and exhibited helpful behaviors during conversations. For instance, participants were helpful when they included others in the conversation, repeated phrases, or provided information about self-management. Participants engaged others in the CME when they called someone by their avatar name when they: (a) welcomed someone in the CME; (b) answered a participant who asked a question; (c) directed a comment to a specific participant; (d) wanted to ensure all participants had partaken in the activity; or (e) concluded a session. Additionally, participants introduced themselves when they entered the CME or when they encountered new participants in the CME.

The diabetes educators moderated the education and support sessions and used actions that facilitated group interaction. Importantly, the diabetes educators looked to see which participants signed into the CME at the beginning of each session and then monitored the presence of participants during the session. After greeting and welcoming all participants, the diabetes educators began the lecture, inquired about participant health, discussed test results, provided information on medications, and addressed any concerns that arose. The diabetes educators addressed and provided additional information on (a) major concerns (e.g., corticosteroid usage after an accident, treating an ulcer on one’s foot); (b) minor concerns (e.g., thoughts on a diet that one read about, nutritional value of “white” foods); (c) knowledge
concerns (e.g., setting up an insulin pump, managing gastrointestinal symptoms that lasted several weeks); or (d) previously discussed information (e.g., replacing meters, items to take to a physician’s appointment).

Importantly, the diabetes educators demonstrated respect for the participants: they empathized, answered questions, engaged participants, and acknowledged the personal information shared by the participants. For example, the diabetes educators engaged in the behavior, sticking to the time schedule, throughout the entire study. The diabetes educators were conscientious of the length of the sessions so they started and ended sessions on time. Also, the diabetes educators used the interaction behavior checking-in frequently to assess knowledge and check for questions. This interaction behavior was used at the beginning of a session, after discussion, and before ending the session.

4.6.2 Expressions of self-management behaviors

During the sessions, the participants interacted with others to indicate a self-management challenge and a desire to change their behavior. There were two attributes of expressions of self-management behaviors in a social interaction: challenging aspects of living with T2D and self-managing in the real world. Table 10 provides the interaction behaviors associated with this characteristic. Below, each attribute is described with examples of some of the essential, but not all, of the behaviors that were identified and listed in Table 10.
Table 10. Description of characteristic expressions of self-management.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Interaction behaviors and definition</th>
<th>Exemplar quotes or instances</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Challenging aspects of living with T2D.</strong> Statements of challenges in T2D self-management.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stating limitations and problems</td>
<td>Stating limitations. A stated financial, temporal, physical, or geographic limitation that may prevent one from engaging in T2D self-management.</td>
<td>“I rarely go out to eat because it is just too much effort for me. Yea, [having other menus in the CME] would be nice. Since I have moved, there is a Wendy’s nearby and I notice they have salads and things like that. It would be nice to be able to leave my apartment, get out of the house, and drive to the drive in. My daughter told me that Wendy’s has salads. Just to get out of the house and not so home-bound all the time.”</td>
</tr>
<tr>
<td>Lacking health knowledge. An indication that something is unknown about T2D self-management.</td>
<td>During an education session in the grocery store a participant stated: “Well, I looked at the regular yogurt versus the Greek yogurt cause I eat regular yogurt, well light yogurt, and I was surprised at how much sodium it had in it. It’s not a lot as far as the number, but I thought it wouldn’t have any sodium in it.”</td>
<td></td>
</tr>
<tr>
<td>Stating problems. A stated problem related to T2D self-management.</td>
<td>During a session, a participant discussed how her daughter buys her groceries every week. The participant’s daughter buys unhealthy foods or foods that the participant does not like.</td>
<td></td>
</tr>
</tbody>
</table>
| Admitting difficulty. Difficulty understanding and applying concepts related to T2D self-management. | • “I’m having a hard time drinking my water”  
• After receiving a compliment on her weight loss, a participant stated, “It’s great though, very tough, but it can be done. That’s the part that makes it worthwhile, is that, with effort, I can make it happen.” |
| **Mistakes.** | Making self-management mistake. Admitting to or making a mistake when self-managing T2D. | “When I first started, I was told to wash my hands. I was diagnosed in [date] and you get sloppy over the years. I had not washed my hands or anything like that. Then I had another [apple] as a snack so when it came supper you can imagine what was on my finger. I had this 379 for suppertime sugar.” |
| Psychosocial aspects | Frustration Expressing frustration about T2D self-management. | “That was a new experience for me. That they [insurance company] can change the meter that you use. I didn’t like that.” |
| Feeling isolated. Feelings of social isolation due to physical limitations, diagnosis of T2D, symptoms of T2D, or self-management behaviors. | • “There are no other diabetics in my family, so everybody’s trying to understand kind of what it [T2D] is.”  
• “I’m the only one in my family with diabetes. Nobody has ever been around anyone with diabetes before in our family. My grandmother had it but she has now passed on and so they don’t understand what I am going through and what they need to do to help me.” |
| **Self-managing in the real-world.** Statements related to enacting T2D self-management behaviors. | | |
| Coping | Satisficing. Choosing a self-management option that is the best choice within the available options. | When discussing food choices and selecting a diabetes-friendly menu item, a participant stated that she goes to fast food places because she has limited mobility and the fast-food places have drive-thru. She described how she worked with her dietician to identify healthy items at the fast food restaurants. |
| Problem Solving. A behavior one engages in to accommodate a physical, financial, temporal, or geographical barrier to engage in T2D self-management. | • Problem solving about depression and T2D: “I laugh a lot. I don’t have to tell you I laugh. I laugh a lot every day and it’s really healing to you. It is. Makes you feel better.”  
• “I went to [restaurant], and my friend has an app that can tell you the ingredients. I was completely surprised at what I thought was a relatively good choice of this 1/2 salad and something else. [That experience] helped me realize I need to look ahead at a book or just be more mindful that not all the salads are [healthy].” |
| **Self-management intentions and objectives.** | | |
| **Stating self-management behavior, making a self-management choice. A statement of how a person completes a T2D self-management behavior.** | • “I use a lot of herbs and spices, and I’m trying to cut back on using a lot of salt. I use certain types of salt, I don’t use the standard table salt anymore.”  
• “My husband brought me some sugar free candy for [holiday] last year and I said why did you bring me sugar free candy? He said because that is what you need! And I said okay, thank you. But I really don’t eat candy. I’m gonna avoid candy tomorrow [holiday]. I don’t want any candy.” |
| **Demonstrating knowledge. When a participant is knowledgeable about T2D self-management.** | • When looking at items in the restaurant, a participant stated, “…it is the sodium that is not bad, but you are getting a whole meal plus of carbohydrates!”  
• Suggesting, “A smaller serving size of the cereal” when modifying a breakfast meal in a session. |
| **Self-efficacy for self-management. When a participant states they can do something related to T2D self-management.** | • “I’ve been real good [about preventing eye complications]. I’m going to get my surgery done and I am going to be okay. I am not going to give up.”  
• When discussing how a family member makes comments about food choices, a participant stated, “I just tell him to get off my back. That I’m doing the best I can.” |
| **External influencers** | • “Yea, I was a diagnosed with diabetes this year. So, this is new to me but I know that I have a brother who had diabetes and he passed away about fifteen years ago from diabetes related circumstances and situations. So this runs in the family. My mother had diabetes, and so it’s in the family.”  
• “My son uses the [meter] and he likes it. He can put it in his backpack and kind of hide it in his pockets if he has to. Right now he is pre-diabetic and he has a lot of episodes of hypoglycemia.” |
| **External social environment. Social and life instances that intrude on learning about T2D self-management or engaging in T2D self-management.** | • “I was reading a magazine while waiting to get my tires rotated. They had a brown rice diet from [University], and it had 2/3 cup of brown rice and two pieces of fruit or two cups of fruit. I just want to know, what you [diabetes educator] thought about that. I mean, that’s what you ate every meal.”  
• “Hold on a second. I’ve got a, I heard a dog throwing up behind me. [laughter]” |
4.6.2.1 Challenging aspects of living with T2D

Participants stated challenges included limitations and problems, mistakes, and psychosocial aspects related to living with T2D. Challenges included physical problems (e.g., being disabled, hard of hearing), family obligations or assistance (e.g., life revolving around children, depending on family members for assistance with errands), acute illnesses (e.g., the flu, the cold, foot ulcer), life events (e.g., vacations, moving, going back to school), and finances (e.g., financial cost of diabetes medications). These stated limitations increased the effort required to incorporate self-management behaviors. However, when participants stated their limitations during the education sessions or support sessions, they also sought information on modifications or ways to ameliorate the problem (e.g., trying water aerobics instead of weight-bearing exercises if one had a physical limitation). Limitations also included the financial burden of T2D, and how multiple co-morbidities and the treatment for those co-morbidities compounded this financial burden. Participants revealed a myriad of challenges in unprompted statements; these admissions of difficulty evolved from discussions in the sessions.

During discussions, participants revealed mistakes they made in self-management and how they received conflicting self-management information. Mistakes occurred when a participant strayed from the treatment plan (e.g., not taking a medication, eating an unhealthy food) or deviated from good self-management behavior (e.g., not washing hands prior to taking their blood glucose, eating a candy bar during a hypoglycemic episode, not reading nutrition labels on food items). Participants shared mistakes and problem-solving behaviors during the sessions to help other participants or to gain information. Additionally, participant questions highlighted conflicting information that they encountered when they sought help outside of the CME with T2D self-management. Conflicting information arose between (a) topics covered in prior sessions; (b) interactions with other people during the week; (c) outside sources such as magazines or TV shows; and (d) information received from their healthcare providers. The
routine nature of the sessions enabled the participants and the diabetes educators to follow-up on topics to provide information or support and address any questions.

During education and support sessions, the participants described external limitations that affected their self-management behaviors. These limitations included unhelpful comments from healthcare providers or family (e.g., shaming participants for their weight status, giving confusing or contradictory information) and the dependence on healthcare insurance (e.g., directives to change treatment devices, relying on a family member to work long hours to keep the health insurance). In these instances, participants living with T2D provided examples in which family members, friends, and healthcare professionals did not understand the participant, their experiences with T2D, or the challenges faced while enacting self-management behaviors. Participants living with T2D expressed frustration and feelings of isolation when they were treated differently by others due to their T2D diagnosis. These participants reported that self-management behaviors became inconvenient, more painful, or harder to enact in the presence of these external limitations.

4.6.2.2 Self-managing in the real world

When participants revealed their self-management practices, they discussed coping (e.g., problem solving, addressing challenges), self-management intentions and objectives (e.g., choices they made regarding self-management), and external influencers (e.g., family and friends that affected their self-management). Coping included knowing the symptoms of complications (e.g., feeling lightheaded as a sign of hypoglycemia), being aware of their own bodies (e.g., at what blood sugar they felt the best, how to best inject insulin), and finding out what works best (e.g., getting an exercise partner). In the group sessions, participants discussed their own challenges and stated their problem-solving approaches. For example, one participant stated that she felt depressed and overwhelmed with her T2D diagnosis and other comorbidities. In response, several other participants in the group shared the steps they took to prevent feeling overwhelmed and
how they coped with depression. Participants also shared positive changes in their health status, how they met a self-management goal, or described a plan to meet a self-management objective during the sessions. These admissions of positive behaviors elicited encouragement and support from the other participants.

Participants’ social environment affected their self-management behaviors and engagement in the CME during the education and support sessions. Family members (e.g., spouses, siblings, parents, and children) functioned in several capacities; they bought and delivered groceries, drove the participants to and from various medical appointments, and affected how participants enacted critical self-management behaviors. Participant statements about family and friends emerged during any topic that related to T2D. In general, the external social environment (1) served as a source of confusion for the participants; and (2) altered the time and energy a participant devoted to learning and engaging in T2D self-management.

Conversations in the CME were interrupted by pets (e.g., dogs barking, cats jumping on the computer), phones ringing, television shows, and people in the background. Events in the social environment prompted discussions as participants asked questions about information the participant read (e.g., diets in magazines), saw on television (e.g., diets discussed on TV shows, advertisements for products), discussed with friends or family (e.g., diets, one friend having success with a certain diet), or learned from another healthcare provider (e.g., medications, nutrition). In these instances, the diabetes educators facilitated the exchange of information, elicited problem-solving behaviors, and addressed confusion among the participants.

4.6.3 Depth

This study operationalized the concept depth as the degree of personalized information shared in a social interaction in the CME. The levels of depth occur on a continuum, where level 1 indicated little to no personalization of information shared by the participant, and level 4
indicated when the participant shared highly personal information and acknowledged weaknesses related to T2D self-management. Table 11 provides the definitions of each level of depth.

Table 11. Description of characteristic depth with exemplar quotes.

<table>
<thead>
<tr>
<th>Dimension and definition</th>
<th>Exemplar quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Making small talk, No personal information revealed.</td>
<td>• “I was out last week, out of town and I didn’t have internet access”  • “I had a new grandbaby arrive”</td>
</tr>
<tr>
<td>Level 2: Opening up, Hinted at personal issues, shared observations about others.</td>
<td>• “When I see my patients, I usually give them a paper and pencil method of doing this [a food diary]. I would encourage you to go to this website”  • “What if you have other limitations? Like if you are on a walker or something like that? Man, some of those exercises are not going to very well work for you.”</td>
</tr>
<tr>
<td>Level 3: Informing, Shared objective facts about T2D self-management.</td>
<td>• “Okay, cause when I saw you a month ago, it was 6.2, and I wondered what if I didn’t have diabetes?”  • “When I was taking insulin I stayed hungry all the time. I guess I’ve been a diabetic so long, it’s easy for me to deal with it.”</td>
</tr>
<tr>
<td>Level 4: Disclosing, Highest amount of personalization, revealed weaknesses.</td>
<td>• “Yea, I had had problems with alcohol, so I don’t drink anything”  • “I had major surgery about a year and a half ago that just brought my life to a standstill. I am pretty much, well I am homebound except, my big social life is when I go to the doctor’s office”</td>
</tr>
</tbody>
</table>

4.6.3.1 Level 1: Making small talk

Level 1 statements, or making small talk, indicated instances when participants did not reveal personalized information. This included when participants talked about their activities (e.g., if they were working or retired), how they spent their time, why they did not attend an education or support session, personal thoughts about self-management, or what they did during the previous week. Additionally, statements included conversations about favorite foods (e.g., vegetables, chocolate), challenging foods (e.g., white bread), and which foods they avoided (e.g., chips with olestra).

4.6.3.2 Level 2: Opening up

Level 2 statements, or opening up, included increased personalization and hinted at personal issues (e.g., unable to grocery shop, being diagnosed with pre-diabetes, gaining weight). Participants revealed personal information when they asked topic-relevant questions during a session or when they were giving information or support to another participant that provided insight into their personal attitudes about T2D self-management. Participants also revealed
difficulties with certain self-management behaviors and referred to past instances to highlight mistakes and problem solving.

The diabetes educators wove personal statements into the conversation when they introduced material, taught the lesson, and answered questions. These statements revealed information about the diabetes educators and how they interacted with patients, or the diabetes educator’s experience with T2D, specifically how long they worked in the clinic and if they had any family members with T2D. Similar to the other conversations in the CME, the majority of the personalized statements given by the diabetes educators related to the topic being discussed by the participants and were used to stress an important point or provide reassurance.

4.6.3.3 Level 3: Informing

Level 3 statements, or informing, included instances in which participants shared objective facts about T2D self-management. Participants hinted at issues with T2D self-management and revealed medical information when they asked a question. Participants shared experiences about T2D when they talked with others about self-management and provided support. Notably, when one participant shared personal information, another participant followed-up with their own experiences when they provided support and information.

