

2017

# Best Practices for Glucose Management Using a Computer-Based Glucose Management

Oteka Jackson-Cenales  
*Walden University*

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# Walden University

College of Health Sciences

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the review committee have been made.

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Walden University  
2017

Abstract

Best Practices for Glucose Management Using a Computer-Based Glucose Management

System

by

Oteka Jackson-Cenales

MS, Loyola University New Orleans, 2012

BS, East Texas Baptist University, 2007

Project Submitted in Full Fulfillment

of the Requirements for the Degree of

Doctor of Nursing Practice

Walden University

November 2017

## Abstract

The prevalence of diabetes mellitus (DM) continues to be a global concern among health care practitioners. Without collaboration and interventions, this chronic disease, which poses a significant financial burden for health care institutions, will continue to be problematic. Promoting the use of glycemic control measures among diabetic patients is an intervention, which has the potential to reduce diabetic complications and improve outcomes. The purpose of this doctoral project was to explore available evidence through a systematic review of the best practices for glucose management. The chronic care model served as the theoretical framework. The evidence based practice question was, What is the current evidence supporting the utilization of a computer-based glucose management system (CBGMS) for inpatient diabetic adults in acute and critical care settings? A systematic review was conducted, yielding 532 studies in which 3 of the studies related to CBGMSs published from 2008 to 2017 were critically appraised. The John Hopkins Nursing Evidence Appraisal Tool with specific inclusion and exclusion criteria was utilized. Participants were adult patients (aged 18 and over) with DM in inpatient care settings who were English speaking. Interventions included the traditional paper-based sliding scale regimen versus the utilization of a CBGMS. Outcome measures included decreased length of stay, reduced cost, and glucose optimization. A conclusion was the implementation of a CBGMS has the potential to improve patient outcomes with additional research that exhibits overall benefits and implement into practice. Thus, implementation of a CBGMS can lead to positive social change by aiding in a change in practice that will ultimately ameliorate patient health outcomes.

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## Dedication

I would like to dedicate this paper to my three wonderful children who have been supportive and understanding throughout my journey. You all are truly my inspiration, and I love you all dearly.

## Acknowledgments

I would like to send a very special note of appreciation, gratitude, and acknowledgment to Drs. Amelia Nichols, Tracy Wright, Sue Bell, and Mary Tilbury. The knowledge and expertise you have exhibited has provided the essential foundation for what it truly means to be a doctoral-prepared nurse. The knowledge and expertise you possess has also guided me towards a proper understanding of what it means to assume the role of a doctor of nursing practice.

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## Section 1: Nature of the Project

### **Introduction**

Diabetes mellitus (DM) type 1 and 2 are complex disease processes that have affected the United States in several key ways. In 2015, there were 30.3 million Americans, which is equivalent to 9.4% of the U.S. population, suffering from diabetes (American Diabetes Association, 2016c). There are approximately 1.25 million children and adults in America with type 1 diabetes (American Diabetes Association, 2016c). To date, there are reportedly 1.5 million new cases of Americans who have been diagnosed with diabetes yearly in the United States and the mortality rate for these individuals has risen significantly (American Diabetes Association, 2016c). Presently, diabetes remains the 7th leading cause of death in the United States, with 252,806 death certificates listing DM as the underlying reason for death in the U.S. population in 2015 (American Diabetes Association, 2016c).

The estimated total cost for individuals diagnosed with DM type 1 and 2 in the United States rose to \$245 billion in 2012 from \$174 billion in 2007 (Romero, 2016). This chronic illness poses a substantial financial burden for the United States with the noted rise of the total cost from 2007 to 2012. The complications associated with DM also may lead to exorbitant health care costs and medical expenditures (American Diabetes Association, 2016a). Results of the Diabetes Control and Complications Trial (DCCT) showed that thorough glycemic control reduces microvascular and macrovascular complications in patients who suffer from DM type 1 and 2 (Gregg, Li, Wang, Burrows, Ali, Rolka, Williams, & Geiss, 2014). These complications include but

are not limited to retinopathy, nephropathy, neuropathy, ischemic heart disease, peripheral vascular disease, and cerebrovascular disease (Gregg et al., 2014).

Thus, the use of a computer-based glucose management system (CBGMS) could aid health care professionals in ameliorating patient care by: optimizing patients' glucose levels, reducing overall health care cost and medical expenditures, and decreasing complications manifested by poor glycemic control (Mann, Jones, Wolf & Wade, 2011). Additionally, the Centers for Medicare and Medicaid Services (CMS) have deemed the manifestations of inadequate glucose control as a preventable error which presents a financial burden to health care organizations (Romero, 2016). Consequently, there are also significant risks associated with inpatient hyperglycemic and hypoglycemic events including but not limited to increased mortality rates, longer length of stay (LOS), and an increased risk for intensive care unit (ICU) admission (Tanenberg, Hardee, Rothermel, & Drake, 2017).

These risks have led to efforts by health care professionals to maintain optimal glucose control in the hospital setting. Tanenberg et al. (2017), indicated that approximately 8% of patients that are admitted into the hospital setting will experience at least 1 hyperglycemic or hypoglycemic event. The use of CBGMSs has also been found to have very successful outcomes within the inpatient care population (Tanenberg et al., 2017). CBGMSs utilize algorithms and/or clinical decision support software, which provide therapy recommendations (Tanenberg, 2017).

There is substantial evidence supporting the utilization of a CBGMS versus the traditional sliding scale protocol (Tanenberg, 2017). The traditional sliding scale protocol

entails rapid-acting insulin administration to aid in rising blood glucose levels pre-meal time and is adjusted based on the blood glucose level (Trotter, Conaway, & Burns, 2013). The results were quite significant in a study discussed in Tanenberg et al. (2017), in which patients who had undergone cardiac surgery with their blood glucose level controlled with the utilization of a CBGMS were compared to patients who had their glucose level controlled with utilization of the traditional sliding scale regimen. The study authors found that cardiac patients who had used the CBGMS had a 2.5-fold decrease related to post-operative complications (Tanenberg et al., 2017).

