

Connected health: a review of the literature

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Abstract: The presence of social support, and more recently, connection, has been linked to multiple health benefits and longevity measures and the lack of connection is associated with premature morbidity and mortality. Connected health is a growing industry, and we were interested in determining whether or not scholars in the field have established the ways in which technology could facilitate or promote connection between patients and healthcare providers. This integrative literature review sought to collect and analyze research studies addressing social support or connection in a sample of patients with diabetes to evaluate the social support or connection metrics in use, the type of technology deployed by researchers to achieve connection, and to assess the state of the science in this area. We hypothesized that being connected to someone who cares is good for your health. We believe this holds true even when connection is accomplished with mobile technologies. Thirty five studies were included in this review, 21 utilized technology to enhance patient-provider connection. The articles included in this review were from a total of more than nine countries and took place in hospital, physician office, and community settings. They represented people from childhood through to old age. Technologies evaluated include: telephone interventions, email, text messaging, interactive voice response (IVR), video blogs, apps, websites, and social media. There were multiple operational definitions of social support and self-management used as variables within the studies. Findings from this review suggest that being connected does matter to patients with diabetes, and being connected to family matters the most, even though the associations are complex and not always predictable. Furthermore, patients with diabetes will utilize a variety of technologies to connect with healthcare providers, team members, and even other people with the same disease. The use of technology with diabetes patients positively impacts a variety of health outcomes, such as HbA1c, weight, physical activity, healthy eating, cholesterol and frequency of glycemic monitoring.

Keywords: Connected health; social support; health information technology (HIT); diabetes mellitus

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In 1998, a brave cardiologist named Dean Ornish published a book called *Love and Survival* with a straightforward hypothesis and went on to defend, with scientific evidence, the notion that “*love and intimacy are among the most powerful factors in health and illness*” (1). He boldly declared, “*I am not aware of any other factor in medicine—not diet, not smoking, not exercise, not stress, not genetics, not drugs, not surgery—that has a greater impact on our quality of life, incidence of illness, and premature death from all causes.*” In the nearly two decades since his seminal work was made available for the general public, patients and researchers alike have focused on the knowledge that the people we surround ourselves

with, providing support and being supported, matters deeply to our health and well-being. This field of inquiry has firmly established the criticality of social relationships for sustaining and improving health (2) and associated the lack of social integration with specific conditions such as cardiovascular disease, depression, cancer, infection, and mortality (3). Newer analytical techniques such as social network analysis are helping a fresh generation of researchers explore patterns of social connectedness through innovative procedures and algorithms that further expand our understanding.

For the purpose of this review, social support is defined as

the various types of support or help people receive from others. Social support is generally classified into major categories such as emotional or instrumental support (4). Connection is included as a variable of interest as it reflects an emerging science and methodological route to discovering the impact of social support. It is possible that “connected health” describes today what social support was yesterday; when typed into a search engine, Google returns 156 million results. While it tends to be used interchangeably in modern parlance, the Merriam-Webster dictionary defines connection as “*The act of connecting two or more things or the state of being connected; a situation in which two or more things have the same cause, origin, goal.*” American researcher Brène Brown’s (5) definition of connection allows us to more clearly see the joining of the two concepts. Connection, she writes is “*the energy that exists between people when they feel seen, heard, and valued; when they can give and receive without judgment; and when they derive sustenance and strength from the relationship.*” Future research will undoubtedly focus on refining definitions that are so critical to our understanding of human health and wellness.

Connected health, which has its own URL managed by HIMMS (himssconnectedhealth.org) and twitter handle, is advancing an agenda to transform care delivery and create opportunities for self-management through the use of technology. Federal Meaningful Use standards, for example promote the use of health information technology (HIT) such as patient portals and secure email with a healthcare provider to promote the goals of enhanced patient and family engagement and supporting care coordination (6). The connected health movement relies fundamentally on patient-facing devices and technology, promising to support patients in their proactive, self-management efforts. Medical devices, purchasable over-the-counter, predate the connected-health movement and include blood pressure monitors and blood glucose meters. They were among the first devices to be connected through Bluetooth™ technology, transferring data to the cloud where it could be shared. There is increasing awareness that the newly liberated data produced by these re-appropriated devices, not traditionally available to healthcare providers, may have clinical utility. As a result, a plethora of connected products are making their way to market, including electrocardiographs, step and activity counters, sleep monitors, and calorie counters (7). As more and more technology is infused into our healthcare system, various authors have argued the merits of technology to support and connect patients, providers, and family caregivers. For the most part, their usefulness and accuracy have not yet been adequately established. The healthcare

system will inevitably see more technological enhancements as a new generation of “digital native” consumers and practitioners permeate the system and researchers ought to work alongside them.