4.6.3.4 Level 4: Disclosing

Level 4 statements, or disclosing, included the highest amount of personalization. They revealed personal weaknesses in managing T2D and showed the patient’s awareness of their self-management routine. Notably, participants shared this potentially stigmatizing information unprompted. For example, one participant revealed that she gave herself too much insulin when she guessed her insulin dose instead of calling her provider for guidance. In several instances, the diabetes educator seemed surprised at the responses and the amount of personal information shared. Participants answered personal questions honestly when they discussed their struggles.
with T2D self-management; participants did this in order to help others or obtain support for themselves.

4.6.4 Breadth

The conversations in these data were restricted to topics related to T2D self-management. Within that restricted range, however, participants discussed a gallimaufry of topics salient to T2D such as nutrition, foot care, self-management challenges, medication management, side-effects of T2D, and overall health issues. Most discussions aligned with the weekly focus of the education sessions or support session. These findings indicated that there was not a great variance in subjects outside of T2D topics discussed in a moderated education and support environment.

4.7 Discussion

This study described the topics discussed in a social interaction, showed that individuals living with T2D discussed personal information (i.e., ties, depth, participation), and indicated that there is not great variations in topics in a moderated conversation (i.e., breadth) in a CME. All together, these data indicate that individuals will interact with others in a disease-specific CME to obtain information and support about living with T2D. The social interactions among individuals were bidirectional exchanges, in which individuals shared their thoughts about living with T2D and engaging in T2D self-management. Individuals used a constellation of communication techniques in social interactions with other individuals; the use of these techniques facilitated the development and maintenance of ties between individuals while they were in the CME.

4.7.1 Participation in a bidirectional social interaction in a CME

A social interaction in a CME is a multidimensional construct because the communication medium (e.g., the CME) affects the communication techniques (e.g., indicators of listening, connecting actions) individuals’ use when talking amongst themselves to form ties with each other. As in real-world interactions, individuals in this study, who primarily engaged with others via voice and interacted with each other as avatars, used techniques such as greeting,
responding to questions, following the conversation, and noticing others to indicate their engagement in the bidirectional interaction. These CME-communication techniques resemble the verbal cues that are present in a face-to-face interaction that facilitate the exchange of conceptual information about the topic being discussed, in addition to the individual’s emotions and feelings (Berger, 2002; Mehu, 2015; Rummel, 1975; Southwell, 2013; Walther, 1995, 1996).

Another way individuals exchange information in a social interaction is by using non-verbal cues. These non-verbal cues are an essential component of face-to-face interaction and include body language, facial expressions, tone of voice, rate of speech, appearance, and body orientation (M. Anderson, 2006). The findings from this study indicate that individuals expressed body language via voice with a ‘verbal head nod’; individuals used verbal utterances such as “mmmmmm” or “uh huh” to indicate they were engaged and listening to the speaker. This ‘verbal head nod’ served two functions in the CME: (1) this action indicated to the speaker(s) that the individual was listening or following along with the conversation; and (2) this action allowed the individual doing the ‘verbal head nod’ to indicate their engagement in the interaction. These ‘verbal head nods’ composed part of the foundation crucial to the bidirectional nature of an interaction.

A further foundational component to an interaction is the sense of sight because this sense provides valuable non-verbal information about the parties involved in the interaction. In this study, the appearance of an avatar on the screen served as a proxy for that individual’s engagement in the interaction. The individuals in this study looked for the avatars of other individuals, commented on the avatar’s appearance, and wanted to “see” the other individual’s avatar when they were talking to that person. An avatar’s visibility in the CME indicated to other individuals that they were “there” in the interaction. This visibility might have reassured individuals that the real-life human who directed that avatar was actually engaged in the conversation, thus making the interaction similar to what would occur in face-to-face environments (Watson, Grant, Bello, & Hoch, 2008). Research on CMEs indicates that
individuals feel increased presence and co-presence in collaborative CMEs when these environments are realistic and when the avatars resemble humans (Bailenson et al., 2008; Bailenson et al., 2005; Blascovich, 2002a; Blascovich et al., 2002; Naughton & Redfern, 2002). Additionally, research indicates that realistic avatars that look like, and behave like, real humans, influence feelings that one is in the CME with others (i.e., co-presence); this increased awareness and acknowledgement of others in the CME may help the development of a community in which repeated interactions occur (Blascovich, 2002a; Naughton & Redfern, 2002; Schroeder, 2002). Therefore, the realistic nature of the CME, in conjunction with the ability to synchronously interact with other individuals, may have accurately replicated key components of a face-to-face interaction and the group dynamics, which then subsequently affected tie development.

4.7.2 Weak and strong ties in a CME

The ties between individuals exist in both face-to-face and CME relationships, and these ties develop over time. A central component of weak and strong ties is the depth and breadth of information shared over time, between individuals who use varied communication techniques in social interactions. The findings from this study indicate that ties developed among (1) individuals living with T2D, and (2) diabetes educators and individuals living with T2D.

The study demonstrates that individuals enter into the CME as weak ties to the other individuals living with T2D. The definition of a weak tie is a relationship that does not require a large amount of investment, the tie can be formed rapidly, and the tie brings in novel information to a group of individuals (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). Study individuals entered into the CME to obtain T2D-specific information and exchange personalized support from diabetes educators and other individuals living with T2D. Examples of weak ties in the CME occurred when individuals shared information during the education and support sessions on how to interact with negative family members, how to find healthy food items, favorite recipes, and ways to prevent depression. Individuals provided personalized information when they
responded to other individual’s questions, responded to the diabetes educator, or provided a comment about their self-management experience. Overall, the findings are parallel to, but not equivalent to, Granovetter’s Strong/Weak Tie Theory (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). Just as the weak ties outside a tight knit group can provide useful information to the group, these findings show that useful information is also exchanged among a group of people with whom the individual has ties of varying strength.

The repeated interactions (i.e., over time, sharing personal information) among individuals in the CME facilitated the progression of weak ties into strong ties. Individuals discussed varying amounts of personal information with each other in response to questions and comments. Over time, individuals referenced previously discussed personal information when they responded or engaged with another individual; this may be a sign that time, and depth of conversation, contributes to tie formation among individuals. For example, one individual, Individual A, suffered from gastrointestinal symptoms for several weeks. During subsequent weekly sessions, Individual A discussed the challenges she faced in attempting to manage her blood sugars, talked about her trips to see several doctors, and stated how these symptoms negatively impacted her quality of life. The diabetes educators and several other study individuals inquired how Individual A was doing and how she was feeling in the subsequent weeks. Individuals and educators offered suggestions and helped Individual A address any challenging issues with her T2D self-management. These empathetic interactions occurred until Individual A reported that she was feeling better and her gastrointestinal issues had resolved. This example highlights how this individual’s participation in the CME (e.g., attending weekly education and support sessions, revealing personal information, verbally participating by asking/responding to questions) may have helped this individual transition from weak to strong ties with others in the CME. However, an individual who did not regularly attend the twice weekly education and/or weekly support sessions, and/or share personal information, and/or who did not verbally
participate may not have built relationships with other individuals in the CME that facilitated the transition from a weak to a strong tie with these other individuals.

A strong tie exists between individuals when there is increased frequency, duration, and closeness of contact, and a direct link between two individuals (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). The diabetes educators’ consistent presence in the CME contributed to the formation of strong ties with the individuals living with T2D. For example, in this study, individuals revealed highly personal matters in response to the diabetes educator’s questions. The individuals revealed prior problems with alcohol, medical test results, and problems with family members. Individuals may have felt comfortable with the diabetes educators, and revealed more personal information, because the interactions occurred at routine intervals (i.e., twice weekly education sessions and weekly support sessions), for a set amount of time (i.e., sixty minutes), over an extended period of time (i.e., duration of contact was six months), with a shared goal of T2D self-management (i.e., a direct link) and enabled the bidirectional exchange of personal information (i.e., closeness).

The diabetes educators engaged in bidirectional interactions with individuals living with T2D which facilitated the creation of strong ties. The research literature indicates that frequent and positive interaction with providers (e.g., diabetes educators), or a strong tie connection, positively influences health behaviors and health outcomes for individuals living with T2D (R. M. Anderson & Funnell, 2008). The diabetes educators responded to questions and elicited personal information from individuals living with T2D during the education and support sessions. Additionally, the interactions between the diabetes educators and the individuals living with T2D were reciprocal as the diabetes educators provided personal information about themselves when they provided an anecdote during a lecture, or talked about their family in response to a participant question. Individuals living with T2D stated that they appreciated the routine, informal contact with a provider with medical knowledge; the individuals talked in-depth with the diabetes educators about topics related to T2D self-management. These findings support the literature
concerning repeated contact with medical providers and the importance in self-management (S. A. Fox & Chesla, 2008; Harrison, Stadler, Ismail, Amiel, & Herrmann-Werner, 2014; The Diabetes Control and Complications Trial Research Group, 1993).

4.7.3 Depth and breadth of the topics discussed in the CME

Intriguingly, the ability to synchronously communicate via voice, and the use of communication techniques, may have positively and negatively influenced the intensity of the conversations (i.e., depth), and the number of topics discussed (i.e., breadth). Research on CMEs indicates that voice conveys more personal meaning and emotion than text alone, and the individual may consider the resulting CME-interaction more similar to a face-to-face encounter (Wadley, Gibbs, & Ducheneaut, 2009; Watson et al., 2008). Yet, conversations via text (e.g., text-chat) may equalize the amount and type of participation in a CME, as individuals can participate in similar amounts. An important consideration when using voice is that verbose individuals can remain verbose, thus drowning out quiet individuals and influencing the quiet individual’s participation and interaction in the CME (Wadley et al., 2009).

Computer mediated environments enable individuals to maintain some degree of anonymity in interactions with others (Lewinski & Fisher, 2016). Individuals may feel more comfortable and open to sharing when interacting as an avatar and using a screen name to remain anonymous (Mitchell et al., 2014; Wadley et al., 2009; Watson et al., 2008). However, the ability to remain completely anonymous is lessened when using an individual’s voice. Therefore, offering the choice to use voice is important as Wadley et al. (2009) found the use of voice was individual-dependent because some people liked the use of voice but others felt that this type of communication violated their privacy. The SLIDES participants determined their own level of anonymity because they used an avatar that may not have resembled their personal appearance, chose a screen name for their avatar, were not required to reveal any personal information to others in the study, and chose how they communicated (e.g., voice or text, although voice was
highly encouraged as the primary mode of communication). In particular, by having several communication channels available, the SLIDES participants retained ownership of how anonymous they remained when revealing personal information by electing to interact with others via voice or text.

**4.7.4 Interaction in a CME: Regularly scheduled and synchronous**

The individuals in this CME stated a desire to learn about T2D self-management during their interactions with other individuals living with T2D and the diabetes educators. The routine education and support sessions enabled repeated social interaction among individuals where they could obtain information and support. Throughout the study, individuals uniformly expressed the notion that, “nobody understands a diabetic like a diabetic” due to the balance of self-management behaviors and need to live a normal life. This routine self-disclosure by the individuals in the SLIDES study, and the ability to remain anonymous and share this information repeatedly, affected the development and maintenance of strong and weak ties in the CME. Additionally, this study showed that individuals self-disclosed to others in unprompted exchanges as several individuals revealed personal information when talking with others such as places of employment, cities of residence, and some demographic information (e.g., age, race) when discussing self-management behaviors. Individuals might have felt comfortable when they exchanged information because each individuals retained control of the information they shared and the degree to which they participated in discussions (Burkow et al., 2013; Seymour, 2001). An individual controls their participation in the CME; this connection enables support to be exchanged and information to be obtained about self-management practices which an individual living with chronic illness may find valuable (Lorig et al., 2010; McKay et al., 1998). Therefore, the CME facilitates the creation and maintenance of strong and weak ties among individuals living with T2D and providers; these ties serve essential purposes in encouraging self-management behaviors due to the exchange of information and support.
The findings from this study indicate that individuals interacted with the diabetes educators and with other peers living with T2D. The diabetes educators provided real-time social support to the individuals during education sessions and the support sessions; these explicit statements by the diabetes educators might have indicated that the diabetes educators support the individual’s well-being (Thoits, 2011). Individuals validated each other’s experiences of living with T2D and the virtual space allowed for venting of the negative experiences because they had all had similar experiences (Thoits, 2011). Similar to the focus groups results in Fukuoka, Kamitani, Bonet, and Lindgren (2011), individuals in this study obtained readily available support and information from providers and peers; they attended sessions when the sessions did not infringe on their daily activities and schedules; attended sessions that were not too long; and came to rely on the predictable schedule of education and support sessions.

4.7.5 Limitations

This study has several limitations. Due to the small size of the sample (N = 24) and only one male, these findings should be interpreted with caution. This study did not analyze each individual’s participation over time in the CME, as this type of analysis is beyond the scope of this descriptive study. As participants entered into the SLIDES study as various time points, the most accurate way to assess tie development (e.g., participation) and tie strength (e.g., breadth, depth) would be to analyze each participant’s interactions with the other participants. Therefore, future research should use a case-study approach to analyze social interaction at an individual level in order to determine how social interaction, and tie development and tie strength, differs by participant (e.g., gender, verbosity, participation, length of diagnosis, age, race/ethnicity) in a CME. Additionally, two of the diabetes educators knew most of the participants because the diabetes educators saw these participants in clinic. This familiarity between the diabetes educators and participants may have influenced tie development, tie strength, and participation in the CME. Finally, several participants were especially verbose during the education and support.
sessions which may have decreased the participation of less-verbose participants. However, despite these limitations, these findings from this descriptive study are valuable due to the insight provided on social interactions in a CME.

4.8 Conclusion

Computer-mediated environments enable individuals living with T2D to obtain disease-specific interaction and support that may help them initiate and maintain self-management behaviors. This study began to describe social interactions among individuals living with T2D who interacted in a CME. Future research on the characterization of social interactions in a CME should focus on describing social interactions in a larger, more diverse sample that includes men and women of diverse ages, races, ethnicities, education levels, and income levels.
5. Characteristics of Social Support in a Computer-Mediated Environment

5.1 Introduction and background

Individuals living with type 2 diabetes (T2D) benefit from frequent and ongoing interaction with providers and other peers living with T2D. Interactions with providers (e.g., diabetes educators, nurses, physicians) and other peers (e.g., others living with T2D) provide individuals living with T2D support throughout the course of the disease (Norris, Lau, et al., 2002; Steinsbekk et al., 2012). These disease-specific interactions serve as a conduit for social support that positively impact behavior and psychosocial outcomes, thus leading to an individuals improved adherence to self-management behaviors (Fisher, Brownson, et al., 2007; Norris et al., 2001; Norris, Lau, et al., 2002). For example, an individual living with T2D can obtain knowledge about critical self-management behaviors (e.g., blood glucose monitoring, diet and nutrition, exercise) in addition to practical tips on how to incorporate these behaviors into one’s daily life (Baksi, 2010; Boren et al., 2009; Holt-Lunstad et al., 2010; Seeman, 1996). Yet, frequent interaction with peers and providers in face-to-face environments may not be feasible due to temporal, financial, physical and geographical limitations (Brundisini et al., 2013; Glasgow et al., 1986; Laranjo et al., 2015; Stiffler et al., 2014). Therefore, identifying limited resource intensive solutions that facilitate an individual’s interaction and support with providers and peers living with T2D is important in sustaining T2D-specific social interaction and support.