The traditional sliding scale insulin regimen has been the standard of care and the most common strategy used to treat patients suffering from diabetes since the 1970s (Badlani, Ford, Yu, Brogan, Pollack, & Volturo, 2014). However, treating patients solely with this regimen has been found to be ineffective (Badlani et al., 2014). Thus, in 2006, the American College of Endocrinology (ACE) and the American Diabetes Association (ADA) recommended that insulin protocols, along with algorithms, and/or order sets be used to treat hyperglycemia and hypoglycemia events in the inpatient hospital care setting (Tanenberg et al., 2017). The aim of this DNP project was to conduct a systematic review of the literature on the use of CBGMSs for inpatient adults.

### **Problem Statement**

Despite the progress and advancements of CBGMS, many organizations and health care providers are reluctant to consider these systems to aid in caring for their patients (Mann, et al., 2011). There are several reasons accounting for health care providers' reluctance in adopting CBGMSs. Some of the reasons include (a) lack of Food

and Drug Administration (FDA) approval for insulin dosing in the United States; (b) cost and reimbursement issues; (c) the recalibration requirement for the systems; (d) training time and the cost for health care professionals who care for diabetic patients within an organization; (e) lack of standardization in available software; (f) the need for more clinical practice guidelines regarding the role of CBGMS; and (g) the need for the clinical research to be disseminated to all health care organizations and professionals to aid in determining best practice (Rodbard, 2016).

The common practice of providers utilizing standard protocols and sliding scale glucose management alone has proven to be ineffectual over time (Mann, Allen, Serio-Melvin, Wolf, & Salinas, 2012). Health care organizations and providers are being held to a higher standard when caring for diabetic patients. This higher standard of care is recommended and supported by the American Diabetes Association. The American Diabetes Association (2016) recommends that health care organizations and providers use a patient-centeredness approach when caring for diabetic patients. This means that health care organizations and providers must provide a comprehensive plan of care for diabetic patients to aid in addressing and reducing complications (American Diabetes Association, 2016). Health care organizations and providers must also have a sound care team (American Diabetes Association, 2016b). This care team includes but is not limited to the primary care provider, diabetic educator, registered dietician, endocrinologist, ophthalmologist, social worker, podiatrist, pharmacist, dentist, and family members or caregivers (American Diabetes Association, 2016b). Moreover, the American Diabetes Association recommends the utilization of decision support tools to aid in meeting

diabetic patient needs (American Diabetes Association, 2016). CBGMSs are considered a decision support tool.

CBGMSs integrate software that utilizes point of care glucose levels to determine the appropriate insulin needed to achieve the desired glucose range (Mann et al., 2012). According to Mann et al. (2012), undesirable outcomes for diabetic patients could continue until health care organizations and providers are willing to enhance their knowledge base and contemplate adopting an assistive computer-based decision support system. Researching best practices related to glucose management and disseminating this research to health care professionals, could aid in the use of CBGMS for diabetics in the inpatient care setting. In developing this systematic review of evidence, I wanted to aid in closing the research-practice gap and provide the evidence necessary to support the adoption of CBGMSs for managing diabetics in the inpatient care setting. Adopting CBGMS could aid in improving patient outcomes, safety, and quality of care and reducing mortality (Crockett et al., 2012).

### **Purpose**

Identifying evidence regarding the utilization of a CBGMS for the management of glucose levels for inpatient adults was the purpose for this systematic review. I used the Johns Hopkins Nursing Evidence-Based Practice Levels of Evidence tools for this systematic review (see Appendix D and E). The Johns Hopkins Nursing Evidence-Based Practice: Levels of Evidence systematic review is used to analyze RCTs (randomized controlled trials) and quasi-experimental studies with or without meta analysis or synthesis (John Hopkins Medicine Center for Evidence Based Practice 2017). Non-

experimental studies, opinions from respected authorities, literature reviews, and case reports are also analyzed (John Hopkins Medicine Center for Evidence Based Practice 2017).

The organization in which I completed my DNP practicum experience hours hired an inpatient diabetic coordinator (IDC) in early 2016. Since the hiring of the IDC, the organization has been seeking ways to improve the care provided to its adult inpatient diabetic population. The new IDC developed a diabetes management program (DMP) and created a diabetes steering committee (DSC). It was decided by myself to conduct research and perform a systematic review for the committee on the benefits of the utilization of a CBGMS. This was decided because the organization's sister facility was utilizing a system called EndoTool which is a CBGMS. According to an official at the practicum site, EndoTool has improved the sister facility's outcomes, and the organization could benefit from a systematic review on CBGMSs.

A systematic review was conducted and carried out prospectively and comprehensively. This review was structured utilizing the Johns Hopkins Nursing Evidence-Based Practice Project Management Guide (see Appendix B). There were a total of 18 steps that could be used to carry out a project utilizing the Johns Hopkins Nursing Evidence-Based Practice Project Management Guide. However, this project was a systematic review, for which the pertinent steps were 1 through 11, 16, 17, and 18 (see Appendix B). Step 12 was eliminated because it requires an action plan. This is a systematic review that will be presented to the IDC and the DSC, and an action plan is not required. Step 13 was eliminated because it requires support and resources to

implement the action plan and there is no action plan needed for this systematic review and the method of dissemination. Step 14 was eliminated because it requires the implementation of the action plan and this is not required for this systematic review. Step 15 was eliminated because it requires evaluation of outcomes. This is a systematic review that will be presented to the IDC and DSC and the decision to adopt a CBGMS will solely rely on their decision.

I drew from the Johns Hopkins Nursing Evidence-Based Practice Question Development Tool (see Appendix C) in developing the evidence-based practice question developed for this systematic review. The evidence based practice question for this systematic review was, What is the current evidence supporting the utilization of a CBGMS for inpatient diabetic adults in acute and critical care settings?

### **Nature of the Doctoral Project**

In conducting this review, I explored the available evidence following a systematic format. A systematic review is defined as a “review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research” (Ham-Baloyi & Jordan, 2016, p. 122). According to Gough, Oliver, and Thomas (2012), researchers performing systematic reviews use explicit, rigorous, and accountable methods to identify gaps in existing literature.