The goal of this integrative literature review was to identify and analyze research focused on the social support, or connection experienced by people with diabetes as they journey along a path of self-management. The hypothesis was that being connected to someone who cares is good for your health. Specific aims included: (I) describing the social support or connection metrics in use; (II) describing the types of HIT employed by the research community, if any, to connect patients and providers; and to (III) assess the state of the science in this area.

Conceptual framework

Diabetes is a chronic, non-infectious disease affecting over 29 million Americans, more than 9% of the population. It is the seventh leading cause of death and contributes greatly to morbidities such as hypertension, dyslipidemia, cardiovascular disease and death, heart attacks, strokes, kidney disease, blindness, and amputations. Diabetes management costs the United States an astounding \$245 billion each year (8). One of the best ways to protect against the long-term devastating effects of diabetes is for a patient and family to engage in rigorous self-management. Ryan *et al.* (9-11) developed the Individual and Family Self-Management Theory (IFSMT) to outline the “process by which individuals and families use knowledge and beliefs, self-regulation skills and abilities, and social facilitation to achieve health-related outcomes” (10). Their model provides the conceptual framework for this review (*Figure 1*). Specifically, (I) the constructs social capital, social influence, and support were used to identify the problem and outline inclusion criteria for the review; (II) the range of evaluation outcomes (from engagement to health status and quality of life) encouraged the inclusion of a variety of studies that defined self-management as an outcome in broad terms; and (III) the emphasis on social elements in multiple places in the model deepened the understanding of social support versus connection that is discussed throughout this article.

Methods

Whittemore and Knafl (12) outline a process for conducting an integrative review of the literature, which facilitates the inclusion of multiple perspectives and diverse

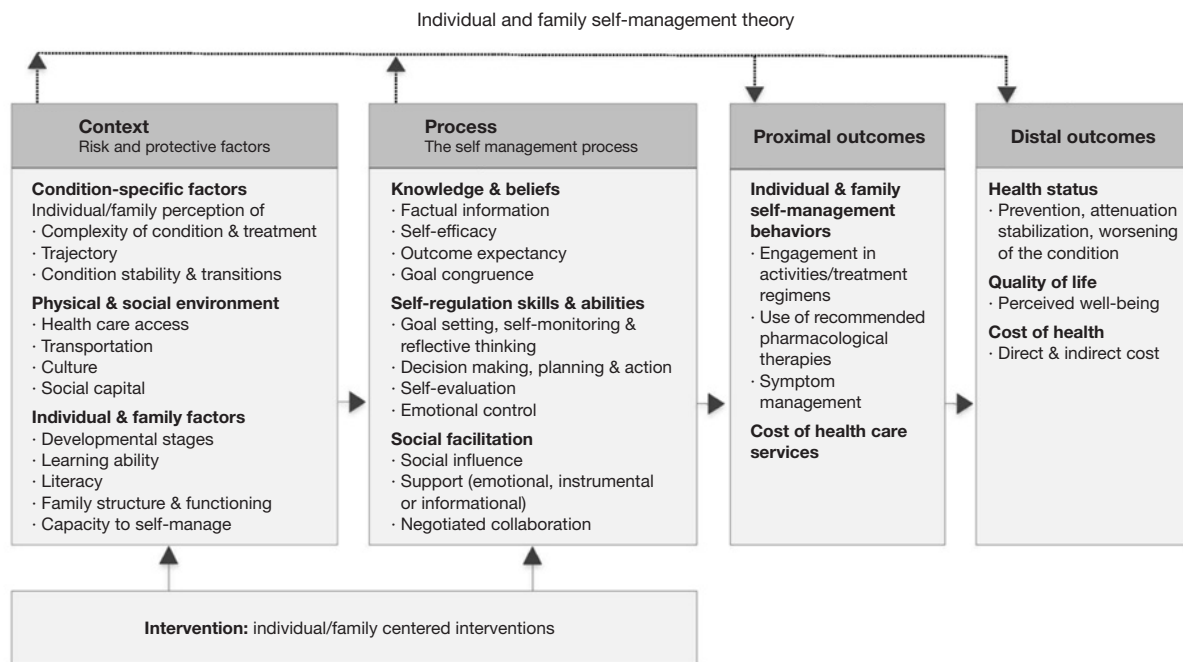


Figure 1 The individual and family self-management theory. Ryan & Sawin, 2014 (<https://uwm.edu/nursing/about/centers-institutes/self-management/theory/>).

methodologies that in turn supports developing knowledge in emerging practice areas. The five steps used in this project were: problem identification, literature search, data evaluation, analysis, and presentation.

This review covered a 5-year period between 2009 and 2015. The databases searched were CINAHL (EBSCO Information Services, Ipswich, MA), PsychInfo (American Psychological Association, Washington, DC), and PubMed (National Library of Medicine, Washington, DC). Keywords used for searches focused on “diabetes” and “connect” or “social support” and “technology” (The term “health information technology” more commonly used to describe technology used in healthcare settings has not been formally mapped to each of three databases utilized in this review. Therefore, the more general term “technology” was used.). Recent studies published in peer reviewed, English-language journals that included adult research participants were included. Worldwide research was considered. Studies performed prior to September, 2009 were excluded because of the rapidly changing nature of the technology field.