One way to provide this disease-specific social support is via computer-mediated environments (CMEs; programs via the Internet). Programs via the Internet are widely utilized in T2D self-management interventions via mobile phones, discussion boards, and social media (e.g., YouTube, Facebook) (Dale et al., 2012; Ershow et al., 2011; Fisher et al., 2012; Heisler & Piette, 2005; Jackson et al., 2006; Johnson, Feinglos, et al., 2014; McKay et al., 1998; Pal et al., 2014). These CMEs facilitate the exchange of social support via asynchronous (e.g., a delay in responses) discussion board postings, text-chat messages, and emails, or synchronous (e.g., real-
time responses) communication methods. Individuals use these Internet programs to obtain health information about T2D, connect with similar others in order to “not feel alone”, and share their experiences (Armstrong et al., 2012; Heisler et al., 2007; McKay et al., 1998). Yet, despite the availability and use of these asynchronous CMEs, T2D self-management remains sub-optimal.

Another purported method to provide disease-specific support and interaction with peers and providers is via synchronous CMEs. Immersive virtual environments, a type of CME, provide T2D self-management knowledge and support to adults living with T2D via synchronous voice interactions (Johnson, Feinglos, et al., 2014; Rosal et al., 2014). In this type of CME, individuals interact with others as avatars, or computer generated replications of themselves, as they talk with others via a microphone in addition to using asynchronous methods such as text-chat and discussion boards (Blascovich, 2002a; Blascovich et al., 2002). These interactions may mimic what occurs in the offline environment, thus enabling an individual to obtain disease-specific support (Mantovani, 2001; Yu, Bahniwal, et al., 2012). Therefore, one way to assist in the creation of synchronous CMEs for T2D is to understand how support is exchanged in a CME.

5.1.1 Purpose

The overall intent of this study is to analyze social interaction (described in Chapter 4) and social support among adults living with T2D, who interact via a CME, to help develop self-management interventions that promote self-management behaviors. This chapter provides an analysis of social support in order to achieve an understanding of a real-time support exchanged among adults who interact via a CME.

5.1.2 Guiding Framework

This study used Sheldon Cohen’s four types of social support to characterize the exchange of social support in a CME: emotional, instrumental, informational, and appraisal support (Cohen & McKay, 1984; Lakey & Cohen, 2000). Additionally, this study used a definition of peer support to conceptualize the exchanges among participants. Peer support is
defined as help with the daily management of T2D, connections to healthcare providers, and the overall readiness of support (Fisher et al., 2012). To facilitate the analysis of the conversational data in this study, the researcher identified examples of asynchronous and synchronous exchanges of support. Table 12 provides definitions of the four types of support in asynchronous CMEs and synchronous face-to-face or CMEs.

Table 12. Social support in asynchronous and synchronous interactions.

<table>
<thead>
<tr>
<th>Type of support</th>
<th>Asynchronous interactions in a CME (e.g., discussion-board posts, text-chat messages)</th>
<th>Synchronous interactions (e.g., support groups, telephone calls, and peer-to-peer interactions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional</td>
<td>• Encouragement, empathy, and prayer (Flickinger et al., 2016)</td>
<td>• Empathy about T2D struggles and challenges (Burkow et al., 2013; Greenhalgh, Collard, et al., 2011; Heisler &amp; Piette, 2005)</td>
</tr>
<tr>
<td></td>
<td>• Empathy when discussing frustration or difficulty (Coulson, 2005; Mo &amp; Coulson, 2008)</td>
<td>• Relating to each other when discussing self-management (Boström, Isaksson, Lundman, Graneheim, &amp; Hörnsten, 2014)</td>
</tr>
<tr>
<td></td>
<td>• Encouraging messages (Loader, Muncer, Burrows, Pleace, &amp; Nettleton, 2002)</td>
<td></td>
</tr>
<tr>
<td>Appraisal</td>
<td>• Communicating positive feedback for behaviors (Flickinger et al., 2016)</td>
<td>• Positive feedback about self-management (Greenhalgh, Collard, et al., 2011)</td>
</tr>
<tr>
<td></td>
<td>• Compliments or statements of praise about abilities (Coulson, 2005)</td>
<td>• Encouraging statements about T2D self-management when discussing personal strengths or enacted behaviors (Boström et al., 2014)</td>
</tr>
<tr>
<td></td>
<td>• Positive assessments of one’s actions (Mo &amp; Coulson, 2008)</td>
<td></td>
</tr>
<tr>
<td>Informational</td>
<td>• Self-management advice, and knowledge (Flickinger et al., 2016; Loader et al., 2002; Mo &amp; Coulson, 2008)</td>
<td>• Information about self-management via personal narratives (Greenhalgh, Collard, et al., 2011)</td>
</tr>
<tr>
<td></td>
<td>• Symptom management and living with a chronic illness (Coulson, 2005)</td>
<td>• ‘Real-world’ application of T2D self-management behaviors (Boström et al., 2014; Burkow et al., 2013)</td>
</tr>
<tr>
<td>Instrumental</td>
<td>• Emailing information (Coulson, 2005) or doing a task (Mo &amp; Coulson, 2008)</td>
<td>• Sharing resources to aid in T2D self-management (e.g., samples of food items during discussions of diet, sewing machines) (Greenhalgh, Collard, et al., 2011)</td>
</tr>
<tr>
<td></td>
<td>• Fundraising requests (Loader et al., 2002)</td>
<td></td>
</tr>
</tbody>
</table>

5.2 Parent Study and Sample

The data from this study came from the *Second Life Impacts Diabetes Education and Self-Management* (SLIDES) study and has been described in detail in Chapters 3 and 4. The SLIDES study was a CME-facilitated study (an immersive virtual environment) that provided diabetes self-management education and support to adults living with T2D. The diabetes educators provided a synchronous lecture in the education session, and the support session provided open-discussion time in which participants synchronously conversed with each other in the presence of a diabetes educator. The researcher analyzed all conversations that occurred in the
SLIDES study among individuals living with T2D ($n = 20$), as well as the diabetes educators and study investigators ($n = 4$) who interacted in the CME. All participants interacted asynchronously via discussion-board posts, text-chat messages, and emails, and synchronously via voice conversations.

5.3 Methods

A complete description of the methods for this overall study are listed in Chapter 3 (Lewinski et al., 2017) and the methods specific to social interaction are detailed in Chapter 4. This investigation of social support utilized the same data, preparation and cleaning as the analysis of social interaction in Chapter 4. Therefore, this chapter (Chapter 5) describes the separate steps taken during the analysis of social support. The Duke University Institutional Review Board (Pro00022132) approved this secondary analysis. The researcher did not collect any new data or re-contact participants.

5.3.1 Qualitative Data Available for this Study

The qualitative data for this study included transcribed real-time conversations, text-chat, emails, and discussion board posts. The researcher transcribed the real-time conversations into a text document from MP3 files with the assistance of a professional transcription service. The researcher then cleaned and organized the text conversations by date, speaker, and location in the CME. The qualitative data available for this study, and the data preparation and cleaning steps are described in Chapter 4 and the appendices.

5.3.2 Research design

This study used a qualitative study design to comprehensively describe social support among participants who engaged in a disease-specific CME. Content analysis enabled the recognition of patterns related to T2D-related social support in these conversational data (Hsieh & Shannon, 2005), and the guiding framework (Chapter 1, Figure 1) provided a lens in which to
analyze and describe the conversations. This approach, with codes defined apriori, and during analysis, was useful in systematically describing the support exchanged among individuals.

5.3.3 Analysis

This study used the transcribed textual data, emails, text-chat messages, and discussion board posts to describe the four types of social support exchanged among adults in a CME. The researcher completed content analysis of these data and used Atlas.ti version 7.5.17 (Atlas.ti GmbH, Berlin, Germany) to support coding and analysis. The researcher worked with Drs. Johnson and Anderson to develop deductive and inductive codes based on the operationalization of the four types of social support. She met biweekly with Drs. Johnson and Anderson; as a group they reviewed all codes, developed the code book, identified exemplar quotations, and discussed emergent themes until consensus was achieved among the three researchers. The researcher ensured reliability and validity of her coding as Drs. Johnson and Anderson reviewed 25% of her coding for the entire study. Additionally, the researcher met with Drs. Vorderstrasse (study investigator) and Fisher to discuss findings and themes.

5.4 Results and discussion

Study participants exchanged social support in the CME in the twice weekly education and weekly support sessions. First, an overview of the social support exchanged, including the sources of social support, in the CME is provided. Then, the findings are presented along the four types of social support, in order from the least to the most frequently exchanged type of support: (1) instrumental support, or the exchange T2D-specific tangible goods in the CME; (2) appraisal support, or the exchange of affirmational support for T2D self-management behaviors; (3) informational support, or the exchange of T2D-specific information; and (4) emotional support, or the exchange of empathy among participants in a conversation. The findings include the elicitation behaviors (i.e., prompts individuals used to obtain support), support responses (i.e.,
support provided), frequency, and providers of the social support exchanged in the CME (Burke, Joyce, Kim, Anand, & Kraut, 2007; Wang, Kraut, & Levine, 2015).

Below, each type of support is described with examples of some of the essential, but not all of the, supportive exchanges that are identified and listed in each table. Unless otherwise noted, the elicitation behaviors and responses are from the transcribed text of the synchronous conversations. Additionally, the term participants indicates the adults living with T2D and diabetes educators indicates the diabetes educators and study staff. The term exchange indicates one unique instance of social support that is exchanged between individuals.

### 5.4.1. Overview of support exchanged

#### 5.4.1.1 Description

The four types of support were not exchanged in equal measure. There were a total of 1170 social support exchanges. Informational support was the most exchanged type of support in these data, followed by emotional support. Few instances of appraisal support and even fewer instances of instrumental support were noted in these data. Table 13 describes the total number of social support exchanges in the CME.

#### Table 13. Total number of social support exchanges exchanged in the CME.

<table>
<thead>
<tr>
<th>Type of Support</th>
<th>Number of Exchanges (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All support exchanges</td>
<td>n = 1170</td>
</tr>
<tr>
<td>Instrumental</td>
<td>41 (3.5%)</td>
</tr>
<tr>
<td>Appraisal</td>
<td>217 (18.55%)</td>
</tr>
<tr>
<td>Informational</td>
<td>535 (45.73%)</td>
</tr>
<tr>
<td>Emotional</td>
<td>377 (32.22%)</td>
</tr>
</tbody>
</table>

#### 5.4.1.2 Sources of support

Social support was exchanged in the education sessions that occurred twice a week and the support session that occurred once a week. Figure 5 describes the frequencies of each type of social support as exchanged in the education and social support sessions.
Most of the informational support occurred in the education sessions that focused on providing T2D self-management education and skills. A similar amount of appraisal support was exchanged in the education session (19%) as in the support session (20%). Most of the emotional support was exchanged in the support session, and most of the informational support was exchanged in the education sessions led by the diabetes educator.

### 5.4.2 Instrumental support

#### 5.4.2.1. Description

Instrumental support, or the exchange of tangible goods related to T2D self-management, was the least exchanged type of support in the CME. Participants and diabetes educators exchanged instrumental support via asynchronous and synchronous methods of communication.

Instrumental support exchanges occurred when everyone exchanged *website links and information (n=31)*, *information on specific self-management tools (n=7)*, and *recipes (n=3)*.

Table 14 details the elicitation behaviors and support responses for instrumental support.

<table>
<thead>
<tr>
<th>Type of instrumental support (n = 41)</th>
<th>Elicitation behaviors. Questions, concerns, or issues raised.</th>
<th>Responses. Support provided.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Links and information (n = 31)</td>
<td>• Formal and information discussion of T2D</td>
<td>• [P]: “This is a subject I have researched in the past and most recently after some blood test results. I find it interesting that this topic is not...”</td>
</tr>
</tbody>
</table>
Asynchronous methods used to exchange instrumental support included discussion board posts, email, and in one instance, physical mail. A discussion board post was the most commonly used asynchronous method to exchange instrumental support. A typical post with a recipe included the name of the recipe, required ingredients, and detailed instructions for cooking. Several discussion board posts included tools such as PDF documents with self-management information and an online quiz that tested one’s knowledge about self-management. Another asynchronous method used to exchange instrumental support occurred when the diabetes educators emailed documents to the participants living with T2D following a discussion in the education session. In one instance, the diabetes educators mailed T2D books to the participants following a holiday party in the CME.

The exchange of instrumental support in synchronous communication occurred via specific communication behaviors. When the diabetes educators shared a website link they slowly spelled out, and clearly enunciated, the website information letter-by-letter (e.g., w-w-w-dot-d-i-a-b-e-t-e-s-dot-o-r-g). The diabetes educators also initiated most of these exchanges when they provided their own contact information such as telephone numbers, office locations, and hospital information to the participants. However, in several instances the participants provided the contact information for the diabetes educators, or mutual friends, in reply to other participants’ questions. Overall, the instrumental support exchanged by everyone correlated with the discussed topics in the education and support sessions.
5.4.2.2. Sources of support

Instrumental support was provided by the participants \( (n = 12) \) and the diabetes educators \( (n = 29) \). Instrumental support was exchanged in the education sessions \( (n = 21) \), social support sessions \( (n = 6) \), and outside session time (e.g. posting to the discussion forum before/after each session) \( (n = 14) \).

5.4.3 Appraisal Support

5.4.3.1 Description

Appraisal support, or affirmational statements regarding information-seeking and engagement in T2D self-management, was exchanged by everyone in the CME. The two types of appraisal support include support for information-seeking \( (n = 32) \), or an affirmational reply after a participant asked a question or provided a comment, and support for self-management behaviors \( (n = 185) \), or an affirmational reply following a participant’s statement about a specific T2D self-management behavior.

Interestingly, when the diabetes educators and participants provided appraisal support simultaneously during an exchange, this support mostly occurred during the social support sessions. Table 15 describes the elicitation behaviors and responses for appraisal support.

Table 15. Appraisal support elicitation behaviors and support responses.

<table>
<thead>
<tr>
<th>Appraisal support type ( (n = 217) )</th>
<th>Elicitation behaviors. Questions, concerns, or issues raised.</th>
<th>Responses. Support provided.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support for information seeking ( (n = 32) )</td>
<td>• [P]: “What about the sugar free sodas?”&lt;br&gt;• [P]: “Excuse me a minute, you haven’t mentioned Precose”&lt;br&gt;• A diabetes educator talking to a participant about their participation in the study.</td>
<td>• [DE]: “That is an excellent question. So, sugar free sodas…”&lt;br&gt;• [DE]: “Precose. That’s very, you’re very astute [name].”&lt;br&gt;• [DE]: “I’m glad that you participated in this, and I hope it has been valuable to you.”</td>
</tr>
<tr>
<td>Support for self-management behaviors ( (n = 185) )</td>
<td>• [P]: “I am sure my lifestyle didn’t help none. You know, I am trying to do something about that now. I’m definitely not feeling like I am a failure with it.”&lt;br&gt;• [P]: “I’ve been spending a lot of money on my eyes lately. All those laser treatments that I had, and I have to have that surgery on [date], just the cataracts.”</td>
<td>• [DE]: “Right, that is good. You shouldn’t. I’m glad you got to that point of feeling like you can feel good about where you are at with your control and can move forward.”&lt;br&gt;• [P]: “Yea that is important, stay on top of your eye problems.”</td>
</tr>
</tbody>
</table>
Diabetes educators affirmed the participant’s information-seeking behaviors when they positively responded to questions or comments during lectures or when the participants shared personal information. When responding, the diabetes educator either began with an affirmational reply, or they ended their reply with the affirmational comment. Diabetes educators also provided global appraisal support when they stated that participants’ questions or discussion points “kept them on their toes” or when they praised the participants for attending sessions and being engaged.

