The Impact of Health Literacy on Clinical Outcomes for Adults with Type 2 Diabetes Mellitus

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Abstract Health literacy is a measure of patient's ability to read, comprehend, and act on medical instructions. Health care literacy entails being able to obtain, process, and understand basic health information and services needed to make appropriate health decisions. Limited health literacy is associated with poor self-management of Type 2 Diabetes [1]. Limited health literacy is common among vulnerable populations including racial and ethnic minorities, the poor, elderly persons, and patients with chronic conditions. Health literacy is a stronger predictor of a person's health than age, income, employment status, education level, and race [18].The objectives of this research his to examine current studies for the impact of health literacy on clinical outcomes for Adults with Type 2 Diabetes. Self-monitoring of blood glucose is a clinical outcome determined to be a vital component of self-management therapy for Type 2 Diabetes Mellitus. From the literature search four homogeneous articles that have confirmed an association between health literacy and glycemic control were selected for a Meta-Analysis to determine the strength of this correlation. The research will highlight vulnerable populations of at risk for low healthcare literacy which may present barriers for effective Diabetes self-management and offer strategies for reducing those barriers. The purpose of this meta-analysis is to test the strength of previously publish correlations of homogenous studies using TOFLHA as the literacy measurement tool. As the focus on health literacy research does not neatly fall within a health literacy framework as several measures for health literacy measure a combination of print and numeracy skills. Some studies measure literacy as numeracy or oral literacy. The meta analysis is of studies using TOFHLA which is recognized as the tool for health literacy measurement

Keywords Diabetes, Health Literacy, Glycemic Control, Self-Monitoring Blood Glucose, TOFLHA

1. Introduction

1.1. Background

Often people with chronic illnesses have the least access to health care information that they can understand.[22], defined health literacy as the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions. [17]. further defines health literacy as the ability to apply reading, listening, speaking, analytic, decision-making, and numeracy skills to health situations. Health literacy for Diabetes self-management affects the patient's ability to understand instructions on prescription drug bottles, appointment slips, medical education brochures, physician directions, and consent forms. In addition to evidence based interventions, social economic status, and demographic factors including ethnicity, all impact a patient's health literacy skills and their ability to improve diabetic health outcomes with self-care management activities [13].According to the American Medical Association report, "Health Literacy and Patient Safety: Help Patients Understand," poor health literacy is a stronger predictor of a person's health than age, income, employment status, education level, and race [18]. Low health literacy may also have negative psychological effects. One study found that those with limited health literacy skills reported a sense of shame about their skill level. As a result, they may hide reading or vocabulary difficulties to maintain their dignity [20].

The research questions addressed in this paper are "What impact does health literacy has on Type 2 Diabetes clinical outcomes?" Secondly, "How strong is the correlation of health literacy for improving Type 2 Diabetes clinical outcomes?" The objective of this paper was to assess the published literature for research on health literacy's impact on health outcomes for Type 2Diabetics to answer these research questions.
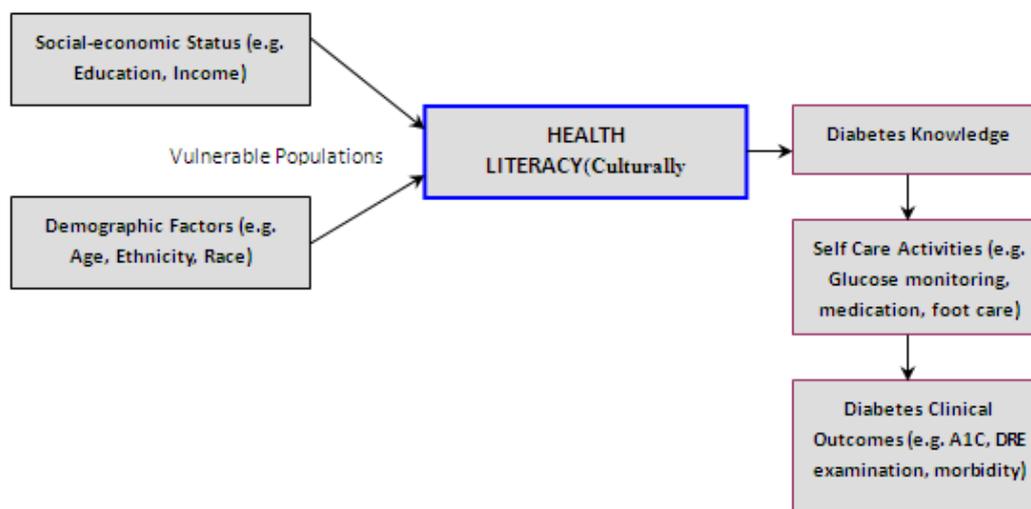
Figure 1. Conceptual framework of Social Economic and Demographic factors, Health Literacy, and Type 2 Diabetes Clinical Outcomes