The literature search revealed 145 articles. Some articles were rejected immediately upon reviewing an abstract because they did not fit the search criteria. A large number of abstracts contained the term “social support” without ever having measured or defined social support as a variable within

the study. Generous leeway was extended to include proxy measures for social support or connection but when the study clearly did not address either construct, the article was excluded. Ninety five remaining articles were read in their entirety to assess for inclusion. After the first reading, a total of 60 studies were rejected for a variety of reasons: when they described a special population with diabetes (e.g., neonates, people with serious mental illness or disabilities), did not use social support as a variable of interest, were reviews or duplicates (*Table 1*). In short, articles were included if they used social support or connection to assess a health outcome in the population of people with diagnosed diabetes, with or without using technology. This left a total of 35 articles included in the review. There were 15 (43%) descriptive or observational studies (13-27), 4 (11%) design or development studies (28-31), 3 (9%) quasi-experimental studies (2,32,33), 7 (20%) randomized controlled trials (34-40), and 6 (17%) qualitative studies (41-46) included in the review.

Articles were read multiple times. A master matrix was created with key research components so that cross-case comparisons about design, sample, setting, and results could be made. From the matrix and the articles, multiple data displays (47) were created to explore various methodological issues of interest such as sample, setting, operational definitions, technology type, and findings.

Table 1 Article rejection reasons

Reason for exclusion	Number
Literature reviews	12
Editorials or commentaries	4
Program evaluations or white papers	2
Descriptions of pilots, feasibility only	4
Not relevant to RQ	27
Non-diabetes population	7
Special population	3
Duplicates	1
Total	60

Results

Data matrices were used to examine all 35 articles, compare them, and analyze results. Frequencies and summaries were tabulated as appropriate. A content analysis approach (48) was used to synthesize findings and answer the research questions. In keeping with the research questions of this review as well as the integrative approach, this section includes the patterns of technology use by the patient community as well as findings pertinent to the state of the science.

Sample

The 35 articles included samples that spanned ages from childhood and adolescents (n=4, 11%) through to older adults (n=3, 9%), the majority focusing on the adult population (n=28, 80%). Several small studies (focus groups, etc.) did not include information on the average age of participants and others provided information in a way that did not allow for extrapolation (e.g., a percentage of ages within a category). These studies represent patients of a variety of ages (Table 2). Females are well represented in this body of research. Studies tended to include largely all-white populations or be focused on specific non-white populations. Interestingly, studies performed outside of the US had a higher rate of non-reporting of race (n=9, 82%) than studies performed within the US (n=10, 42%). Two studies (6%) reported ethnicity instead of race (15,18).

Setting

The included studies were performed in a variety of countries (Figure 2): 1 (3%) each from China (36), South

Africa (32), South Korea (28), and the UK (43), 2 (6%) from Norway (25,31) and Taiwan (13,21), 3 (9%) from Canada (29,30,34), 4 (11%) from Australia (24,26,37,41), and 18 (51%) from the US (2,15-20,22,23,27,33,35,38-40,42,44,45). Two studies (6%) recruited participants from the World Wide Web and were therefore considered to be conducted in multiple countries (14,46). Only two studies (6%) recruited participants from hospital settings. Eleven studies (31%) recruited participants from the physician-office and 22 (63%) from the community.

Operational definitions

Social support was never formally defined in any of the 35 articles, although the concept was referenced liberally. Articles were included in this review when they assessed either social support or connection against a health outcome. As a result, some of the studies reported a social support measure and others assessed connection in different ways, 7 (20%) were judged to include both. Nonetheless, the instruments used to assess variables in these studies were diverse and are outlined in Table 3. To measure social support, 3 studies (9%) used author-defined scales, 4 (11%) used semi-structured interview questions, and 1 (3%) used field observation techniques. Connection measures (n=19, 54%) were focused on utilization rates (e.g., encounters with a coach, posts to an online community, texts to a peer supporter). Often the outcome measure of self-management or self-care was loosely defined.

Technology use

The types of technology utilized in the studies varied greatly. Several studies used simple technologies such as the telephone, email messages, or text messaging. Others utilized website or mobile phone applications. IVR, a system whereby the patient interacts with a pre-recorded, automated, voice-mail message, was tested in one study (17). One study (46) evaluated video blogs (vlogs) posted to YouTube, and three other studies evaluated the use of online forums (like Twitter) and other social network platforms (14,22,28). Fourteen studies (40%) did not use any technology (Table 4).

Selected findings

Selected findings related to the impact of social support and/or connection to health outcomes are presented in Table 5.