Appraisal support included praise for enacted self-management behaviors in addition to information seeking behaviors. Diabetes educators and participants congratulated and praised other participants when they discussed how they overcame a challenge or modified an unhealthy behavior (e.g., portion control during a holiday meal), engaged in a preventative behavior (e.g., received the flu vaccine), or shared positive news about themselves (e.g., a good doctor’s visit, blood glucose readings in a targeted range). Typically, participants stated their self-management behaviors in response to a session topic, a discussion prompt, or another participant’s comment. Participants reinforced the appropriateness of self-management behaviors or other actions taken by a participant. For instance, after one participant stated how she advocated for herself, several other participants positively replied with comments such as “stand your ground, if it is working for you” or “good answer.” These statements reinforced, and affirmed, the appropriateness of the actions taken by the participant.

5.4.3.2 Sources of Support

The diabetes educators exchanged most of the appraisal support. Appraisal support was provided by the diabetes educators only ($n=180$), the participants only ($n = 5$), or by both the diabetes educator and participant within the same supportive exchange ($n = 32$). Just over half of
each type of appraisal support was exchanged in the education sessions, and the diabetes educators provided the most appraisal support for information-seeking behaviors. Figure 6 describes the frequency of each type of appraisal support in each session type and Figure 7 describes the type of appraisal support as exchanged by the diabetes educators and the participant.

![Figure 6](image1.png)

Figure 6. Occurrence of the two types of appraisal support as exchanged in the education and social support sessions in the CME.

![Figure 7](image2.png)

Figure 7. Providers of the two types of appraisal support as exchanged in the CME.

Interestingly, when the diabetes educators and participants provided appraisal support simultaneously during an exchange, this support mostly occurred during the social support sessions. Also when replying simultaneously, the diabetes educators and participants provided more appraisal support for self-management behaviors than for information seeking. The
appraisal support exchanges served to validate the participant’s actions while providing personalized, positive feedback on their self-management behaviors.

5.4.3 Informational support

5.4.3.1 Description

Diabetes educators and participants frequently exchanged informational support, or the exchange of T2D-specific information, in the CME. These supportive exchanges occurred in both the education and support sessions on T2D-salient topics and aligned with the topics discussed in the sessions. The diabetes educators and participants exchanged a total of ten types of informational support: (1) those directly related to T2D self-management—nutrition and food, preventing complications and problem solving, monitoring, medications (insulin), medications (not insulin), psychosocial aspects and coping, pathophysiology, and exercise; and those related to participation in the SLIDES study—SLIDES study information and miscellaneous information. Table 16 provides examples of the informational support exchanged in the CME.
Table 16. Informational support elicitation behaviors and support responses.

<table>
<thead>
<tr>
<th>Informational support type (n = 535)</th>
<th>Elicitation behaviors. Questions, concerns, or issues raised.</th>
<th>Responses. Support provided.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition &amp; Food (n = 149)</td>
<td>• [P]: “What about sugar free sodas?”</td>
<td>• Nutritional values of drinks and suggestions of types of drinks</td>
</tr>
<tr>
<td></td>
<td>• [P]: “What do you think of [name] diet?”</td>
<td>• Discussion of diets and healthy eating</td>
</tr>
<tr>
<td>Preventing complications &amp; problem solving (n = 85)</td>
<td>• A session on foot care led to a discussion about sores, cleaning feet, and shoes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• A personal question about a sore on a foot and what actions the participant should take to ensure that her feet remained healthy</td>
<td>• Sharing of personal foot care habits to keep feet healthy (e.g., how to clean feet, types of footwear, lotion used)</td>
</tr>
<tr>
<td>SLIDES information (n = 81)</td>
<td>• Discussion of types of sessions</td>
<td>• One participant talked about when she did not check her shoes and had a problem with her feet</td>
</tr>
<tr>
<td></td>
<td>• Date, time, and location of the sessions</td>
<td>• Statement about SLIDES sessions</td>
</tr>
<tr>
<td>Monitoring (n = 55)</td>
<td>• [P]: “Is there a cost difference with these meters?”</td>
<td>• Discussion about types of monitoring devices that work for people, insurance companies, and tools that you can use with each device (e.g., online tools), equipment needed for each device</td>
</tr>
<tr>
<td></td>
<td>• [P]: “I have a [brand of meter]. I guess I might need to get a new one. I have had it probably for about eight to ten years.”</td>
<td>• How and when to get a new meter and strips</td>
</tr>
<tr>
<td>Medications (insulin) (n = 36)</td>
<td>• [P]: “What are the indications you need insulin?”</td>
<td>• Review of how insulin works and the importance of working with one’s provider to regulate insulin doses</td>
</tr>
<tr>
<td></td>
<td>• [P]: “How do you choose short- versus long-acting? What makes you decide what type of insulin you put a person on?”</td>
<td>• Signs and symptoms of high and low blood glucose values, how providers may choose a participant’s medical regimen</td>
</tr>
<tr>
<td>Medications (not insulin) (n = 35)</td>
<td>• [P]: “What is [drug]?”</td>
<td>• Description of the requested medication</td>
</tr>
<tr>
<td></td>
<td>• [P]: “I haven’t had a MRI in the last couple of years. I guess I need to make sure they know I’m on Metformin? And Actos?”</td>
<td>• Talking about hospital tests and T2D medications</td>
</tr>
<tr>
<td>Psychosocial aspects &amp; coping (n = 29)</td>
<td>• A participant’s statement about feeling down</td>
<td>• [P]: “I don’t have to tell you I laugh. I laugh a lot every day. It’s really really healing to you. Makes you feel better.”</td>
</tr>
<tr>
<td></td>
<td>• [P]: “I had almost an immediate drop [after starting insulin] and started having good blood sugars right away so I was really happy with that. That kept me going, kept me encouraged. I don’t think I would have believed anybody if they would’ve told me that it was going to happen so quickly. But I was really glad it did because it took away all the bad feelings about being on insulin and turned it into a positive thing right away.”</td>
<td>• [DE]: “Yea. That’s true. It is almost an immediate effect. Sometimes we forget about that, which is encouraging….Yea, cause on a lot of occasions with pills and stuff you have to wait a while to see anything change.”</td>
</tr>
<tr>
<td>Pathophysiology (n = 28)</td>
<td>• [P]: “Can it [T2D] be brought on by stress?”</td>
<td>• Explanation of pathophysiology of disease</td>
</tr>
<tr>
<td></td>
<td>• [P]: “You are saying, the longer we have diabetes, our pancreas decreases in efficiency, so the fact that I’m on insulin is just because I have had diabetes so long? That it’s a natural progression of the disease?”</td>
<td>• Discussion of metabolic values and tests (e.g., HbA1c, cholesterol levels, urine tests) over the course of one’s lifetime with T2D</td>
</tr>
<tr>
<td>Exercise (n = 24)</td>
<td>• Importance of exercise &amp; making it a habit</td>
<td>• A participant shared her morning exercise routine</td>
</tr>
<tr>
<td></td>
<td>• Influence of exercise on blood glucose values</td>
<td>• Monitoring blood glucose values during exercise</td>
</tr>
<tr>
<td>Miscellaneous information (n = 13)</td>
<td>• Information about local diners</td>
<td>• Contact information for local places</td>
</tr>
<tr>
<td></td>
<td>• Discussing shared interests</td>
<td>• Talking about mutual acquaintances</td>
</tr>
</tbody>
</table>

**Note:** All informational support in this table is derived from participant-initiated questions independent of the information taught in the education session by the diabetes educators. [P] = participant; [DE] = diabetes educator.
Participant-initiated questions and comments stimulated the conversation and the subsequent sharing of information by the diabetes educators or the other participants. Informational support was elicited through participant questions, concerns, or other issues raised during the discussion. These elicitation behaviors enabled the diabetes educators and the other participants to respond with informational support.

Topics of informational exchange were exhibited with varying frequency. For instance, nutrition and food and preventing complications were the two most frequently discussed topics. Instances of nutrition and food occurred in both the education and support sessions, and support was typically elicited through direct questions and comments. Participants asked questions and commented on the nutritional value of food, how to incorporate healthy foods into one’s diet, healthy choices during the holidays, and how to read nutrition labels. In several instances, some participants queried everyone on options for breakfast or how to drink more water. These instances resulted in informational support in the form of suggestions for quick and easy breakfast choices, ideas for healthy beverages, or how to incorporate more water into one’s diet. Whereas direct questions elicited informational support for nutrition and food, the diabetes educator’s lectures elicited the exchange of informational support for preventing complications. For instance, in response to the diabetes educator talking about checking one’s feet, a participant shared her experience with neuropathy in her feet and the importance of checking one’s shoes. The participant commented that her intent when sharing the story was to help other participants learn why foot care is important.

On the other hand, pathophysiology and exercise were the least frequently exchanged types of informational support. When these two topics were discussed they were typically done with other topics in mind such as insulin and monitoring. Participants elicited informational support on these two topics by asking questions or making comments that revealed their physical, financial, and geographical limitations. For example, one participant stated her physical abilities were limited after her most current surgery. She stated these limitations decreased her ability to
walk a mile a day and prevented her from driving to the aquatic center for water aerobics. The informational support shared covered topics on water aerobics, stretching, and low-impact walking. Additionally, the questions about pathophysiology indicated that participants lacked information on the trajectory of T2D once diagnosed, and how the body functions as T2D progresses over time. This information on the pathophysiology of T2D cleared up misunderstandings and enabled each participant who initiated an exchange to ask questions until the topic was clear.

5.4.3.2 Sources of Support

Informational support exchanges occurred in the education sessions and the support sessions. One way the diabetes educators provided informational support was during the lectures on pre-specified content. Figure 8 describes the frequency of informational support types in the education and support sessions. Figure 9 illustrates the engagement of the participants for each type of informational support.
Figure 8. Occurrence of the types of informational support as exchanged in the education and social support sessions in the CME.

*Note:* PC & PS = preventing complications and problem solving; Psych & Coping = psychosocial aspects and coping; SLIDES info = SLIDES study information (e.g., session times); Misc. = information on topics not related to T2D. The informational support depicted in this figure includes both *lecture-provided* informational support and *participant initiated* elicitation behaviors.

Figure 9. Source of the informational support in lecture or participant initiated question.

*Note:* The informational support types Misc. and SLIDES info have been removed from this graph as they are not T2D related.
The education sessions provided the majority of informational support in the CME. These lectures included PowerPoint slides, learning activities, and questions to facilitate discussion. Another way the diabetes educators provided informational support was in the support sessions; while these sessions did not have predetermined content or slides, the open time enabled the participants to ask questions and discuss topics with the diabetes educator and other participants. There were few instances noted in which the diabetes educators or individuals delivered information and/or support via corrective feedback during the education and support sessions. These instances of corrective feedback served to correct another individual’s misinformation about T2D self-management knowledge and behaviors. Notably, in both sessions, participants engaged with the diabetes educator and the other participants to receive informational support. Overall, the majority of the informational support exchanged in the CME occurred because of the participants’ elicitation behaviors of asking questions during the lectures, asking questions when the diabetes educator was not lecturing, or during open discussion in the support session.

5.4.5 Emotional support

5.4.5.1 Description

The diabetes educators and participants exchanged emotional support, or feelings of empathy, trust, and caring, during the education and support sessions. Diabetes educators and participants exchanged three types of emotional support: (1) physical health (n=88), or empathy for the physical challenges and symptoms of living with T2D; (2) psychosocial (n=189), or empathy for psychosocial aspects (e.g., loneliness, depression, frustration) when one lives with T2D; and (3) motivational (n=100), or empathy and encouragement for engaging in T2D self-management behaviors. Table 17 describes each of the types of emotional support with the elicitation behaviors and the supportive responses.
Table 17. Emotional support elicitation behaviors and support responses.

<table>
<thead>
<tr>
<th>Emotional support type (n = 377)</th>
<th>Elicitation behaviors. Questions, concerns, or issues raised.</th>
<th>Responses. Support provided.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Health (n = 88). Empathy for the physical challenges and symptoms of living with T2D.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Example 1</strong></td>
<td>[P1]: I had a good appointment today. I am happy.</td>
<td>[P2]: Yea [laughter]</td>
</tr>
<tr>
<td></td>
<td>[P1]: Yea</td>
<td>[DE]: Well good, excellent. Well that is good news.</td>
</tr>
<tr>
<td></td>
<td>[P1]: I like hearing the word controlled, for the first time in a long time, so, and it’s the first time in a while now [laughter]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[P2]: Mmmhmm</td>
<td></td>
</tr>
<tr>
<td><strong>Example 2</strong></td>
<td>[P3]: I missed most of Monday night. I had a bad low like at 4, I guess it went to about 6:30</td>
<td>[DE]: Oh no</td>
</tr>
<tr>
<td></td>
<td>[P3]: And so I had to deal with that and then finish dinner and that set me back, so by the time I got through with all of that and got to class it was about, it was almost over, actually.</td>
<td></td>
</tr>
<tr>
<td><strong>Psychosocial (n = 189). Empathy for psychosocial aspects when one lives with T2D.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Example 1</strong></td>
<td>[P4]: Another diabetic is the best one to understand you…</td>
<td>[DE]: Mmmhmm</td>
</tr>
<tr>
<td></td>
<td>[P4]: …than anybody else ‘cause we go through the same thing, a lot of the same things</td>
<td>[P5]: I notice when we’re on [site], if one of us says something, everybody automatically knows what they’re talking about because it’s not…</td>
</tr>
<tr>
<td></td>
<td>[P4]: Uh huh.</td>
<td>[DE]: Yea</td>
</tr>
<tr>
<td></td>
<td>[P4]: But you have to be a diabetic to understand it. I don’t care how much you tell somebody, you can’t make ‘em understand after, they have to experience it.</td>
<td>[P5]: …like you have to use another language to explain, ‘cause everybody knows what it is [laughter]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[DE]: Mmmhmm</td>
</tr>
<tr>
<td><strong>Example 2</strong></td>
<td>[P6]: My family treats me like I’m sick all of the time…</td>
<td></td>
</tr>
</tbody>
</table>
[P6]: ...so they are always hovering over me and wanting to do stuff…

[P7]: Really?

[P7]: I knew I wasn’t the only one!

[DE]: No, you aren’t the only one.

[P8]: Yea

[DE]: No, you aren’t the only one.

[P8]: Nuh uh

[P6]: You know, and it makes me feel like I’m not adequate like what [P7] was saying.