This review was conducted by accessing databases such as CINAHL Plus with Full Text, MEDLINE with Full Text, and Cochrane Systematic Reviews. Search methodology, terms, and results are discussed in detail in Section 3. This systematic

review provides a summary of the available evidence to support further decision making in acute and critical care settings to help narrow the knowledge-practice gap.

### **Significance**

Traditional sliding-scale insulin has widely been utilized and deemed the treatment of choice for an extended timeframe for health care professionals in their daily practice (Guthrie, Hinnen, & Childs, 2011). Despite the wide acceptance of the utilization of traditional sliding-scale insulin and glycemic control for those experiencing hypoglycemia or hyperglycemia, there is little evidence supporting its efficacy (Guthrie et al., 2011). There are potential complications associated with using the traditional sliding scale regimen for glycemic control for episodes of hypoglycemia and hyperglycemia (Guthrie et al., 2011). Traditional sliding scale insulin has also been linked to an increased fluctuation of blood glucose levels (Guthrie et al., 2011). Moreover, the fluctuation of blood glucose levels is viewed as unfavorable to patients physiologically (Guthrie et al., 2011).

The American Diabetes Association (ADA) also plays an integral role in diabetes care and management in the United States. It is the ADA's recommendation to increase the quantity of individualized care provided in the treatment of those with DM (American Diabetes Association, 2013). The individualized care includes an individualized care plan and a road map that will outline goals specific to the patient needs. This recommendation has been revised and published in the January 2014 issue of *Diabetes Care for Standards of Medical Care* (American Diabetes Association, 2013). Moreover, this recommendation encourages health care professionals to examine an array of options and not solely the

traditional methods of treatment. In conducting this review, I sought to appraise the current body of evidence to discern if there is enough evidence available to prospectively work towards translating the concept of utilization of CBGMS into practice. The identified stakeholders for this review were providers and affected patients with DM type 1 or 2.

### **Summary**

The purpose of Section 1 was to provide background information based on the systematic review. This included the review question, purpose of the study, and nature of the study. The introduction in this section provided the background information into the project and the thought process on why it is vital to practice appropriate glucose management for inpatient adults in acute and critical care settings. The utilization of a CBGMS in the electronic health record (EHR) has been found to ameliorate diabetics' outcomes during hospitalization (Tanenberg et al., 2017). A change in the way that health care organizations provide treatment to patients with DM can advance the organizations knowledge and optimize the quality of care delivered. Properly managing patients' glucose level is deficient in many health care organizations in the United States (Romero, 2016). If DM is not managed appropriately, it may lead to an increase in inpatient population admissions, re-admissions, mortality rates, morbidity rates, diabetic complications, health care expenditures, and barriers to proper treatment (Gregg et al., 2014).

## Section 2: Background and Context

### **Introduction**

Computer decision glucose management support systems ameliorate patient care by comparing distinctive characteristics with a sound knowledge base providing customized clinical recommendations (Gillaizeau et al., 2013). According to Gillaizeau et al. (2013), “ideally, decision support, integrated in the electronic medical record as the platform, can provide physicians with tools making it possible to improve practice and patient safety” (p. 8). An effective computer decision support glucose management system can aid health care professionals in predicting patients’ specific needs and promptly conveying information (Gillaizeau et al., 2013). CBGMSs can aid health care professionals in ameliorating patient outcomes more frequently than the traditional paper-based insulin titration regimen it substitutes, while accomplishing significantly fewer hypoglycemic episodes (Mann et al., 2012).

### **Concepts, Models, and Theories**

Glucose management is an integral component of nursing care. Preventing adverse outcomes and treating glucose levels in inpatient adults should take precedence when caring for diabetic patients (American Diabetes Association, 2016b). The chronic care model (CCM) served as the theoretical framework for my systematic review the use of a CBGMS with inpatient adults in acute and chronic care settings. The CCM employs a systematic approach with a combination of components (Stellefson, Dipnarine, & Stopka, 2013). According to Stellefson et al. (2013), this model utilizes “decision-support components to train providers on guidelines for American Diabetes Association (ADA)

Standards of Care” (p. 21). This model also utilizes a system design component to aid in remodeling the care delivery process to provide self-management support through diabetes self-management education (DSME) (Stellefson et al., 2013). The combination of components utilized to promote optimized quality chronic disease care includes the community, the health system, self-management delivery system design, decision support and clinical information systems (The Chronic Care Model, 2017). Each component has evidence-based change concepts linked to it. Together, the components and elements of the CCM foster valuable interactions between the patient and the health care professional (The Chronic Care Model, 2017). These elements include patient safety (the health system), cultural competency (the self-management delivery system design), care coordination (the health system and clinical information systems), community policies (the community resources and policy), and case management (in the self-management delivery system design; The Chronic Care Model, 2017).

There is evidence showing that use of the CCM effectively improves the health of diabetic patients, with positive outcomes well documented in several studies (Stellefson et al., 2013; see Figure I1). Similarly, the American Diabetes Association (2016) recommends that care be aligned with the components of the CCM. The Association made the recommendation to “ensure productive interactions between a prepared, proactive practice team and an informed, activated patient” (American Diabetes Association, 2016, p. 1). The CCM model also aids health care professionals in facilitating patients’ self-management by supporting patient behavior change and

providing a coordinated care team to aid in optimal diabetes management (American Diabetes Association, 2016).

The evidence-based practice question I sought to answer concerned whether there is a sufficient quantity of evidence to support the utilization of a CBGMS, on the basis that this type of system can prospectively yield positive results and improve glucose levels with inpatient adults. Diabetes can cause many adverse outcomes including increased length of stay in the hospital and microvascular and macrovascular complications (Romero, 2016). For these reasons, it is important that health care professionals seek out systems or processes that can bestow positive outcomes for patients and health care organizations.

### **Relevance to Nursing Practice**

Health care professionals around the United States strain to stabilize managing DM due to the many existing challenges and barriers in the practice setting (Crockett et al., 2012). It is estimated that DM affects 24 million Americans a year, which makes this illness one of the most chronic diseases in the United States (Miller & Dimatteo, 2013). The number of DM diagnoses is expected to double by 2034 (Miller & Dimatteo, 2013). Diabetes has been linked to “heart disease, stroke, kidney failure, lower limb amputation, and blindness” (Miller & Dimatteo, 2013, p. 422).