Table 2 Sample

Lead author, date	Sample	Age, average	Sex, % female	Race, % white
Children and adolescents				
Balkhi, 2013	102 parents of children with DM-1	40	92	93 ¹
Cafazzo, 2012	20 adolescents with DM-1	NR	NR	NR
Carcone, 2011	141 adolescents with DM-1 or DM-2 (IDDM)	NR	NR	NR
Hackworth, 2007	123 adolescents with DM-1	16	NR	NR
Adults				
Battista, 2011	101 adults with DM-1 or DM-2	59–60	71	NR
Cassimatis, 2014	13 adults with DM-1 or DM-2	NR	NR	NR
Chan, 2014	628 adults with DM-2	54	43	NR
Chomutare, 2013	7 adults with DM-2	62	71	NR
Ciechanowski, 2010	3,535 adults with DM-1 or DM-2	NR	54	81
Eakin, 2014	3,012 adults with DM-2	57	16	86
Fischer, 2012	47 adults with DM-2	40–49	64	12
Fortman, 2015	766 adults with DM-1 or DM-2	55	65	NR
Frosch, 2011	201 adults with DM-2	55	43	18
Fukuoka, 2011	35 adult with DM-2	51	57	54
Gunn, 2012	45 adults with DM-1 or DM-2	NR	19	NR
Huang, 2012	127 adults with DM-2	54–59	40	NR
Huh, 2014	72 video blogs posted to Utube	NR	NR	NR
Karlson, 2011	425 adults with DM-2	58	46	NR
Kim, 2014	Participants in social HealthTWITTER initiative	NR	NR	NR
King, 2010	463 adults with DM-2	60	50	NR ²
Koh	331 women with DM-2 and hx of gestational DM	33	100	NR
Lee, 2014	Members of a Facebook page in rural, underserved area	NR	NR	NR
Nishita, 2012	190 adults with DM-1 or DM-2	48	62	>29 ³
Nundy, 2013	18 adults with DM-2	40–54	100	0
Okura, 2009	1,097 adults with DM-1 or DM-2	69	51	80
Piette, 2013	727 adults with DM-2 or depression	61	30	78
Ramal, 2012	27 adults with DM-2	NR	77	NR ⁴
Rosland, 2010	439 adults with DM-1 or DM-2 or HF	NR	46	≤87 ⁵
Rotheram-Borus, 2012	22 adults with DM-1 or DM-2	53	100	0
Smith, 2000	30 adults with DM-1 or DM-2	46	100	–
Turner, 2013	41 adults with DM-1 or DM-2	NR	61	≤20
Venkatesh, 2013	30 adults with DM-2	NR	46	NR
Older adults				
Bai, 2009	165 older adults (≥65) with DM-2	65–69	47	NR
Bond, 2010	62 older adults with DM- or DM-2	66	NR	NR
Dunkler, 2014	6,972 older adults with DM-2 & CKD	66	31	68

¹, 5% Hispanic; ², 21% Hispanic; ³, estimate based on % of Asians; ⁴, 100% Hispanic; ⁵, estimate based on % of non-Caucasians. NR, not reported; HF, heart failure; CKD, chronic kidney disease.

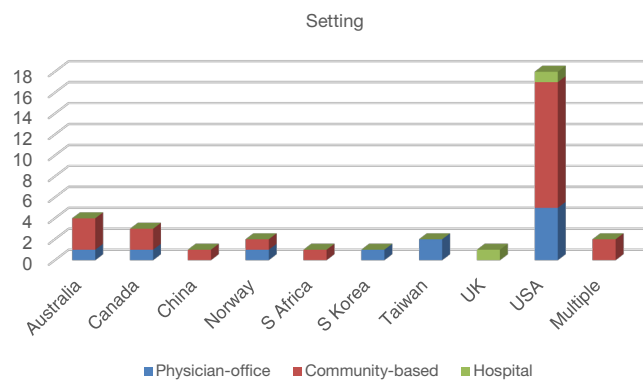


Figure 2 Settings where research was performed.

Social support is significantly positively correlated with self-care behavior (15,21), taking diabetes medication (13), physical activity (13,26,44), and significantly negatively correlated with diabetes distress (25), as well as reductions in body mass index (39) and HbA1c (2,16,45).