<table>
<thead>
<tr>
<th>Motivation (n = 100). Empathy and encouragement for engaging in T2D self-management behaviors.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example 1</strong></td>
</tr>
<tr>
<td>[P9]: Well I do, I am getting ready to restart doing water aerobics</td>
</tr>
<tr>
<td>[DE]: Ooh</td>
</tr>
<tr>
<td>[P10]: I’m with [P9]. I like the water aerobics better.</td>
</tr>
<tr>
<td>[P11]: Mmmhmm</td>
</tr>
<tr>
<td>[DE]: Yea, the water, especially the warm water, it’s nice…</td>
</tr>
<tr>
<td><strong>Example 2</strong></td>
</tr>
<tr>
<td>[P12]: I went to the doctor and he said, I can’t believe you had to diagnose this [T2D] yourself! I said, well, I am here and I know what is going on.</td>
</tr>
<tr>
<td>[DE]: Yea</td>
</tr>
<tr>
<td>[P13]: That is the way to be</td>
</tr>
<tr>
<td>[DE]: Well it is the way to be. I was going to say that is why we should talk about recommendations on when to follow up and other things to keep in mind because sometimes you have to take care of it yourself, right?</td>
</tr>
<tr>
<td>[P12]: Yea</td>
</tr>
<tr>
<td>[P12]: You need to listen to your body, everybody, because your body tells you a lot and we don’t always listen.</td>
</tr>
<tr>
<td>[DE]: If people don’t follow up</td>
</tr>
<tr>
<td>[DE]: No</td>
</tr>
<tr>
<td>[P13]: That is very true</td>
</tr>
</tbody>
</table>

*Note: [P# 1-13] = each number indicates a participant; [DE] = diabetes educator.*
Emotional support consisted of sequential responses exchanged in real-time conversation. The diabetes educators and participants provided emotional support when another participant revealed a challenge, or personal struggle, or discussed an experience or achievement. Supportive comments included short phrases such as “Oh no,” “Oh, I’m sorry,” “Mmmhmm,” “Wow!” or longer phrases such as “Well that is good news” or “I knew I wasn’t the only one!” Typically, these phrases occurred while the participant, the support elicitor, revealed personal information. However, sometimes the phrases occurred after the participant concluded their statements. The participants who responded, the support providers, used these phrases to indicate empathy and their presence in the interaction.

Emotional support interactions centered on integrating T2D self-management into one’s daily life. Participants elicited and provided emotional support when they discussed the physical challenges (e.g., hypoglycemic events), the psychosocial issues (e.g., loneliness, frustration, depression), and restrictions (e.g., unable to eat certain foods) encountered when living with T2D. The statements that elicited emotional support included participant responses to questions during the education lectures, participant responses to direct questions from a diabetes educator or participant, participant comments during a discussion, or a participant-initiated statement. For example, a participant elicited emotional support during a discussion on insulin. This participant asked a question about how to identify locations in which to inject her insulin. As the participant revealed personal information and the challenge she faced, the diabetes educator provided emotional support. The diabetes educator empathized with the participant’s struggle and then helped the participant to assess the situation.

The participants empathized with each other about living with T2D. This mutual understanding of the struggles encountered enabled the participants to discuss their feelings of frustration and loneliness about “feeling different.” For example, several times a participant discussed an unhelpful interaction with healthcare providers, friends, or family member and then stated how the participant advocated for their own health. The other participants provided
emotional support when they motivated the participant to continue advocating for themselves. While the diabetes educator was present and provided emotional support, the most vocal supportive responses came from the other participants.

5.4.5.2 Sources of support

Participants discussed their personal experiences engaging in, or not engaging in, self-management behaviors during the education and support sessions. Figure 10 illustrates the types of emotional support in the education and social support sessions.

![Figure 10. Types of emotional support present in the education and support sessions.](image)

Most of the emotional support types, motivational and physical health, were exchanged in the education sessions. However, the emotional support type psychosocial health was exchanged almost equally in the education and support sessions.

5.5 Discussion

This study described the characteristics of social support among individuals living with T2D who interacted in a CME. Specifically, this study identified the content of a supportive interaction in real-time conversation in a moderated environment. These data indicate that individuals living with T2D obtain social support in sessions focused on providing education and
facilitating support in a disease-specific CME. The diabetes educators and individuals engaged in bidirectional supportive responses during interactions in the CME.

The CME created a group of individuals who shared a common characteristic—living with T2D. This constructed community was individual-centered and enabled individuals to obtain the amount and type of support each individual desired (Armstrong et al., 2012; Barrera, Toobert, & Strycker, 2014; Johnson, Feinglos, et al., 2014). The synchronous interactions with similar others, in addition to the relevant discussions, may have decreased diabetes-related isolation as several individuals stated that “only a diabetic knows what it’s like to be a diabetic.” This synchronous CME enabled individuals to promptly elicit support and provide supportive responses; these timely exchanges may have resulted in increased feelings of support and the desire to reciprocate the support received (Heisler et al., 2013; Heisler et al., 2010). Thus, these exchanges prompted further discussion and opportunities to give-and-take social support among a diverse group of supportive, similar peers (Brundisini et al., 2015; Greenhalgh, Collard, et al., 2011). Additionally, these qualitative findings further describe the SLIDES study result that showed a statistically significant increase in social support from the beginning to the end of the study (Johnson, Feinglos, et al., 2014).

Type 2 diabetes self-management is individual-specific and dynamic, which highlights the need for social support that is personalized and timely. The individuals in this study asked questions, revealed personal information, discussed challenges, and talked about the struggles they encountered when they engaged in, or failed in, T2D self-management. Similar to what is in the research literature, the individuals in this study discussed incorporating T2D self-management behaviors into one’s daily routine, adjusting to one’s new identity after being diagnosed with T2D, adopting healthy behaviors, and interacting with others (e.g., friends, family and healthcare providers) (Bossy, Knutsen, Rogers, & Foss, 2017; S. A. Fox & Chesla, 2008; Johansson, ÖSterberg, Leksell, & Berglund, 2016). The findings in this study are similar to those in Greenhalgh, Collard, et al. (2011), as individuals in that study indicated that they knew the
difference between correct and incorrect self-management behaviors. Yet, these individuals still
desired more information about applying and possibly altering self-management behaviors based
on their own personal situations, highlighting the support notion of “one size does not fit all.”

In addition, the conversations in the CME highlighted the four types of social support:
informational (e.g., exchange of T2D specific information), emotional (e.g., exchange of
empathy, trust, caring, and belongingness when discussing T2D self-management), appraisal
(e.g., exchange of affirmation statements regarding T2D self-management), and instrumental
(e.g., exchange of tangible goods related to T2D self-management). Informational support was
the most frequently exchanged type of support in the CME as individuals living with T2D asked
questions and sought information about how to better self-manage their T2D and address
challenges related to engaging in T2D self-management. Emotional support was the second most
frequently exchanged support, and occurred when individuals expressed empathy, caring, and
belongingness following another individual’s statement of a problem related to living with T2D.
Appraisal support was the third most frequently exchanged support. The findings showed that
individuals living with T2D and the diabetes educators provided affirmation comments after an
individual stated how they enacted a self-management behavior or when the individual sought
information about T2D self-management. Instrumental support was the least exchanged type of
support, and included the exchange of website links, recipes, and self-management tools. These
findings did not show any instances of negative social interaction and support. However, in this
study, there were instances in which the individual living with T2D and the diabetes educators
corrected misinformation and misunderstandings about T2D self-management. The delivery of
this correct information was not a critique of an individual’s behaviors, but rather the corrective
feedback helped individuals engaging in T2D self-management discern between correct and
incorrect information. Altogether, these findings describe the exchange of the four types of social
support among individuals living with T2D and diabetes educators who interact in a synchronous
CME.

117
Diabetes educators were a key component in the exchange of social support in the CME because they provided personalized support and corrected any misinformation during the education and support sessions in response to individuals’ comments and questions. Individuals vocalized their appreciation of these interactions with the diabetes educators during the education and support sessions. In face-to-face support groups, diabetes educators serve as facilitators by connecting others, exchanging information, managing group dynamics, and prompting problem solving (Costello, 2013). In the CME, the diabetes educators demonstrated these same behaviors when they moderated discussions in the education and support sessions, facilitated the exchange of support among individual-to-individual, provided support to the individuals, prompted problem solving when discussing challenges, were receptive to questions, and lectured on T2D content. These overall effect of these actions created a relaxed learning environment that then resulted in a safe space. This safe space might have enabled individuals to feel comfortable when disclosing their personal challenges and struggles of living with T2D in order to obtain personally relevant support (R. M. Anderson & Funnell, 2008; Costello, 2013). Over time, this increased interaction between the diabetes educator and the individual may have resulted in confirmation of the individual’s good self-management behaviors (e.g., praise for exercise or closely monitoring one’s blood sugar values) (Dellasega, Añel-Tiangco, & Gabbay, 2012; Rise, Pellerud, Rygg, & Steinsbekk, 2013). The diabetes educator’s presence in the CME directly benefitted the individuals because the diabetes educator gained knowledge about each individual when the individual self-disclosed. Subsequently, the diabetes educator could use this knowledge to increasingly personalize the support provided to this individual in the CME. This insight enabled the diabetes educator to collaborate with the individual to set realistic goals for the individual’s self-management treatment, address real-time challenges to self-management, and help ameliorate any barriers the individual faced.

Individuals living with T2D encounter a multitude of personal challenges when they engage in T2D self-management. One way to help address barriers to self-management is to
obtain support from similar peers who may have encountered similar challenges in enacting self-management behaviors. Interactions with peers who are successful and unsuccessful in T2D self-management enable individuals to problem solve and identify ways to address their own challenges (Armstrong et al., 2012; Greenhalgh, Collard, et al., 2011; Willis, 2016). In this study, individuals exchanged social support with each other via personal narratives about one’s disease experience or through direct questions and responses to each other during the education and support sessions. Similar to the research literature, the results of this study showed that individuals’ personal narratives included self-management failures and successes; the sharing of this personal information resulted in the exchange of social support (Greenhalgh, Collard, et al., 2011; Kowitt et al., 2015; Wang et al., 2015).

### 5.5.1 Limitations

This analysis of social support has several limitations. Due to the small size of the sample (N=24) and only one male, these findings should be interpreted with caution. Additionally, there were two education sessions per week, whereas there was only one social support session a week. Therefore, individuals had more time during the education sessions to interact with the diabetes educators and participants and receive support. Also, two of the three diabetes educators in this study had pre-existing relationships with the majority of the individuals. The amount of social support exchanged during the sessions may have been increased due to the individuals’ familiarity with the diabetes educators.

Finally, as individuals entered into the study at various time points, individuals who were more verbose and/or comfortable in the CME may have affected the exchange of social support in the education and support sessions. For example, Participant A entered the SLIDES CME in week 1, and Participant B entered the SLIDES CME in week 7. Therefore, during Participant B’s first week, Participant A has been in the SLIDES CME for 6 weeks. Participant A may feel more comfortable using the CME, engaging with the diabetes educators and other participants, and be
familiar with the session format. This familiarity may cause Participant A to ask questions and make comments to elicit support for their behaviors. Additionally, Participant A may be more likely to provide supportive responses due to their comfort with using the CME. Participant A’s actions may encourage or discourage Participant B’s participation during the session. However, despite these limitations, the findings provide valuable insight into the social support exchanged in a CME.

5.6 Conclusion

Computer mediated environments facilitate the exchange of social support among individuals living with T2D. In a CME, individuals living with T2D can obtain support that is personalized and provided by others living with the same disease. This relevant and timely support may help individuals begin, implement, and sustain critical T2D self-management behaviors necessary for good health outcomes. This study began to characterize the exchange of social support in real-time conversation among individuals living with T2D who interacted in a CME. Future research on social support in a CME, and also synchronous conversation, should focus on analyzing support in a more diverse sample.
6. Conclusion

6.1 Introduction

The occurrence of type 2 diabetes (T2D) increases each year in the United States and is the 7th leading cause of death (Centers for Disease Control and Prevention, 2014). Interventions aimed at increasing self-management and improving health outcomes of adults living with T2D have shown mixed results, and self-management in this population remains sub-optimal. Poor self-management is a concern as individuals living with T2D are at increased risk for adverse physical and psychosocial health outcomes associated with uncontrolled T2D (Vigersky, 2011). Research indicates that frequent and sustained interaction and support from providers and peers (e.g., others living with T2D) assists individuals living with T2D in understanding and implementing T2D self-management behaviors (Qi et al., 2015; Steinsbekk et al., 2012). Yet, this frequent interaction and support between providers and peers is not always feasible in face-to-face environments due to temporal, financial, or physical barriers. Therefore, interventions via computer-mediated environments (CMEs; i.e., programs via the Internet) may be one solution for addressing the barriers that individuals face in obtaining interaction and support.

One way to improve the impact of disease-specific CMEs on self-management behaviors is to understand the interaction and support exchanged in these environments. Computer mediated environments enable individuals living with T2D to obtain personalized information and support in a less resource intensive manner than a face-to-face encounter with a healthcare provider. The findings described the social interaction and support exchanged among adults living with T2D who interacted in a diabetes educator-led, T2D-specific CME. Social interaction was operationalized as: topic (e.g., content of discussion), ties (e.g., intensity and duration of contact), depth (e.g., degree of intimacy and personalization of discussed topics), breadth (e.g., number of topics discussed), and participation (present and talking; present and not talking). For this study, the researcher operationalized social support according to the four commonly identified types in
the literature: emotional (e.g., provision of empathy), instrumental (e.g., provision of tangible goods), appraisal (e.g., provision of affirmational comments), and informational (e.g., provision of information) (Cohen & McKay, 1984).

Overall, these findings provided insight into the two theories, *Strong/Weak Tie Theory* and *Social Penetration Theory*, which guided this study. The findings showed that ties are present between and among individuals in a CME, which were similar to face-to-face relationships. A weak tie is a relationship that is created quickly, does not require a large amount of time, and one that brings in novel information to another individual (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). A strong tie is a close and direct relationship between individuals in which there is increased frequency, duration, and closeness of contact (Ballard-Reisch et al., 2011; Granovetter, 1973, 1983). A guiding framework (Chapter 1, Figure 1) based upon Strong/Weak Tie Theory (Granovetter, 1973, 1983) and Social Penetration Theory (Altman & Taylor, 1973) guided the analysis of previously recorded conversations from a CME. Table 18 provides the definitions of each concept from the guiding framework along with supporting evidence from this study.
Table 18. Guiding framework concepts addressed in this study.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Attribute</th>
<th>A priori operationalization</th>
<th>Evidence from the study</th>
</tr>
</thead>
</table>
| Social Interaction | Topic | Content of the discussion about self-management, T2D, or living with chronic illness (Holt-Lunstad et al., 2010). | Individuals discussed expressions of self-management behaviors (Ch. 4: Table 10):  
  - **Challenging aspects of living with T2D** - Statements of challenges in T2D self-management including limitations and problems, mistakes, and psychosocial aspects.  
  - **Self-managing in the real-world** - Statements related to enacting T2D self-management behaviors including coping, self-management intentions and objectives, and external influencers. |
| Ties (Strong and Weak) | Amount and duration of contact, intensity of emotions, reciprocity of interaction (Granovetter, 1973, 1983). | Individuals used communication techniques in interactions to develop ties (Ch. 4: Table 9):  
  - **Indicators of listening**. Verbal utterances indicated that someone was present and listening.  
  - **Being in the CME**. Indications that participants felt they were “there” and they were not alone.  
  - **Attributes of bidirectional information exchange**. Statements used in information exchange.  
  - **Connecting actions**. Statements and actions taken by individuals when associating with others.  
  - The topics discussed (e.g., expressions of self-management, breadth of conversation), participation, and the depth of personal information shared in the CME influenced the development and maintenance of strong and weak ties in the CME. |
| Depth | Degree of intimacy and personalization of discussed topics (Altman & Taylor, 1973; Ballard-Reisch et al., 2011). | Individuals revealed four levels of personal information during discussions (Ch. 4: Table 11):  
  - **Level 1: Making small talk**. No personal information revealed.  
  - **Level 2: Opening up**. Hinted at personal issues, shared observations about others.  
  - **Level 3: Informing**. Shared objective facts about T2D self-management.  
  - **Level 4: Disclosing**. Highest amount of personalization, revealed weaknesses. |
| Breadth | Number of topics discussed (Altman & Taylor, 1973; Ballard-Reisch et al., 2011). | Most topics in the CME focused on T2D self-management (Ch. 4) as the individuals shared a common diagnosis of T2D and desired to obtain knowledge to improve their self-management behaviors. |
| Participation | Active—present and talking. Passive—present and not talking. | Active individuals used communication techniques (Ch. 4: Table 9) when they engaged with others to talk about expressions of self-management (Ch. 4: Table 10) and reveal depth of personalized content (Ch. 4: Table 11). Passive individuals were not as verbose as the active individuals (Ch. 4). |
| Social Support | Instrumental | Exchange of tangible goods or services related to T2D. | Individuals exchanged three types of instrumental support (Ch. 5: Table 14): Links and information, self-management tools, and recipes. |
| Appraisal | The exchange of praise for a T2D self-management behavior or action. | Individuals exchanged two types of appraisal support (Ch. 5: Table 15):  
  - **Support for information seeking**. Affirmations for an individual’s information-seeking behaviors.  
  - **Support for self-management behaviors**. Praise for enacted self-management behaviors. |
| Informational | The exchange of T2D-specific information among individuals. | Individuals exchanged ten types of informational support (Ch. 5: Table 16): nutrition & food, preventing complications & problem solving, monitoring, medications (insulin), medications (not insulin), psychosocial aspects & coping, pathophysiology, exercise, SLIDES study information, and miscellaneous information. |
| Emotional | The exchange of feelings of trust, caring, belongingness, and warmth when discussing T2D self-management. | Individuals exchanged three types of emotional support (Ch. 5: Table 17):  
  - **Physical health**. Empathy for the physical challenges and symptoms related to living with T2D.  
  - **Psychosocial**. Empathy for psychosocial aspects (e.g., loneliness) when one lives with T2D.  
  - **Motivational**. Empathy and encouragement for engaging in T2D self-management behaviors. |
<table>
<thead>
<tr>
<th>Source of support</th>
<th>Provider</th>
<th>Nurse Practitioners, Certified Diabetes Educator, PI of SLIDES.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer</td>
<td>Another individual who had T2D.</td>
<td></td>
</tr>
</tbody>
</table>