Furthermore, research demonstrated health literacy is affected by both social-economic and demographic factors. At risk for low health literacy are vulnerable populations. Without culturally appropriate health literacy, patients are at risk for not being able to acquire proper understanding of Diabetes self-care management activities needed to improve clinical outcomes. The paper will explore social economic status and demographic factors contributing to low health literacy in Type 2 Diabetics which are most prevalent in vulnerable populations. Figure 1 has a conceptual frame work of these factors as it relates to health literacy.

1.2. Research Strategy

Searched were medical subject headings in MEDLINE (1993-2013) for English articles for titles and abstracts. Hand searches was also conducted (e.g. reference list of relevant articles), and Google searches. Search terms included: "Health Literacy" or "Literacy" and "Type 2 Diabetes" or "Type II Diabetes" or "Diabetes"; "Health Literacy" and "Chronic Diseases"; "Health Literacy" and "Diabetes" and "Outcomes". The total number of title/abstracts screened were 136, consisting of citations identified by electronic database search as n=132 and citations identified by hand searches as n =4. This yield potentially relevant health literacy in Adult Diabetics identified and checked n=47 and a detailed review of articles on Type 2 Diabetic outcomes as n=18. Citations were independently screened for inclusions criteria of adults patients, diagnosed with Type 2 Diabetes with health literacy assessment performed.

1.2.1. Research Validity, Limitations and Biases

Selection bias was a potential problem in that some studies requiring patients to be able to speak English. Patients were not always required to have a certain level of education. These factors would cause study subjects to not be an accurate representation of the larger population. Interviewer bias may occur as one Clinician may be able to elicit better responses than another Clinician. For example, study subjects could respond more favorably based on non-verbal cues from the Clinician. Another example of interviewer bias is if the Clinician was able to deliver the message in manner that took in account of cultural competency; this would lead to greater patient understanding of health information. Attrition bias could result from some patients being lost to follow up or the patient's inability to complete the measurement of health literacy. Publication bias could exist as literature search was limited to what was accepted by Editors to be published. Negative or inconclusive results may remain unpublished and would not have been included in the literature search.

2. Health Literacy in Patients with Type 2 Diabetes

The relationship between literacy and chronic illnesses such as Type 2 Diabetes is complex. Literacy impacts health knowledge, health status, and access to health services. There are several socioeconomic factors which health literacy impact health status, such as income level, occupation, education, housing, and access to medical care (NNLM, 2012).

2.1. Skills Needed for Health Literacy

According to [18], Diabetic patients are often faced with using complex information to make treatment decisions. These decisions require patients to be able to evaluate information for credibility and quality, analyze relative risks and benefits, calculate dosages, interpreting test results, and to be able to locate health information. Health literacy also requires that Diabetic patients be visually literate (ability to interpret visual information); computer literate; information literate (ability to apply relevant information to their

treatment); and to be numerically literate (ability to calculate or reason numerically). Oral language skills are just as important as patients will need to be able to explain their health concerns and describe their symptoms accurately and understand verbal medical advice or treatment directions. The healthcare industry move towards joint collaboration between physician and patient in deciding on healthcare options also increases the need for health literacy skills that will promote patient understanding of health information. With the development of the Internet as a source of health information, health literacy now also includes the ability to search the Internet and evaluate information from Web sites.