Connection is related to improved glycemic control (34), improved depression and quality of life (35), and reductions in HbA1C (31,36,38). In general connection is correlated with self-care activities in adolescents (30), improves weight loss through a telephone intervention (37), and is experienced when a family member remains vigilant (43). The number of social connections was negatively correlated

Table 3 Operational definitions

Study (lead author, date)	Social support measure(s)	Connected measure(s)	Health outcome(s)
Bai, 2009	Personal resource questionnaire	–	Self-care behavior (diabetes self-care)
Balkhi, 2013	Author-created scale	Forum membership (number of unique forums a parent was a member of)	–
Battista, 2011	–	Telephone coaching with dietician	HbA1C; weight and BMI; waist circumference
Bond, 2010	Diabetes support scale; diabetes empowerment scale	–	QOL (problem areas in diabetes scale); depression (center for epidemiological studies depression scale)
Cafazzo, 2012	–	Participation in an online community	Logged daily blood glucose readings with iPhone app
Carcone, 2011	Diabetes social support questionnaire—family, friends, parent; measure of process of care; diabetes management scale	–	Blood glucose monitoring (downloaded # of records from blood glucose meters); HbA1C
Cassimatis, 2014	Semi-structured interviews	–	DM self-care practices, specifically exercise and healthy eating
Chan, 2014	Euroqol (EQ-5D); patient health questionnaire (PHQ-9); depression anxiety stress scale for psychological distress (DASS-21); diabetes empowerment scale for self-efficacy (DES-20); Chinese diabetes distress scale (CDDS-15)	Maintaining contact with RN peer supporter	HbA1C; % patients meeting goals (HbA1C, BP, LDL)
Chomutare, 2013	Researcher observation	Utilization of smart phone app	HbA1C; blood glucose
Ciechanowski, 2010	–	Relationship Style Questionnaire	Mortality
Dunkler, 2014	–	Physical social network (# social interactions and personal relationships created a social network score)	Chronic kidney disease progression (more than 5%/year decline in GFR or progression to end-stage renal disease); microalbuminuria
Eakin, 2014	–	Utilization of telephone counseling	Weight; moderate; intensity PA; HbA1C

Table 3 (continued)

Table 3 (continued)

Study (lead author, date)	Social support measure(s)	Connected measure(s)	Health outcome(s)
Fischer, 2012	Focus group discussion	Appointment rates; response rates to TXT messages	Logging daily blood glucose readings
Fortman, 2015	Cohen social network index; interpersonal support evaluation list	–	HbA1C
Frosch, 2011	–	Telephone coaching with nurse educator	HbA1C
Fukuoka, 2011	Focus group discussion	–	Mobile phone use
Gunn, 2012	Semi-structured interviews	–	Self-management (author defined)
Hackworth, 2007	Author-created questionnaire	–	Self-management, specifically better metabolic control and mental health (diabetes self-care inventory)
Huang, 2012	Social support scale	–	Self-care (self-care behavior)
Huh, 2014	–	Use of video blogs (vlogs)	Self-management (author defined)
Karlson, 2011	Patient questionnaire on empowerment; diabetes family behaviour checklist	–	Diabetes-related distress (problem areas in diabetes)
Kim, 2014	–	Utilization of social networking app between patient and provider	Health management (author defined, theory based)
King, 2010	Patient assessment of chronic illness care, chronic illness resources survey	–	BMI; BP; lipids; HbA1C; 10-year risk score
Koh, 2010	Author-created questionnaire	–	Physical activity (active australia questionnaire); activity logs
Lee, 2014	–	Utilization of website	Self-management (author defined)
Nishita, 2012	–	Utilization of individual self-directed support from life coach and pharmacist	Self-efficacy (diabetes empowerment scale); QOL (WHO QOL); BMI; HBA1C
Nundy, 2012	Semi-structured interviews	Response rate to text messages	Self-management
Okura, 2009	Diabetes care profile	–	HBA1C
Piette, 2013	–	Utilization of interactive voice response system	Self-management (assessment call)
Ramal, 2012	Focus group discussion	–	Self-management
Rosland, 2010	Family APGAR; author-create scale	–	Self-management adherence (survey of diabetes self-care activities)
Rotheram-Borus, 2012	–	Utilization/communication with a buddy for peer support	BMI; blood glucose; emotional distress and styles of coping (brief symptom inventory)
Smith, 2000	Attitude survey; personal resource questionnaire; social readjustment rating scale; psychosocial adjustment of illness scale (PAIS)	Computer use (utilization of various features including a mailbox, healthchat, conversation and resource rack)	HbA1C; quality of life (quality of life index)
Turner, 2013	Messages containing emotionally supportive content	Utilization of system	Hb1AC
Venkatesh, 2013	Semi-structured interviews	–	Hb1aC

Table 4 Types of technology utilized in studies

Technology type	N
Email	1
IVR	1
Video blogs	1
Blood glucose meters	2
Text messaging	2
Online forums/social network	3
Telephone	3
Website	4
Mobile app	4
None	14
Total	35

with chronic kidney disease progression (14). Ciechanowski and colleagues (27) found that those who were least connected has a greater risk of death.

Three studies (n=3, 9%) furthered our appreciation of the complexity of connection, especially when family was used to provide social support. Connections or social interactions were found to either improve or limit self-management in patients with diabetes depending on whether or not the adult felt supported (18). Rosland and colleagues (19) noted that women receive less family support than men do and also report more barriers to self-management than men. When caregivers of patients with diabetes are supported, the patient experiences better self-management (20).