Diabetic patients must adhere to strict treatment such as medication including insulin injections, self-monitoring of blood glucose levels, strict dietary changes, frequent vision examinations, and daily exercise routines (Miller & Dimatteo, 2013). The strict treatment regimen that patients suffering from DM follow, makes it imperative for nurses

to provide adequate glucose management for all inpatient diabetic patients in the acute and critical care setting. For a number of years, health care organizations around the United States have provided the standard traditional sliding scale insulin regimen (Mann et al., 2012) to patients with DM. There is evidence supporting the expansion of the traditional practice of glucose management in acute and critical care settings (Mann et al., 2012). However, according to my review of the literature, little has been done to translate the evidence into practice.

The U.S. public's opinion is assessed by the Gallup poll annually. The Gallup poll measures issues that matter to the society which includes but not limited personal safety, well-being, and confidence in national institutions such as health care organization (Gallup, 2017). For 13 plus years, the results of the Gallup poll have shown that Americans rate nursing "as the most honest profession and nurses as having the highest ethical standards" (Winland-Brown, Lachman, & Swanson, 2015, p.268). The American Nurses Association's (ANA) Code of Ethics is comprised of nine provisions (Winland-Brown et al., 2015). The first three provisions explain the most essential merits, values, and commitments for a practicing nurse (Winland-Brown et al., 2015). Also, the first three provisions address nursing duties, how patients should be respected, and the need for consideration of social and economic status, personal attributes, and the nature of health problems (Winland-Brown et al., 2015). The fourth provision addresses how a nurse should be held accountable in day-to-day practice (Winland-Brown et al., 2015).

Provisions 5 and 6 of the ANA Code of Ethics primarily focus on do's and don'ts of nursing duties and issues of loyalty (Lachman, Swanson, & Winland-Brown, 2015).

Similarly, Provisions 7 through 9 focus on nurses' ethical duties. However, these provisions support the notion that nurses are obligated to be directly involved in health policy as well as responsible to contributing nursing knowledge through scholarly inquiry and research (Lachman et al., 2015). With all of this noted, it is a nurse's sworn duty to ensure that all patients are cared for optimally and in a safe manner, and to stay current on evidence regarding best practices (Lachman et al., 2015). By providing an alternative way to manage glucose levels for inpatients, nurses can promote and advocate for the rights and overall health of their patients and provide safe care. Hence, the utilization of a CBGMS to care for inpatient diabetic patients is pertinent to nursing practice in acute and critical care settings.

### **Local Background and Context**

The practicum site of this DNP student is a full service acute-care facility in the local area. The facility has over 1,600 employees and over 1,000 physicians employed, with over 70 specialties and subspecialties (Medical City Plano, 2017). Overall the facility has a capacity of 493 beds and are in the process of building another inpatient unit. The review question was identified by myself during patient rounding on the Neuroscience Progressive Care Unit (NSPCU) and with the Inpatient Diabetes Coordinator (IDC). I have a nursing background with experience in caring for adults with diabetes mellitus. During my research on diabetes management, I discovered several different computerized clinical decision support systems for treatment of hyperglycemic and hypoglycemic episodes. I am an active member of the diabetes steering committee (DSC) within the practicum site. When asked about the possible utilization of a CBGMS,

the diabetes steering committee members noted that they have heard of a CBGMS called EndoTool. They stated that one of their sister facility utilizes it. The committee members stated that to their knowledge, there is not enough sufficient evidence to support the utilization of a CBGMS (S. Harris, personal communication, September 15, 2016). Moreover, the members also stated that the cost associated with the software that is needed to be integrated into the EHR was too expensive to even consider. This prompted the need for further investigation on my part and the formulation of the review question to present to the diabetes steering committee (DSC).

### **Role of the DNP Student**

The essential skills of a DNP prepared nurse bestow collaboration and utilization of leadership skills to “improve patient outcomes, the creation of new collaborative care delivery models that will meet the increasing demand for services, and the development of policy to enhance services and remove practice barriers” (Houghton, Casal, Fortuna, & Larsen, 2015, p.13). As a Doctor of Nursing Practice (DNP) prepared student, my role in this project is to integrate knowledge acquired through my studies and exhibit representation of clinical evidence of CBGMSs to optimize clinical outcomes. This also entailed conducting a systematic review of literature on the review question.

### **Summary**

Section 2 provided background and context information on CBGMSs and how the utilization of these systems can ameliorate patient care and patient outcomes. The clinical recommendations by the American Diabetes Association were also discussed in this section which aids in validating the feasibility and probability of the utilization of

CBGMSs. The CCM was identified as the appropriate theoretical framework for the DNP project in this section. The key components and elements that are encompassed within the CCM aid in optimizing patient outcomes not only in the inpatient care setting but also aids in self-management and behavior changes. The relevance to nursing practice, the local background and context of the practicum site, which noted the number of employees, specialists, sub-specialists, and bed capacity, provided details as to why and how adopting a CBGMS is relevant to current nursing practice. Lastly, the role of the DNP student was discussed in detail with emphasis on applying knowledge obtained through studies, collaborating with the DSC and IDC, and conducting a systematic review to support the adoption of a CBGMS for the practicum site.

### Section 3: Collection and Analysis of Evidence

#### **Executive Summary**

##### **Background**

Diabetes is the seventh leading cause of death in the United States (American Diabetes Association, 2016). Total costs of diagnosed diabetes are \$245 billion annually, \$176 billion for direct medical costs, and \$69 billion in reduced productivity (American Diabetes Association, 2016). Without collaboration and interventions by health care professionals, the cost and numbers will continue to increase. Researchers have found that patients with DM type 1 and 2 who receive assistance from health care professionals with glycemic control measures show reduced microvascular and macrovascular complications (American Diabetes Association, 2016b). Despite the evidence exhibiting the advantages of tighter glycemic control within the inpatient adult population group there have been minimal efforts to translate the evidence into practice (Tanenberg et al. 2017).