2.2. Assessing Health Literacy Skills– Validated Tests

Identifying Type 2 Diabetic patients at risk for adverse clinical outcomes due to low health literacy can be done with one of many well validated instruments used to assess health literacy in a research or clinical setting. Table 1 highlights those assessment found useful in identifying health literacy impact on Diabetic outcomes for both English and Spanish speaking patients: The Test of Functional Health Literacy in Adults (TOFHLA), Adult Basic Learning Examination (ABLE), Literacy Assessment for Diabetes (LAD), Newest Vital Sign (NVS), and Short Assessment of Health Literacy for Spanish-speaking Adults (SAHLSA). Table 1 provides an overview on the various types of health literacy assessment tools and its suitability for different populations.

As there are many tools to assess health literacy, for purposes herewith, the focus was identifying studies using the validated assessment tool TOFHLA. However consideration for future research on diabetes population using diabetic specific literacy assessment.

Table 1. Health Literacy Assessment Tests

Health Literacy Assessment Tests		
TOFHLA	The Test of Functional Health Literacy in Adults	TOFHLA is the recognized standard tool used to measure health literacy. The TOFHLA tool consist of 50 item reading comprehension and a 17 numerical ability timed test composed of materials patients may encounter in a health care setting. These test the patient's ability to use numerical skills that are necessary to understand directions on prescription bottles, monitor blood glucose levels, keep clinical appointments and read and write clinical forms such as Medicaid application and informed consent forms. The scoring categorizes respondents into inadequate, marginal or adequate levels of health literacy [13].
ABLE	Adult Basic Learning Examination	The ABLE is designed to measure the functional abilities in adults, specifically those whose education does not exceed the 8th grade level. The test is divided into levels based on the years of formal education the patient has completed. Subjects covered on the Adult Basic Learning Exam are spelling, reading comprehension, vocabulary knowledge, language skills and mathematical function [10].
LAD	Literacy Assessment for Diabetes	The LAD is a Diabetes-specific literacy assessment. Specifically, it is a word recognition test that has three graded word lists ordered by difficulty for the patient. It measures the patients' ability to pronounce terms related to healthcare. The terms are on a 4th grade level, or on a 6th to 16th grade reading level. It is devised to be a screening instrument to assess an adult patient's ability to read ordinary nutritional and medical terms as well as those terms specific to Diabetes. The purpose of this test is to indicate relevant literacy information to those medical personnel who assist diabetic patients in understanding nutritional and medical instructions [16].
NVS	Newest Vital Sign	The NVS test is meant to allow healthcare providers to make a quick assessment of patients' literacy, which can then allow them to adapt communication to achieve better outcomes. It assesses literacy and numeracy, and is available in both English and Spanish versions. This literacy test, which was specific to Diabetes, measured a patient's ability to pronounce terms that they would encounter during clinic visits and in reading menu and self-care instructions [9].,
SAHLSA	Short Assessment of Health Literacy for Spanish-speaking Adults	The SAHLSA consists of a word-recognition section, designed after the Rapid Estimate of Adult Literacy in Medicine (REALM), in addition to a comprehension test that employs multiple choice questions. It was designed to assess the health literacy for adults who speak Spanish [12].

3. Population Groups at Risk for Limited Health Literacy

Social economic factors and demographic factors effect on health literacy in heighted in populations groups at high risk for limited health literacy. These population groups which include members of ethnic minorities, the elderly, people with a primary language other than English, and the unemployed or those with limited income; are also disproportionately diagnosed with Type 2 Diabetes.[25].

3.1. Ethnic Minority Groups

As the burden of Diabetes disproportionately falls on ethnic minority groups who recurrently experience higher morbidity and mortality than in majority populations, lower health literacy attributed to a complex of cultural physiological and linguistic reasons is also most affected in theses ethnic minority groups [16].