Table 5 Selected findings

Lead author, date	Findings
Bai, 2009	Social support is significantly (↑) correlated with self-care behavior
Balkhi, 2013	102 parents of children with IDDM used online forums for social support and knowledge; biggest benefit was social support
Battista, 2011	Coaching by a dietician improves glycemic control (significantly ↓ in HbA1c) and improved energy
Bond, 2010	A web based intervention for older adults showed significantly improvements to depression, QOL, social support, and self-efficacy
Cafazzo, 2012	Adolescents with IDDM who used mHealth intervention to track glucose and insulin in Canada saw significantly increase in daily glucose readings, saw improvements to QOL
Carcone, 2011	Support for the caregiver from another adult was related to better diabetes management in the loved one with diabetes
Cassimiatis, 2014	Participants in studies with technology reported satisfaction with the intervention when using an online (web-based) self-management program because it helped to support them when “feeling down” and helped them connect with healthcare professionals
Chan, 2014	628 patients with DM-2 from three public hospitals had reductions in HgA1C with the use of a peer-based telephone support program, and also reduced negative emotions associated with DM management
Chomutare, 2013	Adults in Norway who used mobile phones to access a social media-like app to manage DM saw decreases in HgA1C and significantly decreases in blood glucose levels during feasibility test
Ciechanowski, 2010	Those who were not connected (independent relationship style) had a greater risk of death
Dunkler, 2014	The number of social interactions and personal relationships within one’s social network positively affected progression of chronic kidney disease
Eakin, 2014	Telephone delivered weight loss and physical activity intervention helped 3,000+ Australians with DM achieve significantly weight loss, increase physical activity, improved diet quality and waist circumference
Fischer, 2012	Adults engaged with text messaging between routine clinic appointments reported increased social support, feeling accountable, and awareness of health information
Fortman, 2015	Higher levels of function support significantly related to poorer glycemic control in Hispanics

Table 5 (continued)

Table 5 (continued)

Lead author, date	Findings
Frosch, 2011	Significantly (\downarrow) in HbA1C at 6 months, behavioral measures improved over time in both control and intervention
Fukuoka, 2011	Participants in studies with technology reported satisfaction with the intervention when using mobile phones and text messaging because of the “real time” peer support from other participants and the ability to connect with a healthcare professional
Gunn, 2012	Family members help people with diabetes by remaining vigilant, influencing self-management practices, and being directly involved with clinical care
Hackworth, 2007	1 Social support and community involvement is (\uparrow) correlated* with self-care activities in adolescents with diabetes
Huang, 2012	Patients who took DM medication and engaged in regular exercise and dieting had more social support than those who only did one of the three
Huh, 2014	People use video blogs (vlogs) to journal, help others, and respond to others, and for entertainment, allowing users to expand their social network, providing needed social support
Karlson, 2011	Social support is significantly (\downarrow) correlated with diabetes distress
Kim, 2014	80% of participants in a DM education camp intended to use social network app
King, 2010	Self-efficacy, problem solving skills, and social support increased the variance accounted for in self-management variables in a statistical model
Koh, 2010	Social support and self-efficacy were significantly associated with health-enhancing physical activity
Lee, 2014	Patients with DM will use a Facebook site for information about DM management
Nishita, 2012	Social support has a positive effect on self-efficacy, QOL, BMI but not HgA1C
Nundy, 2013	Women with gestational diabetes who engaged in more physical activity (to reduce risk of developing diabetes) had higher social support scores
Okura, 2009	People with high levels of social support had significantly lower odds of having higher HbA1C
Piette, 2013	285 patients with diabetes at the VA completed 83% of assessments initiated by an interactive voice response (IVR) system, indicating willingness to utilize technology to connect with healthcare providers involved in caring for diabetes
Ramal, 2012	Social interactions either enhanced or limited self-management depending on whether or not the adult with diabetes felt supported
Rosland, 2010	68% of patients with diabetes report supportive family involvement. Women receive less support than men and women report more barriers than men. Both social support and barriers to social support significantly correlated with self-management adherence
Rotheram, 2012	Women participating in a “diabetes buddies” program in South Africa used mobile phones with text messaging to support each other through a diabetes self-management program. Older and severely ill women used it the most
Smith, 2000	Rural women who tested a telecommunications program to deliver education said the program provided social support and gave them a sense of connectedness, facilitating its use
Turner, 2013	An increase of supportive messages delivered via text messaging was associated with a significantly \downarrow in HgA1C. Among Alaska Natives, American Indians and Aleuts, a web-based self-management system with text messaging for social support resulted in a significantly \downarrow in HgA1C but not in any health outcomes at 6 months
Venkatesh, 2013	Patients with HgA1C in the acceptable range ($\geq 7\%$) were more likely to have received family support for lifestyle changes and have a family member with a medical background

*, subsequent structural equation modeling was not significant.