This systematic review explored the evidence available on adult patients (those aged 18 and older) with type 1 or type 2 diabetes who are managed with the traditional sliding scale insulin protocol versus a CBGMS in acute and critical care settings. A future review would be beneficial to study the efficacy of a clinical decision support tool with a narrower age range. Glucose fluctuations have been found to contribute to adverse outcomes for patients in the inpatient population (Blair, Zamora, Brumbelow, & Mercer, 2012). These fluctuations increase the mortality, morbidity, and length of stay in the hospital (Blair et al., 2012). Use of a computerized clinical decision support tool which

incorporates a software that is integrated into the EHR could aid in improving patient outcomes, reducing the financial burden faced by health care organizations, and decreasing patients' LOS (Blair et al., 2012).

The chronic care model (CCM) served as the theoretical framework for my project study of use of computerized clinical decision support systems for inpatient diabetic adults in acute and critical care settings (The Chronic Care Model, 2017). This model is comprised of decision support components that are used by health care professionals in providing optimal care for those suffering from a chronic illness such as DM (The Chronic Care Model, 2017). A literature review was performed with specific inclusion and exclusion criteria. The articles were appraised using the John Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal Tool as a guide for qualitative studies (John Hopkins Medicine Center for Evidence Based Practice, 2017). Each article was categorized by level of evidence and quality rating. Results of my project analysis aided in supporting the utilization of a computerized clinical decision support tool and provided evidence of the need for future studies to narrow the gap in knowledge and practice. I received confirmation from the Walden's University Institutional Review Board (IRB) to collect and analyze data from public reports and published literature on July 7, 2017. The IRB approval number is 07-07-17-0496733.

### **Objectives**

The evidence based practice question was, What is the current evidence supporting the utilization of a CBGMS for inpatient diabetic adults in the acute and critical care settings?

**Inclusion Criteria and Exclusion Criteria**

**Type of participants.** This review included studies of adult patients, who were aged 18 and over and who spoke the English language, and were in the inpatient setting with type 1 or type 2 DM, where they were using the traditional paper-based sliding scale method versus a CBGMS. Articles excluded were studies done on infants, children 4 years of age or older, toddlers 12 to 36 months old, neonates under 28 days old, or adults less than 18 years of age, and any article written in a language other than English. The search was limited by years. A majority of the research was conducted over the past 7 years, with the landmark study occurring 9 years ago in 2008. All duplicates have been removed.

**Type of intervention.** This review included studies in which the traditional paper-based sliding scale glucose management regimen was compared to the utilization of a CBGMS.

**Types of outcomes.**

This review included studies examining the following outcome measures: decreased length of stay, reduced cost, optimized hyperglycemic, and hypoglycemic episodes.

**Types of studies.**

This review included systematic reviews from multiple other studies with meta-analysis of RCTs, which studied inpatient adults treated with the traditional paper-based glucose regimen compared to a CBGMS. Cohort studies (prospective observational studies), systematic reviews without meta-analysis or synthesis, and quasi-experimental

studies were considered only in the absence of systematic reviews with meta-analysis or synthesis.

### **Search Strategy**

The search strategy included both published and unpublished studies. A three-step search strategy was used in this review. An initial limited search of CINAHL, MEDLINE, and Cochrane was utilized followed by an analysis of the keywords contained in the title, abstract, and the index terms used to describe the article. A second search utilized all identified keywords and indexed terms to assess all included databases. Thirdly, the reference list of all relevant articles was searched for additional studies. Studies published or translated into English were considered for inclusion in this review. To remain consistent with the current technology of CBGMS, studies published between 2008 and 2017 were considered for inclusion in this review. The databases included in the search were the following:

- CINAHL Plus with Full Text,
- MEDLINE with Full Text,
- Cochrane Database of Systematic Reviews,
- Ovid Nursing Journals Full Text,
- PubMed,
- Health Technology Assessments,
- ProQuest Central,
- Joanna Briggs Institute (JBI) Database of Evidence Based Practice,
- Web of Science,

- PsycINFO,
- Thoreau Multi-Database Search, and
- Academic Search Complete.

I also made an effort to identify literature that may not have been published. I searched for unpublished studies on the search engine Google Scholar and on the websites of the following organizations: American Diabetes Association, American Association of Clinical Endocrinologists, American College of Endocrinology, and International Diabetes Federation.

Initial keywords included the following: type 1 diabetes, type 2 diabetes, adults, computer-based glucose management systems, computer glucose management systems, glucose management, acute care setting, critical care setting, traditional insulin sliding scale AND disadvantages, computer based AND glucose management, computer based glucose management system AND critical care, computerized glucose management systems, computer based glucose management AND acute care, and computer based glucose management algorithms. A detailed individual evidence summary tool/table was maintained. Please see Appendix F for a visual representation.

**Methodological quality.** Papers selected for retrieval were assessed by one independent reviewer for methodological validity utilizing a standardized critical appraisal instrument from the Johns Hopkins Nursing Evidence-Based Practice Research Appraisal Tool. The independent reviewer possesses a Master's of Science degree in nursing, with a specialty in Healthcare Systems Management. Likewise, the reviewer has also completed all course work for the Doctor of Nursing Practice terminal degree. The

Johns Hopkins Evidence Level and Quality Guide were utilized as a guide to aid in the grading level and quality of all papers received (Appendix D).

### **Method of the Review**

After completing the search for studies and the study selection process, there were an abundance of studies collected but none that met the specific inclusion criteria for the review, which was determined to be too narrow. To aid in capturing more relevant data to answer the evidence based question, there was a decision made to deviate from the original protocol. Initially, the protocol intended to evaluate keywords: type 1 diabetes, type 2 diabetes, adults, computer-based glucose management systems, computer glucose management systems, glucose management, acute care setting, critical care setting, traditional insulin sliding scale AND disadvantages, computer based AND glucose management, computer based glucose management system AND critical care, computer based glucose management AND acute care, and computer based glucose management algorithms. However, the inclusion criteria was amended to include clinical decision support glucose management systems in order to capture all relevant data.