Research demonstrated African Americans are from 1.4 to 2.2 times more likely to have Diabetes than white persons. Hispanic Americans have a higher prevalence of Diabetes than non-Hispanic people, with the highest rates for Type 2 Diabetes among Puerto Ricans and Hispanic people living in the Southwest and the lowest rate among Cubans. The prevalence of Diabetes among American Indians is 2.8 times the overall rate. Major groups within the Asian and Pacific Islander communities (Japanese Americans, Chinese Americans, Filipino Americans, and Korean Americans) all had higher prevalence's than those of whites [1]. An Agency for Healthcare Research and Quality funded literature review of 290 articles revealed that those health care interventions that take into consideration of health literacy, cultural and population-specific characteristics can reduce the prevalence and severity of Diabetes and its resulting complications [1]. The burden of Type 2 Diabetes coupled with the increase requirement of complex disease-management interventions, necessitates a demand for the use of culturally competent health literate interventions in ethnic minority groups with Diabetes.

3.2. Elderly as Defined Age > 65

In general, elderly adults use more medical services and acquire more chronic illnesses including Diabetes than other population segments. According to [25], adults greater than 65 years of age make nearly twice as many physician office visits per year than adults aged 45 to 65. However, an estimated two-thirds of older people are unable to understand the information given to them about their prescription medications. Health literacy issues in the elderly include difficulty using print materials and documents such as forms or charts as well as difficulty interpreting numbers and performing calculations. Improving health literacy is essential for improving both Diabetes clinical outcomes and overall health of older adults.

3.3. Low Income

Adults living below the poverty level have lower average health literacy than adults living above the poverty threshold. Thirty percent of Adults, who received Medicaid have "below basic" health literacy. According to a report by [18] 42% of the people who report their health status as poor and 33% of the people who reported their health status as fair scored at the "below basic" literacy level [18]. Lower literacy scores can lead to poor medication regimen adherence that may inhibit patient from reaching desired therapeutic outcomes.

4. Health Literacy Impact on Type II Diabetic Clinical Outcomes

Approximately 90 million adults in the United States have basic or below basic skills and greater than 110 million have limited numeracy skills. Research indicated that low health literacy impacts health outcomes for Diabetic patients lead to worse health outcomes and increased mortality. Low literacy was found to be common in Diabetic patients and associated with less knowledge about Diabetes and the poorer glycemic control [6].

Inadequate health literacy is a particular problem for Type 2 Diabetes. Disease self-management, described as the daily decisions and activities individuals perform to live with and control Type 2 Diabetes illness, requires both knowledge of what to do and the ability to carry out the medical and lifestyle regimen. To successfully self-manage their chronic illness, Diabetics must know how to monitor disease, manage symptoms, carry out daily medical regimens, and interpret results of home-monitoring therapies. Poor health literacy hampers these important tasks. When written educational materials are developed for use by individuals with poor literacy skills, they must be readable and understandable by the intended audience; provide associations between new information and what is already known; and involve participants in design and use visuals to emphasize the main message [4].

Research supported that low health literacy for Diabetics is associated with a number of adverse health outcomes including kidney disease, nerve damage, eye and foot complications and mortality, all of which are affected by patient's Diabetes self-management [5]. The review of the literature revealed blood glucose self-monitoring as having the greatest impact on clinical outcomes for Type 2 Diabetics. Assessing whether inadequate health literacy is associated with patients self-monitoring of blood glucose is an important area to explore for additional research.

4.1. Glycosylated Hemoglobin Concentration (HbA1c)

Patient with Diabetes less likely to know symptoms of hypoglycemia [25].Ineffective self-management of blood glucose measured by glycosylated hemoglobin concentration

(HbA1c) can significantly impact Diabetes clinical outcomes. The goal of therapy is to achieve HbA1c levels as close to normal (<7%) as possible. Secondary outcomes measurement is fasting glucose between 90 and 130 mg/dl [3]. Type 2 Diabetic patients that maintain near normal blood glucose levels can gain an extra five years of life, eight years of sight, and six years free from kidney disease [14]. Every percentage drop in HbA1c reduces the risk of eye, kidney and nerve disease complications by as much as 40%[17].