- Communication techniques (Ch. 4: Table 9) facilitated the exchange of expressions of self-management (Ch. 4: Table 10), depth of personal information shared (Ch. 4: Table 11), and breadth of topics.
- Individuals exchanged instrumental (Ch. 5: Table 14), appraisal (Ch. 5: Table 15, Figure 6 and Figure 7), informational (Ch. 5: Table 16, Figure 8 and Figure 9), and emotional (Ch. 5: Table 17, Figure 10) support.
- Individuals encouraged participation when they used communication techniques (Ch. 4: Table 9) to exchange support during the education and support sessions (Ch. 5: Figure 5).

Note: This study used Sheldon Cohen’s operationalization of the four types of social support (Cohen, 2004; Cohen & McKay, 1984); Ch. = chapter; T2D = type 2 diabetes; PI = primary investigator; SLIDES = Second Life Impacts Diabetes Education and Self-Management.
The aim of this research was to obtain knowledge about how individuals living with T2D interacted to obtain personalized support which assisted them in practicing and sustaining critical self-management behaviors. First, the literature review (Chapter 2) provided a basis for understanding peer-to-peer interactions in a CME (Lewinski & Fisher, 2016). Then, the researcher described the protocol for the study (Chapter 3) which used concepts from the guiding framework to qualitatively analyze conversational data (Lewinski et al., 2017). The results of the primary study described social interaction (Chapter 4) and social support exchanged among adults in a CME (Chapter 5). The insights gained in this study into social relationships in a CME contributes to the research literature concerning description and analysis of social interaction and support in disease-specific CMEs that are focused on providing self-management education and support to individuals living with T2D.

6.2 Implications for the design of disease-specific computer-mediated environments

The findings indicate that T2D-specific CMEs should contain information and support in addition to having dedicated “free-time” for individuals living with T2D to interact with each other. Therefore, the researcher offers four recommendations for designs of disease-specific CMEs that support this implication.

6.2.1 Recommendation 1: Diabetes educator as moderator

The findings indicate the importance of a diabetes educator serving as a moderator in a disease-specific CME. A finding of the literature review (Chapter 2) highlights the importance of a moderator (Lewinski & Fisher, 2016). The literature review noted that some studies included a moderator who promoted conversation, engaged individuals, facilitated the exchange of support and information, and answered questions for the duration of the intervention (Burkow et al., 2013; Jernigan & Lorig, 2011). Additionally, the findings also noted that moderators initiated discussions and answered questions while also serving as an informational resource (Bond et al.,
Thus, the implication for practice is that disease-specific CMEs which provide knowledge to individuals living with chronic illness should contain a moderator, as this individual can help facilitate the exchange of interaction and support among other individuals in the CME. This finding from the literature review is supported in the study (Chapters 3, 4 & 5).

Diabetes educators fulfilled the essential role of the moderator in the SLIDES CME. The primary study showed that diabetes educators helped in the exchange of information (Chapter 4) and social support (Chapter 5) amongst the individuals in the CME. These educators facilitated group interaction and participation when they demonstrated respect for the individuals, welcomed individuals at the beginning of each session, inquired about individual’s health, discussed medications, asked the individual’s questions, called the individuals’ by name, and addressed any concerns that arise. The diabetes educators’ use of these actions in the management of group dynamics in the CME are similar to those in face-to-face support group settings (Costello, 2013).

The diabetes educators in the primary study used several communication strategies to create an environment conducive to the sharing of personal information (i.e., depth), on a variety of topics (i.e., breadth), which enabled individuals to form relationships with each other over time (i.e., ties) in order to obtain personalized support and information (Table 18) (R. M. Anderson & Funnell, 2008; Costello, 2013). This repeated interaction may have enabled the creation of ties between the diabetes educators and the individuals living with T2D.

Healthcare providers remain the preferred resource of disease-specific information. Lopez et al. (2016) and Goering and Matthias (2010) found that individuals living with T2D preferred information from healthcare providers (e.g., diabetes educators) over the information from peers. The findings in Chapters 4 and 5 showed that individuals in the study sought information and support from the diabetes educators on a variety of topics salient to T2D self-management. Based upon the research literature and the findings from this study, the functions of the moderator should be to: (1) organize education and support sessions; (2) facilitate interaction
among all individuals; (3) assist individuals in using the components of the CME to their fullest potential; and (4) assist individuals in problem solving (R. M. Anderson & Funnell, 2008; Costello, 2013; Lopez et al., 2016). Diabetes educators are important components in a T2D CME because they serve as important sources of support and information to individuals living with T2D.

6.2.2 Recommendation 2: A group of participants

In addition to the contributions of the diabetes educators, the findings indicate that a successful T2D-specific CME includes the viewpoints of many individuals living with T2D who become a community. A group of individuals offers a variety of experiences and insights that they can contribute to other individuals living with T2D (Armstrong et al., 2012; Greenhalgh, Collard, et al., 2011; Willis, 2016). Sharing personal narratives that contain an individual’s self-management failures and successes serves as a basis for the exchange of support and information among individuals living with T2D (Greenhalgh, Collard, et al., 2011; Kowitt et al., 2015; Wang et al., 2015). These contributions enhance the knowledge exchanged between individuals in the group setting and help to meet the needs of all individuals as they self-manage their T2D.

Type 2 diabetes is a dynamic disease which requires a multitude of skills to implement self-management behaviors effectively. The literature review (Chapter 2) found that the CME enabled individuals to connect with other individuals living with T2D. Additionally, the CME enabled individuals to choose how much they wanted to interact with others, when they wanted to interact with others, and what information they wanted to share with others (Lewinski & Fisher, 2016). The findings in Chapters 4 and 5 showed that individuals entered into the CME having weak ties to each other; these initial connections among participants were based on the shared experience of living with T2D and a desire to improve one’s self-management. Over time, some individuals shared increasingly personal information about their self-management experience when they discussed their own struggles, challenges, and problem solving techniques.
The T2D specific-information and support received from the weak ties complemented the support received from the individual’s provider or the moderator in the CME. Chapters 4 and 5 showed that individuals received support from other group members when they reported stories about having to advocate for themselves or when they struggled to explain how they felt about living with T2D. In these instances, individuals in the CME reinforced, and affirmed, the appropriateness of the individual’s actions. Although the individuals who participated in the SLIDES study (Chapters 3, 4 and 5) had a common diagnosis, they had different lived experiences. These different experiences enabled the individuals to share a variety of perspectives when they provided empathy, suggested solutions to challenges, and offered personal stories in order to help the other study individuals improve their self-management skills (Armstrong & Powell, 2009; Barrera et al., 2014). These shared perspectives on addressing challenges and incorporating behaviors may help individuals self-manage their disease (Armstrong et al., 2012; Johansson et al., 2016). Therefore, creating a community of individuals in the CME that can offer multiple viewpoints on T2D self-management increases the likelihood that an individual’s support and information needs are met.

6.2.3 Recommendation 3: Synchronous interaction

The findings showed that synchronous CMEs enabled individuals to ask questions and receive answers promptly in real-time. The findings in Chapter 2 showed that individuals in CMEs benefitted from support and information exchanged in synchronous interactions among a group of individuals living with T2D (Lewinski & Fisher, 2016). Four of the eleven articles included in this literature review incorporated synchronous communication which enabled individuals to feel that they were not alone as well as receive prompt responses to their questions (Lewinski & Fisher, 2016). The findings in Chapter 4 demonstrated that individuals and diabetes educators used an array of verbal behaviors during synchronous interactions that both promoted and inhibited social interaction and the exchange of support. For instance, behaviors such as
double-checking information in the conversation, giving verbal cues that an individual was engaged in the conversation, responding to questions, or reflecting emotions back to a speaker promoted interaction. Whereas, behaviors such as not responding to questions, interrupting another participant, or verbalizing an inappropriate comment inhibited interaction among individuals. The findings in Chapter 5 showed how individuals and diabetes educators provided real-time social support in response to individuals’ questions, personal narratives, and comments during education and support sessions.

Individuals and diabetes educators used communication techniques, similar to those used in face-to-face environments, to interact in the CME (Table 18). The findings showed four characteristics of a social interaction in a CME (Chapter 4, Table 9): communication techniques, expressions of self-management, depth of conversation, and breadth of conversation. For example, the findings in Chapter 4 showed that interaction was promoted among individuals in the group when the individuals used indicators of listening (e.g., such as following the conversation, responsiveness, and reflecting back) during the exchange of personal information (e.g., depth—low intensity to high intensity of personal information, and expression of self-management—such as a statement of a challenging aspect of living with T2D). Most conversations in the CME focused on T2D-related topics (e.g., breadth) as individuals’ revealed challenges in response to questions from other individuals, prompts from the diabetes educators, and discussion topics. The individuals’ and diabetes educators’ interaction behaviors facilitated the sharing of personal information and exchange of T2D self-management information, and enabled interactive group discussions.

The interactions in the CME enabled the individuals to discuss the challenges they encountered with self-management, and not feel so isolated due to their diagnosis. The sharing of these challenges enabled the diabetes educator, and other individuals, to provide increasingly personalized and immediate advice to help the individual address these challenges. In this study, the technological components of the CME (voice vs. text) enabled individuals to maintain choice
in how they communicated, what they revealed, how much privacy they retained, what information they obtained, and what support they provided to others. Therefore, synchronous interactions, that enable individuals to ask questions in real-time and receive real-time information and support, helps to ensure that each individual’s information and support needs are being met.

6.2.4 Recommendation 4: Information and support over time

The findings indicated that regularly scheduled information and support sessions enabled individuals to receive frequent information and support over time. A diagnosis of T2D, and the resulting need to engage in self-management, is a life-altering event. Once diagnosed, an individual feels “different” from the people around them, and they may feel that others do not understand their information needs and their support needs (Bossy et al., 2017; Browne, Ventura, Mosely, & Speight, 2013; Carolan, Holman, & Ferrari, 2015). The findings from the literature review indicated that study individuals benefitted from the ability to obtain T2D-specific information and support while they were in the CME (Lewinski & Fisher, 2016). These interactions allowed individuals to obtain personalized feedback regarding their individual progress and self-management behaviors. Chapters 4 and 5 showed that individuals exchanged information and support in the CME throughout the study duration. The synchronous and scheduled nature of the sessions enabled individuals to better manage their disease by obtaining knowledge each week as well as learning more about the other individuals in the CME. Thus, the regularly scheduled sessions provided the individuals and the educators the time to begin to transition from weak ties to strong ties.

The individuals discussed a variety of topics related to T2D during the education and support sessions; some topics were discussed infrequently and other topics were revisited each week. For example, one individual suffered from an illness for several weeks. In subsequent weeks, the diabetes educators and other individuals asked how this individual was feeling, offered
suggestions, served as a sounding-board for her frustration, and helped her to address any self-management challenges as a result of her illness. This example highlights the importance of having a regularly scheduled session, because this individual was able to discuss her feelings of frustration with others and receive support and information.

Individuals who feel supported and who feel they have accurate information engage in better, and more consistent, self-management behaviors (Bossy et al., 2017; Brundisini et al., 2015). Individuals living with T2D do not self-manage as well when they feel socially isolated, depressed, and have poor coping strategies (S. A. Brown et al., 2016; Brundisini et al., 2015). The findings suggest that the regular interactions with the other individuals living with T2D and the diabetes educators, offered more timely support and information than traditional, episodic face-to-face interactions solely with healthcare providers. Individuals identified with the struggles of other individuals; these connections enabled individuals to not feel alone (Bossy et al., 2017). Discussions in the CME enabled individuals to share their experiences of living with this disease and the ever-present self-management needs. The findings revealed that individuals will reveal personal information (depth) in order to obtain personalized support and information from others living with T2D and diabetes educators; this frequent follow-up and interaction may have helped to support and maintain self-management behaviors (Fisher, Brownson, et al., 2007). Therefore, CMEs should be designed to facilitate repeated, synchronous, bidirectional interaction among individuals and providers over time.

6.3 Implications for research and practice

Disease-specific CMEs are valuable modalities to study the synchronous exchange of social support among individuals. The findings add to the current research literature as the findings are applicable to the exchange of support across a variety of modalities (e.g., face-to-face T2D support groups; patient-provider interactions). Additionally, the findings showed how CMEs can serve a method for understanding the synchronous exchange of social support. Typically,
social support is assessed via a valid and reliable questionnaire, which measures an individual’s retrospective perceptions about previously completed actions. Using this approach showed how individuals converse, what these individuals say, and when in an interaction they exchange support in synchronous conversations. Synchronous conversations more accurately depict real-time social support elicitation behaviors and the social support provided among individuals who discuss challenges with T2D.

Diabetes educators, a role commonly fulfilled by nurses, provide valuable support and information to individuals living with T2D. These findings revealed that diabetes educators provided support and information which complemented the support and information provided by the other individuals living with T2D. Diabetes educators moderated the support and education sessions, encouraged individuals to communicate with others, and assisted in the continued use of the educational tools in the CME. The findings advance knowledge about the crucial role of the diabetes educator in synchronous interactions, and provides concrete facilitation techniques and communication behaviors that promote or inhibit interaction among the individuals in a CME. As CMEs are becoming an increasingly popular medium to promote T2D self-management, this analysis of synchronous interactions provides tangible techniques and behaviors that diabetes educators can use to facilitate the essential exchange of T2D-specific information and support among individuals living with T2D.