Several studies (n=3, 9%) confirmed that patients, even elderly and sick patients, will use technology to connect with healthcare providers and others with the same condition (17,28,29). Social support was cited as the greatest benefit of an online forum (22,41), of text messages delivered between clinic encounters (33) and among peers (40,42,49) and with vlogs (46).

Discussion

The goal of this integrative literature review was evaluate research that attempted to change a health outcome by the provision of social support or connection, and to assess the ways in which they were successful. Sixty percent (n=21) of the studies included in this review used some form of technology to facilitate or enhance human connection. Findings that support the hypothesis, being connected to someone who cares is good for your health, will be discussed below in six subheadings, in keeping with the presentation style common to content analysis (47,50). These content areas address the first and second specific aims of this review. In the seventh and final subheading, the state of the science is addressed.

Being connected matters

The findings from this study suggest that being connected matters. In qualitative studies, when asked what factors are motivating for self-management activities, participants describe the social support they receive from their friends (51). People from all sociodemographic categories will go to great lengths utilizing unfamiliar technology because it helps them to connect with their healthcare providers and with others who manage the same condition as themselves. Connection is so important, in fact, that people who do not have robust social networks suffer adverse outcomes such as worsening disease states (14) and even premature death (41). Hence, “the social in medicine” as defined by Ljungdahl & Moller (52) has become a legitimate field of study. They explain that with “*the WHO development of the bio-psycho-social model of health, the social was identified as a cause of people’s health condition ... An awareness of social factors influencing people’s mental and physical health grew from the statistical research pointing out that strong association between social position and health status. From this it followed that the endeavor of health promotion must be to ... design intervention programs that would take these social factors into account.*” It is no surprise then, that both the scholarly

and popular literature (53,54) which measure the impact of being connected and supported to one’s health, are growing in popularity. The findings of this review support the notion that being connected to someone who cares, whether a layperson or a healthcare professional, matters. Future work in the field, then, ought to plan for social support and/or connection as a variable of interest when evaluating self-management strategies.

Connection to family matters the most

People experience support in numerous ways. Typically social support behavior is categorized in terms of being emotional (e.g., expressions of love or caring), instrumental (e.g., taking a casserole to a sick neighbor), informational (e.g., receiving advice or suggestions on parenting), or appraisal (e.g., someone asks you to recall the times you have been successful at meeting challenges in the past to summon the courage to move forward). While patients value support in all forms from their doctors and healthcare providers, it is social support from family that appears to matter the most. Particularly in people with diabetes, support from a loved one is related to better disease management. Family members undoubtedly help in numerous ways, but due to the complexity of diabetes self-management, supportive family members can directly influence practices such as taking medications, preparing healthy foods, or recording insulin levels. Families help by being directly involved in care (instrumental support) and by remaining vigilant (emotional and informational support) (43). In fact, people who have good glycemic control (e.g., HbA1C scores >7%) are more likely to have received family support for lifestyle changes and have a family member with some type of medical background (45) than those with poor glycemic control. These findings suggest that research focused on ways to support family members with chronic disease may be a sound strategy for improving the health of the chronically ill.

Connection is complex

Nonetheless, connection is complex and we ought to be cautious in assuming that all support is good support. Emerging research suggests that the support provided by a family member is judged to be supportive or not supportive by the patient, and that summative verdict changes outcomes (18). This finding might help to explain the plethora of standardized instruments used to measure social

support; each one trying to define support in just the right way from the patient and family perspective. Furthermore, there are striking implications from Fortman's work (23) which suggest that supporting the caregiver of the patient with diabetes has an impact on glycemic control, and not always a positive one (to ascertain why, it might be helpful to think of grandma who lovingly "supports" her family with a constant stream of cakes and cookies). This is reminiscent of the "three degrees of influence" that Christakis and Fowler (54-57) write about, whereby we commonly influence not only the people directly within our social network, but their friends, and their friend's friends, as well. This is a virtually untapped area of scholarly research in the realm of chronic disease self-management and its implications have the potential to be incredibly powerful. The power of these findings suggest that social network theory ought to be taught in schools of public health, nursing, medicine, engineering, and informatics where technological solutions are conceived and developed.

Technology supports connection

The variety of techniques demonstrated in this body of research to support connection can be celebrated. Within these studies, there are nurse coaches, dietician coaches, family support, text messages, phone calls, interactive voice mails, nurse-mediated discussion forums, elaborately developed web content, Facebook pages, Twitter accounts, email messages and video blogs. The blend of traditional approaches with modern technology, however seemingly simple, was varied and thoughtfully constructed. Each serves to embrace the patient and make her feel as though she is being supported between office visits. Technology in this way can be seen as an extension of the healthcare provider. In a system that affords an American physician, on average 10 to 15 minutes per patient encounter (58,59), technology has the potential to extend the time spent with one's doctor beyond the confines of the examination room. In a healthcare system that is focused on patient experience, technology has the potential to play an important part in patient perception and satisfaction.