4.2. Importance of Self- Monitoring of Blood Glucose for Hypoglycemic Symptoms

With various methods of glucose monitoring are available, from HbA1c measurement to self-monitoring of urine or blood glucose at an appropriate frequency, health literacy to equip patients with knowledge on how to identify hypoglycemic symptoms early is essential. Glucose meters models vary with and requiring testing strips specific to each monitor. Self-monitoring of blood glucose for patients require education on how to use insulin and how and when to adjust insulin doses top improve outcomes in patients with of Type 2 diabetes. Patients should be given adequate training in self-monitoring techniques, including interpretation of results and appropriate action when required. Many people with diabetes provide books full of results but still don't fully understand the implications of the results or have a full understanding of diabetes mellitus and its implications and management. Research found that diabetes education was found to be effective in improving self-management, diabetes knowledge, and glycemic control for patients with adequate and limited health literacy. These findings suggest programs for patients with low literacy may reduce disparities in diabetes outcomes related to literacy status. [11].

5. Meta Analysis

Four homogeneous research articles that have confirmed an association between health literacy and glycemic control were selected for a Meta-Analysis on the strength of the correlation for health care literacy on Type 2 Diabetic clinical outcome of glycemic control. (Table 2)

The purpose of this meta-analysis is to test the strength of previously publish correlations of homogenous studies using TOFLHA as the literacy measurement tool. The focus on health literacy research does not neatly fall within a health literacy framework. Several measures for health literacy measure a combination of print and numeracy skills. Some studies measure literacy as numeracy or oral literacy. The TOFHLA is now recognized as the tool for health literacy

measurement and is a requirement standard for this meta-analysis. Articles for the meta- analysis were selected based the research approach on based on domains and elements appropriate for cross sectional observational studies to include:

- Study population
- Intervention and study type
- Date of research with preference on recent research
- Comparability of subjects.
- Literacy measurement (TOFHLA)
- Maintenance of comparable groups.
- One or more diabetes outcome measurement.
- Statistical analysis used

To ensure homogenous of research articles, further examination were made of the Quality of the research, Quantity of studies, including number of studies and adequacy of the sample size and the consistency of findings. The four studies selected for the Meta-analysis met all the selection criteria and were selected based on the homogeneity within populations as evident by similar inclusion criteria. Further strengthen the homogeneity were the demonstration of consistency of results that were able to be quantified and analyzed. Table 2 provides an overview of the four studies selected for the meta-analysis highlighting each study homogeneous attributes. The articles selected researched if health literacy and literacy measures were strongly related. By determining that within homogeneous studies there is a correlation between health literacy and glycemic control, we can now explore and examine closely factors that may be confounding the relationship between literacy and health outcomes (e.g., age, income, or health insurance status) as well as consider mediators, such as self-care, trust and self-efficacy that may impact health literacy and health outcomes. We can examine the effects of social economic factors and demographic factors impact on health literacy and related disparities.

Studies for the meta-analysis were selected based on their inclusion and exclusion criteria limitation to selection of cross sectional observational and quantitative studies that measured literacy with the valid instrument The Test of Functional Health Literacy Assessment (TOFHLA) and measured one of more health outcome related to type 2 diabetes self-management. Patients included in meta-analysis were Adult patients a from 18 – 65 years of age, diagnosed with Type 2 Diabetes with outcome variables with recent hemoglobin A1C testing within 3 months of study record. Patients were either English or Spanish speaking. Literature search included MEDLINE as the primary database, using key words terms such as "literacy" and "health literacy" and, in some cases, "numeracy" and the name or accepted acronym for standardized tests of literacy related to health outcomes such as REALM, and TOFHLA.