6.4. Concerns of Internet-based research

Computer mediated environments are becoming increasingly ingrained in the social fabric of daily life, and there is increased opportunity for digital data collection (Markham, 2005). Examples of CMEs include social media sites (e.g., Facebook, PatientsLikeMe, Twitter, and discussion forums on websites such as Yahoo!), open sites (e.g., American Diabetes Association’s Support Community discussion board, Second Life), or private, password-protected sites (e.g., patient portals in electronic health records) (Greene, Choudhry, Kilabuk, & Shrank,
2011; Johnson, Feinglos, et al., 2014; Oster et al., 2015); these CMEs are repositories of information on the human experience and social interactions of individuals living with T2D (McKee, 2013; Vitak & Ellison, 2013). Researchers can collect data in these public and private CMEs, and these data provide valuable insight into an individual’s self-management behaviors, challenges when enacting these behaviors, and overall thoughts on living with chronic illness.

Individuals who interact online may do so because of the anonymous nature of the Internet (Allen, Vassilev, Kennedy, & Rogers, 2016). This study focused on conversations in an immersive CME that enabled synchronous conversation among individuals who used screen names. Research on CMEs indicates individuals may share more personal information when they can use an anonymous screen name to interact with others (Mitchell et al., 2014; Wadley et al., 2009; Watson et al., 2008) and when they can select for themselves what personal information they share and when they share this information to the group (Brady, Segar, & Sanders, 2016). Yet, one concern is that the ability to converse with others in a synchronous CME may influence the ability of an individual to remain anonymous. For example, individuals created avatar names and were not required to reveal identifying information about themselves when they interacted with others in the CME. However, several individuals in the SLIDES study revealed identifying information during interactions with others such as their real first name, place of work, place of worship, and where they lived. Computer mediated environments should offer individuals the choice to interact via voice because some individuals may enjoying talking with others like they would in a face-to-face environment, whereas others may feel that voice violates their privacy (Wadley et al., 2009).

Individuals who interact in CMEs should be able to determine their own level of anonymity during social interaction with others. Participant created screen names promote anonymity and can facilitate the sharing of information as an individual’s true identity remains confidential to other participants and some research team members. Anonymous identities enable dialogue between peers and providers about sensitive information such as mental health.
diagnoses (Farrer, Gulliver, Chan, Bennett, & Griffiths, 2015), clinical health matters (Frost, Vermeulen, & Beekers, 2014) and private information (Wilkerson, Iantaffi, Grey, Bockting, & Rosser, 2014) due to the participant’s true identity remaining unknown. Additionally, Wilkerson et al. (2014) noted that anonymity may decrease the social pressures found in face-to-face situations, and result in participants disengaging from the study or dropping out. Therefore, researchers should use methods to ensure that participants’ personal data remains private, and procedures should be in place to ensure that each individual participant retains the ability to reveal as much, or as little, information as they want to reveal to the group.

6.5 Factors inherent in CMEs that promote self-management

Computer mediated environments transcend temporal and geographical barriers to provide support and information for self-management. In a CME, an individual can control how and when they obtain information and interact with peers. Abrams, Wang, Song, and Galindo-Gonzalez (2015) found that topic specific discussions occurred in face-to-face, audio-visual, and text-chat among peers, and that individuals who interacted in the text-chat groups had the most text that was unrelated to the topic of all of the groups. Interestingly, these researchers found that the text-only group exchanged the highest amount of socializing, or comments of a social nature, textual data followed by the audio-visual, and then the face-to-face groups (Abrams et al., 2015).

An inherent feature in CMEs is that individuals control the information they seek, their social interactions, their anonymity, and their amount of participation (Brady et al., 2016; Burkow et al., 2013; Seymour, 2001). Therefore, CMEs and the perceived control they provide the individual facilitate connection between peers. A connection with others enables individuals to exchange support and obtain valuable self-management information (Lorig et al., 2010; McKay et al., 1998). This social interaction and exchange during the challenging times of T2D, which is essentially problem solving, may improve health outcomes. As seen in earlier studies, the findings of this study show that advice and problem solving areas are important in CMEs as
individuals can learn how to self-manage their illness and obtain support (Burkow et al., 2013; Jernigan & Lorig, 2011; McKay et al., 1998).

6.6 Limitations

This study has several limitations. First, the SLIDES study eligibility criteria included (1) participants had to have reliable access to a computer and the Internet and (2) participants had to be computer literate. These two enrollment criteria may have excluded individuals living with T2D, who did not have reliable access to a computer or the Internet, but who may have benefitted from the social interaction and support in the CME. Second, due to the small size of the sample (N = 24), and only one male, the findings from the primary study (Chapters 4 and 5) should not be over generalized. This research did not analyze individual-level participation in the CME; this level of analysis of individual participation would have provided additional insight into tie development and tie strength among individuals in the CME. Additionally, individuals in the primary study entered into the CME at various time points. The individuals already in the CME, and who were comfortable navigating around the CME and engaging in social interaction with others, may have affected the exchange of information and support in the education and support sessions. This research was a secondary analysis of conversational data and individuals were not contacted for further information. Therefore, this study did not query individuals about their perspectives on interaction and support in a CME and the presence of negative interaction and support. Despite these limitations, the findings are valuable because of the insight provided on social interaction and social support in a disease-specific, synchronous CME.

6.7 Conclusion

In this study, the researcher analyzed conversations among adults who interacted in a CME using the attributes of topic, ties, depth, breadth, participation, instrumental support, appraisal support, informational support, emotional support, provider, and peer. Computer mediated environments facilitate the exchange of social interaction and social support from a
variety of sources (e.g., diabetes educators and peers), who provide an array of information (e.g., diabetes knowledge) and support (e.g., instrumental support, appraisal support, informational support, and emotional support). Individuals who provide this support and information use a range of interaction behaviors (e.g., indicators of listening, being in the CME, attributes of bidirectional information exchange, connecting actions) in response to personal expressions of T2D self-management (e.g., challenging aspects of living with T2D, self-managing in the real world, varying levels of depth, breadth of topics) in order to positively influence self-management behaviors. These data support the broader research that dynamic learning environments, such as CMEs, help individuals living with T2D to engage in, and maintain, self-management behaviors during the course of one’s disease. Additionally, the findings show that CMEs provide similar interaction and support as face-to-face environments, with the added benefit of the individual living with T2D being able to interact and receive support from a location of their choosing (e.g., home). These real-time interactions, in a CME, help individuals manage their T2D when they can get immediate information or support for a spontaneous question, thought, concern, or challenge. Altogether, the findings indicate that the concepts of interaction and support are entwined with one another. Social relationships with others are important because social interactions generate the exchange of information and support for individuals living with T2D, which helps these individuals self-manage their T2D more effectively.
Appendix A: Description of Raw Qualitative Data

A graduate student affiliated with the SLIDES study reviewed all recorded MP3 files \( n = 7,886 \) and sorted the MP3 files into two folders. Junk MP3 files \( n = 7,025 \) contained nonsensical recordings, feedback, or miscellaneous sounds; I did not include these in the current study.

<table>
<thead>
<tr>
<th>Total MP3 files collected in SLIDES study</th>
<th>7, 886</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of junk MP3 files (size of files)</td>
<td>7, 025 (5.52 GB)</td>
</tr>
</tbody>
</table>

**Study Appropriate Data Files**

<table>
<thead>
<tr>
<th>Number of MP3 files (size of files)</th>
<th>861 files (435 MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of MP3 files (min to max)</td>
<td>3s to 9m:52s</td>
</tr>
<tr>
<td>Size of MP3 files (min to max)</td>
<td>6 KB to 1,736 KB</td>
</tr>
<tr>
<td>Number of files MP3 files transcribed</td>
<td>861</td>
</tr>
</tbody>
</table>

*Note: s = seconds, m = minutes, GB = gigabytes, MB = megabytes, KB = kilobytes, min = minimum length/size of file, max = maximum length/size of file*
Appendix B: Origins of Raw Qualitative Data

The origins of the raw conversational data collected during the SLIDES study (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014).

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversations</td>
<td>Transcripts of real-time conversations among participants and providers in the CME.</td>
</tr>
<tr>
<td>(Synchronous)</td>
<td></td>
</tr>
<tr>
<td>Text-Chats</td>
<td>Text messages that were sent when participants were unable to utilize their microphone to speak with others or the participants wanted to type a question or comment.</td>
</tr>
<tr>
<td>(Synchronous)</td>
<td></td>
</tr>
<tr>
<td>Emails</td>
<td>Four types:</td>
</tr>
<tr>
<td>(Asynchronous)</td>
<td>1. <strong>Automatic reminders from the SLIDES study team</strong> – these emails prompted participants to re-engage with the SLIDES CME if the participant had not logged into the site within a certain number of days.</td>
</tr>
<tr>
<td></td>
<td>2. <strong>Participant replies to automatic reminders</strong> – participant responses to the automatic prompts.</td>
</tr>
<tr>
<td></td>
<td>3. <strong>Participant and diabetes educator</strong> – follow-up emails with information and answers from questions asked during sessions.</td>
</tr>
<tr>
<td></td>
<td>4. <strong>Technical support questions</strong> – emails focused on technical challenges faced by the participants and responses from the study coordinator.</td>
</tr>
<tr>
<td>Discussion Forum</td>
<td>Two types:</td>
</tr>
<tr>
<td>(Asynchronous)</td>
<td>1. <strong>Engagement prompts</strong> – discussion forum posts that stated questions or statements by the diabetes educators in an attempt to facilitate discussion among participants.</td>
</tr>
<tr>
<td></td>
<td>2. <strong>Participant initiated posts</strong> – discussion forum posts that were initiated by the participants and included recipes, helpful self-management tools, and questions about T2D self-management.</td>
</tr>
</tbody>
</table>
Appendix C: Data Preparation and Data Cleaning Methods

I developed impressions about the social interactions that took place between participants and diabetes educators after transcribing several MP3 files. These are the detailed steps that I took in preparing and cleaning the data.

Preparation of the Raw Conversational Data

The preparation of the raw conversational data occurred in three stages over a period of several months. During the first stage, I focused on becoming familiar with the data through listening to the MP3 files and learning about the SLIDES CME. The second stage consisted of the transcription of the MP3 files by a professional transcription service. The third stage focused on organizing the data by date.

<table>
<thead>
<tr>
<th>First Stage: Familiarity of the data</th>
<th>I used several methods to become familiar with the SLIDES study and the data collected. I created an avatar and walked around to the various locations and interacted with the tools in the SLIDES. I interacted with Dr. Johnson in the SLIDES environment so that I gained greater knowledge about the participant experience. Additionally, I worked with the study investigators (Drs. Johnson and Vorderstrasse), one of the diabetes educators, and graduate student to learn about the virtual environment, the interactions that occurred among participants, and the structure of the education sessions and support group sessions. Then, I transcribed several MP3 files (n = 164) into Microsoft Word documents to become familiar with the voices of the participants and the conversational style in the CME.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second stage: Transcription service</td>
<td>An IRB approved transcription service transcribed the remaining MP3 files (n = 697) into Microsoft Word documents. I ensured that all MP3 files were transcribed by systematically verifying each MP3 file with the appropriate Microsoft Word document that contained the transcribed dialogue. These raw files contained the transcribed text, indicated when the speakers changed, and noted when the dialogue could not be transcribed due to feedback.</td>
</tr>
<tr>
<td>Third stage: Organization of the raw data</td>
<td>I organized conversations by time in which they occurred (i.e., afternoon, evening) and location. I verified time of conversation by referring to the log-in times of participants, talking with the study investigators, words utilized by the participants (i.e., good morning, good evening), and references to time (e.g., 3:15 PM). The diabetes educators led sessions that lasted greater than 30 minutes and the MP3 files only recorded data in ten minute intervals. I organized these exchanges sequentially so that the transcribed conversations accurately depicted the actual real-time dialogue that occurred.</td>
</tr>
</tbody>
</table>

Cleaning of the Raw Conversational Data

| Spoken Word | I verified each transcribed file by comparing the contents of each MP3 files with the transcribed text. I corrected any sections of text that were missing or inaccurate and linked spoken words to the participant, educator or investigator. I removed all personal identifying information in the conversations (e.g., first names, last names, phone numbers, cities, hospital names, physician names). |
| Verbal utterances, pauses, and interruptions | Verbal utterances were transcribed when they occurred in conversation and by which person. I noted instances when one individual or the group stopped talking or paused before resuming the conversation. Additionally, I noted instances when... |
participants would talk over each other, interrupt one another, or followed along (e.g., uh-huh, mmmhmm).

<table>
<thead>
<tr>
<th>Signs of emotion</th>
<th>I transcribed signs of emotion such as laughter, sighing, excitement, and yawning and linked these to the correct individual. I indicated when an emotion was present in several members of the group or by only one participant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>External noise</td>
<td>I transcribed noises or sounds from external sources outside of the CME. Noises included instances of dogs barking, family members talking to the participant, phones ringing, sneezing, or coughing.</td>
</tr>
<tr>
<td>Unintelligible conversations and feedback</td>
<td>The spoken conversation was unable to be understood in several instances. I noted when audio feedback occurred which prevented me from hearing or accurately understanding the works spoken. Participant related reasons that prevented me from accurately hearing the conversation included: participants talking over one another, participants sneezing/coughing/laughing into their microphone, participants mumbling or talking softly, and participants forgetting to turn their microphone on. Technology related reasons that prohibited me from hearing the conversation included feedback or an internet interruption which caused a participant to immediately leave the CME. I did not transcribe nor did I attempt to fill in missing words in conversations where the spoken word could not be heard.</td>
</tr>
<tr>
<td>Linking spoken words to individuals</td>
<td>All participants, diabetes educators, and study investigators selected avatar names to use in the SLIDES CME. These screen names enabled participants to interact with each other while maintaining confidentiality (Johnson, Feenan, et al., 2014; Johnson, Feinglos, et al., 2014). I worked with the SLIDES affiliated graduate student and Dr. Vorderstrasse to learn participant voices. This help enabled me to link the spoken word to each participant’s avatar name because both the graduate student and Dr. Vorderstrasse had observed and interacted with the participants during the study.</td>
</tr>
<tr>
<td>Including text-chat, emails, and discussion board postings</td>
<td>Participants and diabetes educators conversed via text-chat, email, and discussion boards in the SLIDES site. Copies of these exchanges were stored on the secure server at the University. I removed all personal identifying information, linked the participant’s avatar name to each relevant exchange for identification purposes, and then added these conversations to the master document. I included information such as the correct date and time with a note indicating what type of conversation it was (i.e., email, discussion board posting, text-chat). Several lines of text-chat could not be linked to a specific participant, and those instances were left unlinked to specific individuals.</td>
</tr>
<tr>
<td>Ensuring accuracy of the transcribed conversations</td>
<td>I did not participate in creation, design, or implementation of the SLIDES study. Therefore, at the beginning of the data preparation process, I was unfamiliar with certain terms or phrasing utilized by the participants and diabetes educators. During the cleaning process, I flagged instances where I was not confident in identifying the speaker’s voice, was not familiar with a word or phrase, did not understand what was being said, or was not 100% sure that I accurately cleaned the conversation. Dr. Vorderstrasse and I reviewed and discussed these flagged instances. When we could not clarify a conversation, I noted this in the transcript with a reason why the conversation could not be understood and the time in the MP3 file.</td>
</tr>
</tbody>
</table>
Appendix D: Importing the data into Atlas.ti

The master document was 1,537 pages (2,120 KB) at the completion of cleaning, and comprised 42 distinct Microsoft Word files. We utilized Atlas.ti version 7.5.16 (Berlin, Germany) to support coding and analysis of the data. I created one hermeneutic unit (HU) in Atlas.ti, and then each Microsoft Word file containing one week was imported into Atlas.ti as a separate primary document (p-doc). The total number of lines of text in the HU in Atlas.ti equaled 62,237. I created a master document in Microsoft Word with conversations organized by date and location in the CME where the conversation took place. Below is a description of conversations from two MP3 files.