### **Critical Appraisal**

The studies selected for retrieval were assessed by one independent reviewer for methodological validity prior to inclusion in the review utilizing a standardized critical appraisal instrument from the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal Tool (Appendix E). The independent reviewer possesses a Master's of Science degree in nursing, with a specialty in Healthcare Systems Management. Likewise, the reviewer has also completed all course work for the Doctor of Nursing

Practice terminal degree. With only one reviewer, gaining a consensus regarding the research assessment was not available and thus risked bias. Studies included required positive responses to questions number 1 through 15 of the Johns Hopkins Quality Appraisal of Research Studies and questions 1 through 12 of the Johns Hopkins Quality Appraisal of Systematic Review with or without Meta-Analysis or Meta-Synthesis (Appendix E).

### **Data Extraction**

Data was extracted from studies included in the review utilizing the standardized data extraction tool from Johns Hopkins Nursing Evidence-Based Practice Appraisal Tool (Appendix E). The data extracted encompassed explicit details about the interventions, populations, study methods and outcomes of significance to the evidence based practice question and the specific objectives.

### **Data Synthesis**

Data synthesis was assisted by the utilization of the Johns Hopkins Nursing Evidence-Based Practice Synthesis of Evidence Guide and Recommendation Tool (Figure I2).

### **Results**

The initial literature search results included approximately 532 studies of which each title was reviewed. From those titles, 177 articles were determined to be potentially relevant studies. Upon review of the abstracts, 158 articles were excluded from the review. Exclusion was due to age of the participants, pediatrics, different disease processes, telemedicine, smartphone decision support, different outcome measures

including study focus on hemoglobin A1c levels, diet, exercise, self-management, non-systematic review randomized control trials (RCTs), or non-qualitative outcomes measures. The remaining 19 articles were reviewed in their entirety. All were excluded because they did not meet the inclusion criteria of: adult patients, speaking the English language, aged 18 and over, in the inpatient setting with type 1 or type 2 diabetes mellitus utilizing the traditional paper-based sliding scale method versus a computer-based glucose management system. The primary outcomes of the studies were different, or the study was not a systematic review randomized control trial with meta-analysis. Following the decision to amend the inclusion criteria to include clinical decision support glucose management systems a second review was conducted. After the second review of the full papers, a total of 16 papers were excluded. (Appendix G). This resulted in three papers, which met the inclusion criteria and were critically appraised by the reviewer. (Figure I3).

### **Conclusions**

From the findings in the review, the implementation of a computer-based glucose management system versus the traditional paper-based sliding scale regimen has the potential to improve patient outcomes but more research studies are needed to validate its overall benefits.

### **Implication for Practice**

The systematic review supported the initiative to, at the minimum, consider adopting a computer-based glucose management system in the inpatient care setting. Since the practicum site has not implemented any type of computer-based glucose

management system, a systematic review was conducted to address that need. During the systematic review, it was discovered that a sister facility of the organization had already adopted a computer-based glucose management system called EndoTool and the software was already integrated into their EHR system. The success of the systematic review in providing knowledge on best practices when caring for inpatient diabetes should increase the capability for healthcare professionals to optimize inpatient diabetic outcomes. The systematic review will be presented to the Diabetes Steering Committee (DSC) and the Inpatient Diabetic Coordinator (IDC), if approved for implementation the system can be adopted and mirror the practicum sites sister facility.

### **Implication for Research**

There are several significant implications for future research. Ongoing research regarding the safety, efficacy, and effectiveness of computer-based glucose management systems should be at the forefront. Education that aids the practicum site in (a) training; (b) obtaining the skill-set to care for patients through the assistance of a computerized management system; and (c) education on maintenance of the system should also be ongoing if the decision is to adopt the system. There should be an ongoing assessment of the healthcare professionals (a) knowledge; (b) skillset; and (c) confidence in caring for the inpatient diabetic patients.

Completion of the systematic review does suggest that there are benefits to computer-based management systems in general. Some of the benefits are (a) a therapeutic range could be reached and maintained; (b) it spearheads to an optimized physiological parameter more frequently; (c) it aids in ameliorating stabilization of

medications quicker; and (d) it is predicted to ultimately reduce the length of stay (LOS) and is cost-effective (Gillaizeau et al., 2013). However, with this information presented, it is imperative to continue research to validate the validity and feasibility of a computer-based glucose management system.

**Keywords**

Type 1 diabetes, type 2 diabetes, adults, computer-based glucose management systems, computer glucose management systems, glucose management, acute care setting, critical care setting, traditional insulin sliding scale AND disadvantages, computer based AND glucose management, computer based glucose management system AND critical care, computer based glucose management AND acute care, computer based glucose management algorithms and clinical decision support glucose management systems.

## Section 4: Findings and Recommendations

### **Findings and Implications**

The Johns Hopkins Nursing Evidence-Based Practice Research Appraisal Tool (see Appendix E) and the Johns Hopkins Nursing Evidence-Based Practice Evidence Level and Quality Guide (see Appendix D) were used to evaluate and appraise the strength of the data extracted from all three research articles. All scientific data extracted went through a rigorous process, wherein I first appraised the level of evidence which is the study design, the quality of research studies, and the quality of systematic review with or without meta-analysis or meta synthesis and, then, surmised the quality rating based upon the quality appraisal. All three studies were systematic reviews of multiple other studies with meta-analysis of randomized controlled trials.

The three studies included 30 plus RCTs. Data were extracted from several different scientific databases including Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, PubMed, Ovid, EMBASE, Psych INFO, Web of Science, ASLIB Index to Theses, ProQuest Digital Dissertations and Theses, and CINAHL. All studies were full-text articles. All subjects were diagnosed with type 1 or type 2 DM and were over the age of 18. Fillmore, Bray, & Kawamoto (2013) was updated for a strategy search adapted from previous systematic reviews in 2013. Gillaizeau, et al. (2013) was updated earlier by the Cochrane systematic reviews which were first published in 2001 and updated in 2008. Nieuwlaat et al. (2011) was updated with new studies in January 2010 from MEDLINE, EMBASE, Evidence-Based Medicine Reviews, and Inspec databases. In all three studies, the participants were health care professionals who were

responsible for patient care. Data were extracted from RCTs, nonrandomized controlled trials (NRCTs), controlled before-after studies (CBA), and interrupted-time series (ITs). However, for this systematic review, I decided to focus on RCTs with meta-analysis were analyzed. There were two reviewers for each systematic review. For each study, a flowchart was used to show how articles were managed during the analysis.