Table 2. Homogeneous Literature for Meta-analysis

Author(s)	Name of Article	Date Published	Sample Method/and Tools	What was analyzed hypothesis	Sample Size and Demographics	Medical Conditions	Health Literacy Test	Outcome Variables	Results
Williams, et. al	Relationship of functional health literacy to patient knowledge of their chronic disease: A study of patients with hypertension and diabetes	1998	Cross Sectional Survey of Patients	Examine patients with diabetes, the relationship between their functional health literacy level and knowledge of chronic disease and treatment	114 Adult Patients	Type 2 Diabetes	TOFHLA	Knowledge of symptoms of hypoglycemia	A total of 94% of patients with diabetes and adequate health literacy knew the symptoms of hypoglycemia compared to 50% of those with inadequate literacy
Mancuso, J.	Impact of Health Literacy and Patient Trust of Glycemic Control in an Urban US Population	2010	Quantitative study	Exam health literacy and patient trust as predictors of glycemic control. Looked at related factors such as demographics, and socioeconomic status and diabetes knowledge	102 age 26-67	Type 2 Diabetes		Recent hemoglobin A1c preceding 2-3 months	Independent variable of Health literacy shown significance at $P<0.05$. Health literacy, knowledge of diabetes and self-care activities demonstrated predictors of glycemic control but with weak correlations
Schlinger, et al.	Association of health literacy with diabetes outcomes	2002	Cross Sectional Observational Study	Examine the association between health literacy and diabetes outcomes among patients with type 2 diabetes	408 English and Spanish Speaking Patients > 30 years of age	Type 2 Diabetes	Did not state	Recent hemoglobin A1c	Patients with inadequate health literacy were less likely than patients with adequate health literacy to have poor glycemic control $P=.02$
Mbaezue, et al.	The Impact of Health Literacy on Self Monitoring of blood glucoe in patients with Diabetes receiving care in an Inner-City Hospital	2010	Cross sectional survey	Examine the relationship between health literacy and SMBG	189 adults 18-65 years of age	Type 2 Diabetes	TOFHLA shorten version	Blood sugar testing	Health literacy was associated with recording of blood sugar testing (P = 49)

Unification of the health literacy test was achieved for the meta-analysis by selecting studies that used TOFHLA to measure the functional literacy level of patients, using real-to-life health care materials relevant to diabetes self-management. These materials include patient education information, prescription bottle labels, registration forms, and instructions for diagnostic tests. The TOFHLA assesses two main constructs, numeracy and reading comprehension; it has a total of 67 items. In diabetes self-management, the ability to read and understand numbers and understand health care-related passages is vital to ensure optimum patient outcomes.   The TOFHLA test is valid and standardize test for health literacy.   This provided the health literacy unification and supported homogeneous of the four research articles selected for meta-analysis.

The first study, [27] conducted a cross–sectional survey of patients with hypertension and diabetes with the objective was to examine among patients with hypertension or diabetes the relationship between their functional health literacy level and their knowledge of their chronic disease and treatment. Literacy was measured by the Test of Functional Health Literacy in Adults. Knowledge of their illness was assessed in patients with diabetes using a 10 diabetes questions based on key elements in educational materials used in our clinics.   The study concluded that inadequate functional health literacy poses a major barrier to educating patients with chronic diseases, and current efforts to overcome this appear unsuccessful.[27], A quantitative study was conducted that examined health literacy and patient trust as predictors of glycemic control. The related factors of demographics, socioeconomic status, diabetes knowledge, self-care activities, and depression were also considered. Implementing a cross-sectional, predictive design, a convenience sample of 102 patients with diabetes was recruited from two urban primary care clinics in the USA. The study found that there was a significant positive relationship between socioeconomic status and health literacy and between diabetes knowledge and health literacy.

Schlinger, et al was a cross-sectional observational study of 408 English- and Spanish-speaking adults patients was done to examine the association between health literacy and diabetes outcomes among patients with type 2 Diabetes to learn to what extent health literacy affects clinical health outcomes. Assessed was patients' health literacy by using the short-form Test of Functional Health Literacy in Adults (s-TOFHLA) in English or Spanish versions examining (HbA(1c) level as outcome measures. The study concluded that among primary care patients with type 2 Diabetes, inadequate health literacy is independently associated with worse glycemic control and higher rates of retinopathy. Inadequate health literacy may contribute to the disproportionate burden of diabetes-related problems among disadvantaged populations.