**Conversation 1: [Location in CME][Calendar Date Recorded][File Number]**

[Educator]: How you doing, [Participant 1]?

[Participant 1]: Good.

[Educator]: Good. You’re all dressed. You’ve got a different outfit every time I see you.

[Participant 1]: Yeah. I have to change.

[Educator]: Yea

[Participant 1]: You know I like to look, I like to look cute, now.

[Laughter – [Participant 1], [Educator], [Participant 2], [Educator 2]]

**Conversation 2: [Location in CME][Calendar Date Recorded][File Number]**

[Participant 2]: Well, particularly, if you’re, like she was at a, as I understood, a high school reunion or something and you have the buffet or something. You, you know, you can’t gauge it. Now, my nutritionist at [University], said that Taco Bell, you know, the tacos themselves were good

[Educator 3]: Mmmhmm

[Participant 2]: Because they bake them, they don’t fry them.

[Educator 3]: Mmmhmm

[Participant 2]: But, now I like the crunchy taco Supremes and it has

[Laughter – [Participant 2], [Educator 3]]
Appendix E: Definition of Terms

The conceptualization of terms utilized in this study.

<table>
<thead>
<tr>
<th>Conversation</th>
<th>Email: PST</th>
<th>An email between a participant and a study team member.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email: STST</td>
<td></td>
<td>An email between a study team member and a study team member.</td>
</tr>
<tr>
<td>Forum</td>
<td></td>
<td>A post in the discussion forum.</td>
</tr>
<tr>
<td>Self</td>
<td></td>
<td>This code indicates that a participant was talking with/to their avatar and no study participant or study team member was present for the conversation. Another example is when the participant is talking to someone in the background or to someone on the telephone. This is also when a person is attempting to converse with another person.</td>
</tr>
<tr>
<td>Text-Chat</td>
<td></td>
<td>A conversation via text-chat.</td>
</tr>
<tr>
<td>With Others</td>
<td></td>
<td>A bidirectional and continuous exchange of verbal and non-verbal communication between individuals. Each individual involved in a conversation adjusts their responses and actions on the feedback received from the other individual(s). Content, context, and the presence of other individuals are necessary components of a conversation. Therefore, talk among others is classified as a conversation if individuals are present, a language is being spoken (verbal or written), and the talk occurs within context. Consists of statements and responses. Talking between two or more people in the same, shared virtual space at the same time. This begins with two people in the same, shared, virtual space at the same time, and ends when an individual disperses.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Bookstore</th>
<th>The bookstore in the SLIDES environment where the conversation/interaction occurred.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clothier</td>
<td>The clothier in the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
<tr>
<td></td>
<td>Community</td>
<td>The community center the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
<tr>
<td></td>
<td>Grocery</td>
<td>The grocery store in the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
<tr>
<td></td>
<td>Gym</td>
<td>The gym in the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
<tr>
<td></td>
<td>Patio</td>
<td>The patio in the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
<tr>
<td></td>
<td>Pharmacy</td>
<td>The pharmacy in the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
<tr>
<td></td>
<td>Restaurant</td>
<td>The restaurant in the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
<tr>
<td></td>
<td>Welcome</td>
<td>The welcome center in the SLIDES environment where the conversation/interaction occurred.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participant</th>
<th>Participant [Name]</th>
<th>A study participant who has been consented, who has created a screen name and created an avatar in their self-image. An individual who is living with T2D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Time</td>
<td>Person Study [Week Number]</td>
<td>Point at which the participant is in the study (e.g., length of time in the study). Week 1 begins when the consent form is signed. This information is from the SLIDES final data file. Weeks start at #1 and go to week #51.</td>
</tr>
<tr>
<td>Session Type</td>
<td>Education</td>
<td>Education session taught by one of the CDEs/NPs. This session could also be taught by the co-PI/NP when she is filling in for the other NPs. These sessions typically have a set agenda with slides and a set topic.</td>
</tr>
<tr>
<td></td>
<td>Focus Group</td>
<td>The focus group led by the SLIDES study PI and Co-PI.</td>
</tr>
<tr>
<td></td>
<td>Support</td>
<td>Support session led by a NP and study co-PI.</td>
</tr>
<tr>
<td>Study Team Member</td>
<td>HCP [Name] or Tech [Name]</td>
<td>Provider of technical assistance, support and/or education within the CME. Individuals include nurse practitioners, a certified diabetes educator, SLIDES study PI, the study coordinator, CME technical support and a PhD student.</td>
</tr>
</tbody>
</table>

Note: [Name] = SLIDES screen name.
Appendix F: Apriori Codes

Codes developed iteratively during the coding process. However, my immersion in the data provided me with directions to investigate in order to characterize social interaction, in addition to those codes developed from Altman’s Social Penetration Theory and Granovetter’s Strong/Weak Tie Theory. The table below provides examples of how insights developed during the coding process along with citations for relevant work.

<table>
<thead>
<tr>
<th>Stage of Study &amp; Thought</th>
<th>Example &amp; Topic researched</th>
<th>Code developed &amp; Linkage to guiding framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transcription</strong></td>
<td>Participants laughed with each other and made verbal utterances during personal stories and conversations.</td>
<td>• Emotions: Humor influences relationship development among individuals (Vettin &amp; Todt, 2004).&lt;br&gt;• Sharing a story or personal information: Provides insight into depth of ties between individuals during computer-mediated communication (Walther, 1992, 1995, 1996, 2012).</td>
</tr>
<tr>
<td></td>
<td>Topic researched:&lt;br&gt;- Laughter&lt;br&gt;- Self-disclosure</td>
<td></td>
</tr>
<tr>
<td><strong>Data cleaning</strong></td>
<td>Participants talked over each other or repeat information.</td>
<td>• Interrupting another, responsiveness: Interruptions and responsiveness may promote or inhibit interactions with others (Abrams et al., 2015; Armstrong et al., 2012).</td>
</tr>
<tr>
<td></td>
<td>Topic researched:&lt;br&gt;- Focus group interactions</td>
<td></td>
</tr>
<tr>
<td><strong>CME Expert</strong></td>
<td>Participants engaged with others as avatars.</td>
<td>• Feelings of co-presence: All social interactions occurred in the CME (Ledbetter et al., 2011; Walther, 1992, 1995, 1996, 2012).</td>
</tr>
<tr>
<td></td>
<td>Topic researched:&lt;br&gt;- Computer-mediated communication, co-presence</td>
<td></td>
</tr>
<tr>
<td><strong>Social interaction expert</strong></td>
<td>Participants exhibited connecting actions when interacting with others.</td>
<td>• ‘Being’ codes: Concept of social interaction in the guiding framework (Abrams et al., 2015; R. A. Anderson, Toles, Corazzini, McDaniel, &amp; Colon-Emeric, 2014).</td>
</tr>
<tr>
<td></td>
<td>Topic researched:&lt;br&gt;- Group interaction</td>
<td></td>
</tr>
</tbody>
</table>
Appendix G: Apriori coding methods for social interaction and social support

I used several coding strategies for these data.

- **First Level Coding:** To characterize social interaction, I utilized a ‘splitting’ coding technique (Saldaña, 2013), and to characterize social support I used the ‘lumping’ coding technique.
  - **Descriptive coding:** Summarize the main topic of each conversation (e.g., type of session, changes in topic discussed, content discussed) (Saldaña, 2013).
    - **Purpose:** Note if the session was a support session or an education session led by a diabetes educator, the natural flow of a conversation, and if any new topics emerged in a discussion.
  - **Attribute coding:** Annotate the descriptive information (e.g., speaker name, location) in the conversation (Saldaña, 2013).
    - **Purpose:** Note the speakers in a conversation, where the conversation occurred. I used process coding to capture the interactions among participants (e.g., being friendly) (Saldaña, 2013).
  - **Emotion coding:** Capture the participant’s expressed emotions (Saldaña, 2013).
    - **Purpose:** Code the depth of the personal information shared and the statements of self-management behaviors and knowledge.

- **Second Level coding:** I utilized pattern coding (Saldaña, 2013) to identify patterns in the data about the instances of social interactions and social support among participants.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Variable</th>
<th>Coding Method</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Outcomes</td>
<td>Person &amp; Person Study Time</td>
<td>Attribute</td>
<td>Associate the spoken word, email, text-chat, or discussion board postings to each study participant and their time in study or healthcare provider.</td>
<td>Participant screen name Study Time Week</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>Attribute</td>
<td>Location of the conversation in the CME.</td>
<td>Bookstore Clothier</td>
</tr>
<tr>
<td></td>
<td>Conversation</td>
<td>Attribute</td>
<td>The origin of the transcribed text.</td>
<td>Text Chat Conversation</td>
</tr>
<tr>
<td></td>
<td>Session Type</td>
<td>Descriptive</td>
<td>The session in which the conversation occurred.</td>
<td>Education Support Group</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>Topic</td>
<td>Descriptive</td>
<td>Discussed topics among participants.</td>
<td>Assigned Emergent</td>
</tr>
<tr>
<td></td>
<td>Ties: Breadth</td>
<td>Descriptive</td>
<td>Changes in discussed topics.</td>
<td>Topic change</td>
</tr>
<tr>
<td></td>
<td>Ties: Depth</td>
<td>Emotion</td>
<td>Discussed personal information.</td>
<td>Sharing personal information</td>
</tr>
<tr>
<td></td>
<td>Participation</td>
<td>Descriptive</td>
<td>Participant was present but did not talk.</td>
<td>Present not talking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Management</td>
<td>• Descriptive • Process</td>
<td>Statements of behaviors, self-efficacy, T2D Knowledge, and perceived support for T2D management.</td>
<td>• Indication of knowledge • Lack of T2D knowledge • Self-efficacy for T2D self-management</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>CME</td>
<td>• Descriptive</td>
<td>Statements of feelings of co-presence.</td>
<td>• Co-presence</td>
<td></td>
</tr>
<tr>
<td>Social Support</td>
<td>Appraisal, Informational, Emotional, and Instrumental</td>
<td>The type of social support exchanged</td>
<td>• Appraisal support, Informational support</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* CME = computer-mediated environment; T2D = type 2 diabetes.
## Appendix H: Social support examples in a CME

Examples of the types of support in asynchronous and synchronous interactions and the resulting social support definition used for coding the textual data.

<table>
<thead>
<tr>
<th>Type of support</th>
<th>Asynchronous interactions in a CME (e.g., discussion-board posts, text-chat messages)</th>
<th>Synchronous interactions (e.g., support groups, telephone calls, and peer-to-peer interactions)</th>
<th>Code book (e.g., definition use for coding the transcribed text)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emotional</strong></td>
<td>- Encouragement, empathy, and prayer (Flickinger et al., 2016)</td>
<td>- Empathy about T2D struggles and challenges (Burkow et al., 2013; Greenhalgh, Collard, et al., 2011; Heisler &amp; Piette, 2005)</td>
<td>- Feelings of empathy, trust, caring, love, belongingness, and warmth when discussing T2D self-management or behaviors (Heaney &amp; Israel, 2008; van Dam et al., 2005)</td>
</tr>
<tr>
<td></td>
<td>- Empathy when discussing frustration or difficulty (Coulson, 2005; Mo &amp; Coulson, 2008)</td>
<td>- Relating to each other when discussing self-management (Boström et al., 2014)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Encouraging messages (Loader et al., 2002)</td>
<td></td>
<td>- Encouragement that provides support and friendship (Miller 2005)</td>
</tr>
<tr>
<td><strong>Appraisal</strong></td>
<td>- Communicating positive feedback for behaviors (Flickinger et al., 2016)</td>
<td>- Positive feedback about self-management (Greenhalgh, Collard, et al., 2011)</td>
<td>- An affirmational statement of praise for an enacted self-management behavior (e.g., exercising, eating healthy) that reinforces the participant’s behaviors (Gleeson-Kreig, 2008; Heaney &amp; Israel, 2008; Israel, 1982)</td>
</tr>
<tr>
<td></td>
<td>- Compliments or statements of praise about abilities (Coulson, 2005)</td>
<td>- Encouraging statements about T2D self-management when discussing personal strengths or enacted behaviors (Boström et al., 2014)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Positive assessments of one’s actions (Mo &amp; Coulson, 2008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Informational</strong></td>
<td>- Self-management advice, and knowledge (Flickinger et al., 2016; Loader et al., 2002; Mo &amp; Coulson, 2008)</td>
<td>- Information about self-management via personal narratives (Greenhalgh, Collard, et al., 2011)</td>
<td>- The exchange of T2D-specific information among individuals (Armstrong et al., 2012; Greenhalgh, Collard, et al., 2011; Heaney &amp; Israel, 2008; Heisler &amp; Piette, 2005)</td>
</tr>
<tr>
<td></td>
<td>- Symptom management and living with a chronic illness (Coulson, 2005)</td>
<td>- 'Real-world’ application of T2D self-management behaviors (Boström et al., 2014; Burkow et al., 2013)</td>
<td></td>
</tr>
<tr>
<td><strong>Instrumental</strong></td>
<td>- Emailing information (Coulson, 2005) or doing a task (Mo &amp; Coulson, 2008)</td>
<td>- Sharing resources to aid in T2D self-management (e.g., samples of food items during discussions of diet, sewing machines) (Greenhalgh, Collard, et al., 2011)</td>
<td>- The exchange of tangible goods or services related to T2D self-management (Heaney &amp; Israel, 2008)</td>
</tr>
<tr>
<td></td>
<td>- Fundraising requests (Loader et al., 2002)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

146
References


Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science and Medicine, 51*(6), 843-857. doi:[http://dx.doi.org/10.1016/S0277-9536(00)00065-4](http://dx.doi.org/10.1016/S0277-9536(00)00065-4)


158


Seymour, W. S. (2001). In the flesh or online? Exploring qualitative research methodologies. *Qualitative Research, 1*(2), 147-168. doi:10.1177/146879410100100203


Standards of Medical Care in Diabetes—2016. (2016). *Diabetes Care, 39*(Supplement 1), S4-S5. doi:10.2337/dc16-S003


Biography

Allison Ann Lewinski was born in 1980 and grew up in the suburbs of Detroit, Michigan. She is the daughter of Mary F. and Joseph Lewinski, and the sister of Adam J. Lewinski. Ms. Lewinski attended Birmingham Detroit Country Day School for high school where she fell in love with foreign language and travel. Ms. Lewinski graduated with a Bachelor of Science in Zoology from Michigan State University in 2003. In 2005, she graduated from the University of Michigan, School of Public Health with a Master of Public Health degree in Health Behavior and Health Communication. In 2007 she graduated from Maryville University in St. Louis with a Bachelor of Nursing and was inducted into Sigma Theta Tau at that time. Ms. Lewinski worked for 4.5 years as a critical care nurse before she enrolled in the Duke University School of Nursing PhD Program in August 2012. During the PhD program, Ms. Lewinski received funds from the National Institutes of Health – National Institute for Nursing Research, the Jonas Center for Nursing and Veterans Healthcare, the Duke University School of Nursing PhD Student Pilot Study Fund, and the North Carolina Foundation for Nursing Mary Lewis Wyche Fellowship. Additionally, Ms. Lewinski received Summer Research Funding from the Duke University Graduate School Alice Blackmore Hicks Fellows Endowment Fund and the Graduate Research Patent Royalties Fund. Ms. Lewinski received the Student of Year in 2015 from the North Carolina Nurses Association Triangle Region. Additionally, Ms. Lewinski published six articles during her tenure as a PhD student. Ms. Lewinski is involved in several professional organizations with a focus on interdisciplinary collaborations.