The researcher in all three studies identified what was known and/or not known and whether further research is needed to address any knowledge gaps. The purpose of each study was clearly presented. All literature reviewed was current with most sources within a 5-year timeframe from date of publication. With all control groups, the characteristics and demographics were similar and the interventions were the same to validate the feasibility of a CBGMS versus the traditional paper protocol. The researchers of all studies used reliable instruments to validate the research question or hypotheses. All results were presented clearly for the reviewer to interpret. The tables, diagrams, and figures included in all three studies entailed a narrative to explain content. In all three studies, limitations and how these limitations could be addressed were discussed. The reviewer also identified other limitations (see Appendix F). All three studies presented conclusions based off the results from their findings. The background information presented in all three studies discussed the purpose for the systematic review. All three studies included keywords or key terms and inclusion criteria that also matched the reviewer inclusive inclusion criteria list. All pertinent details were included in each study; these included design, sample size, methods utilized to extract data, results, strengths of the data extracted, limitations of the data extracted, and recommendations. To some

degree, the authors of each study appraised the evidence by stating whether the evidence was of high, good, or low quality.

### **Assessment of Methodological Quality**

The three studies selected for assessment of methodological quality were evaluated by one independent reviewer for methodological validity prior to inclusion in the review using a standardized critical appraisal methodology, the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal Tool (see Appendix E). Based on an independent review prior to the appraisal process,

I decided a positive response was required to Items 1 through 15 of the Johns Hopkins Quality Appraisal of Research Studies and Questions 1 through 12 of the Johns Hopkins Quality Analysis of Systematic Review with or without meta-analysis or meta-synthesis. However, following detailed review, all relevant assessment questions were addressed. Based on methodological quality assessment, three studies were included in the review (see Table 1).

**Table 1**

#### *Number of Studies Included and Excluded in the Project Study*

Number of studies included	Number of studies excluded
3	16

### **Detailed Discussion of Findings**

**Fillmore et al. (2013).** Fillmore et al. (2013) is an evidence level I, quality level B RCT with meta-analysis. The authors described increasing health care costs, how

inpatient hospitalizations are the driving force for this increase, and how clinical decision support systems could aid in improving these issues (Fillmore et al., 2013). The findings in this systematic review exhibited that clinical decision support (CDS) systems are an optimizing approach to ameliorating care and reducing cost in inpatient care settings. The purpose of the Fillmore et al. (2013) systematic review was to analyze trials using CDS systems interventions that had the possibility of reducing inpatient care costs.

Fillmore et al. (2013) searched and retrieved 7,663 articles and 78 manuscripts, 78.2% of which were controlled before-after studies, and 15.4% of which were RCTs. Most of the manuscripts were published during the years 2008 and thereafter. Moreover, 7,500 references were excluded after screening of titles and abstracts. A total of 163 full-text articles were deemed potentials per Fillmore et al (2013), of which 78 met the criteria for inclusion for the review. A total of 70.5% of the studies exhibited clinical amelioration through financial and proxy financial measures (Fillmore et al., 2013). However, the actual financial impact was not measured adequately, and the researchers encouraged further research.

The search strategy to retrieve articles included only MEDLINE through July 18, 2013 (Fillmore et al., 2013). The following search terms were included: decision support systems, clinical; decision-making, computer-assisted; computerized decision support; reminder systems; guideline adherence; and medical informatics (Fillmore et al., 2013). The inclusion, exclusion, and objective criteria included clinical decision support systems in an inpatient setting, cost reduction, and decrease in length of stay. Exclusion criteria that specifically matched the reviewers' exclusion criteria were non-English studies. The

study selection was similar to the reviewers with the titles and abstracts being evaluated by a single reviewer which aided in determining inclusion eligibility. All studies where data were extracted was full text. The trials that were extracted entailed outcomes that presented potential cost saving if a clinical decision support system was adopted. The Fisher's exact test of independence was used to aid in the proxy cost measure. This test was used due to the two variables, cost and study setting. Fillmore et al (2013), Authors determined that a p-value of  $< 0.05$  was significant. The proxy cost measures included length of stay, re-admissions rates, resource utilization metrics such as imaging studies, adverse events that may occur, and different process measures (Fillmore et al., 2013). Fifty-five (70.5%) of the studies reported a statistically and clinically significant improvement in a cost or proxy measure (Fillmore et al., 2013).

It was concluded by Fillmore et al (2013), that CDS systems do represent a favorable approach to decrease inpatient care cost. This study did determine that there were benefits to adopting a CDS system to aid in reduction of inpatient care costs versus the traditional paper sliding scale insulin protocol. The researchers also mentioned that there is more research encouraged to support CDS and inpatient care cost. There is also a significant gap in research studies to show how CDS can reduce inpatient care cost indefinitely.

**Gillaizeau et al. (2013).** Gillaizeau et al. (2013), evidence level I quality level A randomized control trial with meta-analysis paper described how physicians and other healthcare professionals frequently prescribe medications that only work during certain times and not consistently working always. This paper was a systematic review on how

these drugs are prescribed, the efficacy of the therapeutic index (TI), how it causes a therapeutic effect, and for how long the therapeutic effect lasts. This paper made a critical point in expressing how calculating and prescribing of medication can be very cumbersome for healthcare professionals in general. The paper went on to express how ascertaining the correct dosage is critical to the patients' overall outcomes. The following databases were included to retrieve articles for the systematic review: EPOC Group Specialized Register, Reference Manager; Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, Ovid; EMBASE, Ovid; and CINAHL, and EbscoHost (Gillaizeau et al., 2013). Another search was conducted from January 2012 to January 2013 and were placed on the Studies Awaiting Classification. The reviewers of this review also searched the reference lists from other relevant studies from the studies they chose to analyze. This systematic review utilized a reference manger called reference manger 5 to aid in removing all duplicates. The authors reviewed the titles and abstracts first then excluded studies that were not pertinent. All studies included were full text studies which were screened by the reviewers. All extracted data was reviewed by the reviewers independently. They could come to a consensus by having a group discussion with four other review authors (Gillaizeau et al., 2013).