In Mbaezue, et al,a cross sectional study of 189 patients, the objective was to examine the relationship between health literacy and self-monitoring of blood glucose. The study used shortened version of the Test of Functional Health Literacy in Adults. The study results that most or 60.9%)of the survey participants were assessed as functionally health literate. The majority or 90.9% of the study participants reported testing their blood sugar at least once daily. Results found adequate health literacy was associated with recording of blood sugar testing (p = .049).

The Meta-analysis was conducted using a Lite version of Meta-analysis In eXcel or MIX software. Provided for each study was the P-value, Tails, Sample size and Effect direction. One-tailed tests as selected as the analysis is measuring integrity of health literacy would be for improving glycemic control in Type 2 Diabetic patients. A fixed effect model was used as studies were from a population in which the average effect size was fixed or homogenous.

The Meta-analysis demonstrated a correlation coefficient of 0.102 which suggests a relationship between health literacy and glycemic control exists, but is not strong. This correlation may suggest that health literacy impact on glycemic control is directed at the patient's ability to understand instructions for glycemic self-management such as monitoring HbA1c.

The meta-analysis used Fisher's Z method to combine results from several independent P values with same overall hypothesis and yield a Meta-Analysis P-value of .004. A P-value of .004 less than a significant level of 0.05 indicates a rejection of the null hypothesis: Health Literacy does not impact Type 2 Diabetics Clinical Outcome of Glycemic Control and a 95% confidence level that health literacy has a significant effect on glycemic control for Type 2 Diabetics. (Table 3 and Table 4)

Table 3.   Meta-Analysis Input

Study Name	P Value	Tails	Sample Size	Effect Direction	Correlation	Std Err	Fisher's Z	Std Err
Wiliams et al	0.001	1	114	Positive	0.286	0.087	0.295	0.095
Mancuso	0.050	1	102	Positive	0.164	0.098	0.165	0.101
Schilinger, et	0.050	1	408	Positive	0.082	0.049	0.082	0.050
Mbaezue, et al	0.490	1	189	Negative	-0.002	0.073	-0.002	0.073

Table 4.   Meta-Analysis Correlation and Effect Measure Results

Study name	Statistics for each study					Correlation and 95% CI				Model
	Correlation	Lower limit	Upper limit	Z-Value	p-Value	-1.00 -0.50	0.00	0.50	1.00	
Wiliams et	0.286	0.108	0.447	3.105	0.002					
Mancuso	0.164	-0.032	0.347	1.644	0.100					
Schilinger.	0.082	-0.016	0.177	1.645	0.100					
Mbaezue.	-0.002	-0.145	0.141	-0.025	0.980					
	0.102	0.033	0.170	2.892	0.004				Fixed	

This research supported that health literacy and literacy measures are strongly related. By determining that within homogeneous studies there is a correlation between health literacy and glycemic control, we can now explore and examine closely factors that may be confounding the relationship between literacy and health outcomes (e.g., age, income, or health insurance status) as well as consider mediators, such as self-care, trust and self-efficacy that may impact health literacy and health outcomes. We can examine the effects of social economic factors and demographic factors impact on health literacy and related disparities

6. Enhancing Type 2 Diabetes Outcome Health Literacy Strategies

Diabetes education was found to be effective in improving self-management, Diabetes knowledge, and glycemic control for patients with adequate and limited health literacy. Expanding educational programs for patients with low literacy may reduce disparities in Diabetes outcomes related to literacy status (Kim, Love, Quistberg, Shea, 2004). Clinicians are advised when communicating therapy instructions to patients with low health literacy to provide limited but clear information using plain language and avoiding medical jargon. Using illustrations of important concepts and confirming patient understanding by a "teach back" method has been found to be effective [21].

Osborn, [6] recommend the use of simple language for both verbal and written information, and avoiding medical terminology. Information to patients should be organized in to manageable units for the patient and given in the same order it is needed so that subsequent information makes sense. Words such as 'could', 'may' and 'might' should not be used as they can be ambiguous. It is advised to either not use acronyms or explain the acronym the first time it is used [19].