Patients will use technology to connect

It is encouraging that patients are willing to interact with their healthcare teams in this way with technology, even if the technology appears to be as simple as answering the

phone or replying to a text message. We learned from multiple studies performed with vulnerable populations that technology has the potential to level the playing field and bring much needed healthcare resources (emotional and informational support) to people in rural or socio-demographically disadvantaged regions. The fact that this holds true even for aged and racially diverse samples should encourage the use of technology in future research with disparate populations.

Connection with technology changes outcomes

In the population of patients with diabetes, moving the HbA1c to an acceptable range is one of the most meaningful things you can do to ensure long-term control of the disease with minimal risks and side-effects. Several studies demonstrated a positive impact on glycemic control with the use of technology to support patients in self-management; Turner and Rotheram-Borus (2,49) used supportive messages delivered by text messages, Chan *et al.* (36) used a telephone-based peer support system, Chomutare *et al.* (31) tested a social-media app on a smart phone, a specialized app helped adolescents in Canada to increase the number of daily blood glucose readings. Other related outcome variables also showed positive movement; Eakin's (37) participants achieved weight loss and increased physical activity with a telephone-delivered program and Fukuoka's (42) participants achieved weight loss, reductions in hip circumference, blood pressure and total cholesterol with a web-based program that was combined with in-person and telephone support. Technology studies have struggled in the past to move the needle on health-related outcomes, and so these results are encouraging and embolden future testing.

Connected Health is ready for testing

One of the goals of this literature review was to assess the state of the science. Prominent nurse researchers (60) suggest that disciplinary knowledge is built by first identifying and describing phenomena of interest and then by discovery through progressive levels of exploration, explanation, and prediction as knowledge and evidence is amassed. Identification research seeks to identify and name the phenomenon of interest. Description research seeks to define the prevalence, characteristics, frequency, or importance of the phenomena. Exploration research defines factors related to the phenomena (e.g., antecedents, process

of experience, the nature of its evolution). Research in the explanation stage seeks to unearth underlying causes, causal pathways, theoretical explanations, meaning, or why a phenomenon exists. Finally, prediction and control research determines causation, directionality, the prevention or control of phenomena (60,61). In this sample of 35 articles, there were: 1 study (3%) at the identification level, 3 (9%) at the descriptive level, 22 (63%) at the exploration level, and 9 (26%) at the prediction level. The state of the science then, is firmly grounded in the exploratory level of knowledge, defining factors related to social support, connection, and health outcomes, seeking to understand the relationships between variables. The volume of exploratory research suggests that we are ready to move toward testing interventions that utilize these phenomena to achieve desired outcomes.

However, several factors may hinder our efforts. First, there is a lack of standardization when it comes to defining and measuring the phenomena of social support and connection. The research community would quicken the testing and dissemination of methods and findings if there were agreement on relevant definitions and standardized instruments of measurement. Second, self-management is a complex construct that does not lend itself to easy partitioning. We likely need more sophisticated study designs if we are to adequately assess which element of a comprehensive program is affecting the outcome (62), asking how exactly do the “*interventions impact the psychosocial aspects of the lives of people with diabetes?*” (63). Third, very few studies made use of a guiding theoretical framework, and none were judged to be in the explanatory stage. Social support is often seen as both a problem and a solution. Self-management is often seen as a process variable and an outcome measure. These facts alone suggest that we do not fully understand the phenomenon we are attempting to predict and control through randomized controlled trials. Authors such as Christakis, Fowler, and Pinker have convinced us that the science of connection is nuanced and complex, and that the people in our social networks influence us in a multitude of profound ways. There is an opportunity for future researchers to conduct theoretical work that will serve to advance the state of the science.

Limitations

The limitations of this study include (I) the possibility that studies were unintentionally left out of the sample or

inappropriate inclusion of studies that biased results; (II) failure to search other, relevant databases; (III) a limited 5-year time span; (IV) publication bias; (V) improper definition of terms used in the search; and (VI) the potential of reviewer bias.

Conclusions

The research studies collected in this integrative review serve to underscore the importance of social support and connection in patients with diabetes as they journey through their life’s work of self-managing chronic disease. Clearly, being connected to someone who cares is good for your health. Implications for practice include a willingness to utilize technology to reach patients between appointments, and ensuring appropriate family support mechanisms are in place through suitable patient and family engagement strategies. Members of the HIT community are well positioned to support this work as varied patient populations in a variety of countries and settings have shown a willingness to utilize HIT to connect with each other and with their healthcare providers.

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Footnote

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