Making Type 2 Diabetes information culturally appropriate has proven to have beneficial effects on glycemic control [8, 16] and recommended that nurses learn the names of ingredients commonly used in a patient's cultural cuisine and adapt them in dietary advice. Illustrations used in educational materials could be made culturally sensitive to the patient population and include the ethnic pictures from the patient's ethnic group.[16]

The 'teach back" method can be used by the Clinician by having the patient to explain back to the Clinician, or to another person, what the Clinician stated to do in order to alert the nurse to any misinterpretations, gaps in knowledge or understanding. The "teach back" method has been proven to a patient's retention, recall and comprehension of information [19], and has been shown to improve glycemic control [16].
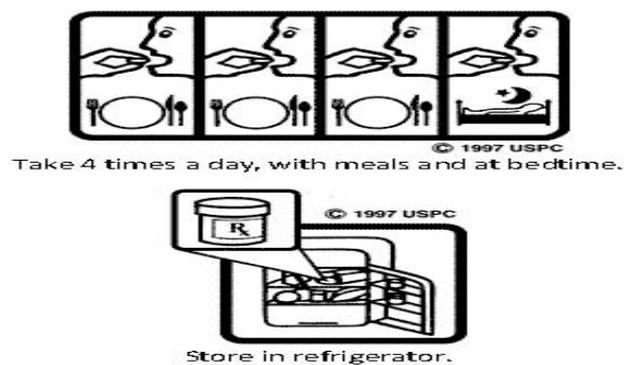
Figure 2.   © 1997 US Pharmacopeia (US Pharmacopeia 2013)

Pictograms or line drawings can be a useful addition to Diabetes information and have been shown to increase understanding in patients with low health literacy [16]. US Pharmacopeia is a resource with a range of pictograms that may be downloaded and used by Clinicians free of charge. Pictograms are standardized graphic images that help convey medication instructions, precautions, and/or warnings to patients. Pictograms are useful for passing on important

information to patients with a lower level reading ability and for patients for whom English is not their primary language. Figure 2 contains examples of pictograms that can be used for diabetic's medication dosing and storage instructions.

7. Conclusions

Limited literacy has been shown to be associated with poor health in a wide variety of settings, and is particularly prevalent among the elderly, minorities, those with lower levels of educational attainment, and those with chronic diseases such as Type 2 Diabetes. Diabetes is a long-term condition and patients with low health literacy struggle to comprehend their disease and aspects of self-care, and as a result these patients experience the worse health outcomes. The literature review supported the urgent need for research to combat low health literacy in patients with Type 2 Diabetes. Among patients with Diabetes, low health literacy is associated with less disease specific knowledge, worse performance of required self-care activities, and impaired glycemic control. The literature makes recommendation on specific strategies to increase health literacy to include the use of plain language in both print and oral communication, appropriate elicitation of questions from patients, and the use of the "teach-back" technique to confirm patient understanding of vital health information. The literature suggests that understanding the social economic and demographic relationship between health literacy and Diabetes self-management behaviors will further enhance efforts to improve Diabetes outcomes.

8. Future Outlook – Using Technology

The future outlook for improving health literacy in Type 2 Diabetics will incorporate the use of technology. Health information is being conveyed by the communication, information, and technologies that people interact with every day. Technology can assist in creating education materials or providing medical instructions that is sensitive to health literacy. New technologies are improving Diabetes disparities and health literacy in multiple ways. Many strategies to address low health literacy are not moving to using technology such as delivering Diabetes information to patients via mobile devices. Patients are now able access information via websites using their own smart phone and technology has improved access to health information for individuals of low literacy, especially when interactive computer technology is employed [4]. Future research is needed that examine the effectiveness of Health IT interventions in under-resourced settings that serve minority patients. Stakeholders need to understand the feasibility, acceptability, and effectiveness of technological interventions for reducing health literacy in Diabetes. The future for improving health literacy in Type 2 Diabetes to improve clinical outcome lies with the use of technology and

its wide and growing choice of formats.

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