The authors reviewed previous data abstraction and developed a checklist that aided in extracting decision support technical features such as: was the computerized advice given in real time or delayed or was dose recommendation given (Gillaizeau et al., 2013). Bias was assessed in this review. This was guided by EPOC Risk for Bias checklist (Appendix H). Two authors examined the quality of evidence for each outcome

for the review ranking: high, moderate, low, or very low. A risk ratio was also utilized. This ratio was utilized to determine the probability of a hypoglycemic or hyperglycemic occurring. A standardized mean difference (SMD) with a 95% confidence interval (CI) was also utilized. The SMD measures the impact of the adverse event (diabetes crisis). The outcomes that were measured include: “proportion of participants or time for which the plasma drug concentrations was within the therapeutic range, proportion of participants or time for which the studied physiological parameter was maintained within the target range, time to achieve therapeutic control, proportion of participants with toxic drug levels, proportion of participants with clinical improvement, proportion of participants with adverse effects of drug therapy, proportion of deaths, length of hospital stay, and total cost per participant” (Gillaizeau et al., 2013, p.9).

There were 42 trials with 40 randomized trials. The 42 trials were reported in 53 references (Gillaizeau et al., 2013). There was a decision to include 2 other computer-assisted dosage programs as subgroup analyses (Gillaizeau et al., 2013). The 40 randomized trials were individuals who were chosen at random to receive therapy through a computer-based protocol and 2 were non-randomized controlled trials where the participant were chosen before the intervention was carried out. The reviewers excluded 143 of 199 full text articles because inclusion criteria were not met. The systematic review did not only specifically focus on computer-based systems for glucose management, this review also included: aminoglycoside antibiotics, oral anticoagulants, insulin, anesthetic agents, anti-rejection drugs, and antidepressants (Gillaizeau et al., 2013). The studies utilized well-grounded outcomes measures such as: proportion of

participants with clinical amelioration, time for attaining a therapeutic effect, quantity of participants that experienced an unfavorable effect from the drug therapy, length of hospital stays, and the total direct and indirect cost per participant (Gillaizeau et al., 2013). The insulin studies are as follows: Eight (80%) strictly evaluated patients admitted into the intensive care unit with hyperglycemia, six of the studies included those undergoing cardiac surgery, and two were patients in the critical care setting that were critically ill. Only one study included a patient with type 2 diabetes mellitus. A computer decision support system was integrated into healthcare systems EHR systems. Model Predictive Control (MPC) was the software that was integrated. This software incorporated an algorithm that aided in glucose management (Gillaizeau et al., 2013). This software generates time for the next glucose intervention with set intervals of 0.5 to 4 hours (Gillaizeau et al., 2013). The six studies were a part of a closed loop insulin infusion for critically ill patients. This system was integrated by the European which wants to obtain a tighter glucose control for intensive care unit patients (Gillaizeau et al., 2013). Three other studies utilized another software called Karlsburg Diabetes Management System (KADIS), EndoTool Glucose Management System, GIN Computer Software, and one other study utilized a weight-based insulin dose calculator (Gillaizeau et al., 2013).

In the ten insulin studies, the effects differed between studies and the statistical heterogeneity which determines a problem when conducting a meta- analysis was elevated at 83% (Gillaizeau et al., 2013). However, all studies were in favor of computerized assistance (Gillaizeau et al., 2013). In three of the studies there was no

significant difference noted. The group showed favor of a computerized glucose management system by SMD of 1.27, 95% to 1.98 (Gillaizeau et al., 2013). However, there were noted inconsistencies because one study exhibited after a patient underwent cardiac surgery and nine studies reported that the mean glucose level displayed a high heterogeneity.

In the studies, a computer-based software was integrated into: healthcare organizations electronic health record (EHR), laptop computers, smartphones, table computers, or online calculators (Gillaizeau et al., 2013). In relation to insulin therapy specifically, evidence did not exhibit any variance between mortality or any other clinical unfavorable events. However, it was concluded by the researchers that computerized advice for drug dosage can benefit people taking insulin compared to dosing where the physician sets based on observation rather than computer assistance.

**Nieuwlaat et al. (2011).** Nieuwlaat et al. (2011), evidence level I quality level A randomized control trial with meta-analysis, described different medications, the therapeutic ranges associated with them, and the monitoring that is required for them. The study examined how computerized clinical decision support systems (CCDSSs) have the potential to ameliorate efficacy and safety of medication administration. A systematic review was conducted and articles were retrieved from several different databases. These databases include: MEDLINE, EMBASE, and Evidence-Based Medicine Reviews (Nieuwlaat et al., 2011). There were 33 randomized controlled trials which assessed more than glycemic control. It assessed computerized clinical decision support systems (CCDSS) regarding: management vitamin K antagonists (14), insulin (6),

theophylline/aminophylline (4), aminoglycosides (3), digoxin (2), lidocaine (1), or as part of a multifaceted approach (3) (Nieuwlaat et al., 2011). The research question for this systematic review was: do CCDSSs improve process of care or patient outcomes for therapeutic drug monitoring and dosing (TDMD)? (Nieuwlaat et al., 2011). The study selection included RCTs and the aim was to assess the effect of a CCDSS on care measures, patient outcomes, the providing of dosing recommendations based on individualized patient data placed into an integrated CCDSS (Nieuwlaat et al., 2011). Data extracted consisted of a pair of reviewers that even attempted to contact the primary authors of the studies via email to validate accuracy and to aid in filling the gap for missing data (Nieuwlaat et al., 2011). There was a total of 25 out of 33 replies via email back to the reviewers totaling 76% (Nieuwlaat et al., 2011).

The assessment of quality of all the RCTs for this study were scored for methodological quality on a 10-point scale with 0 being the lowest quality level and 10 being the highest (Nieuwlaat et al., 2011). This scale was called the Jadad scale. The CCDSS was considered effective with a ( $p < 0.05$ ) which mean they were of statistically significance (Nieuwlaat et al., 2011). The database search rendered:  $n=14,794$  that screened potentially eligible, there was a total of  $n=14,188$  eligible to be screened after duplicates were removed,  $n=13,859$  were excluded,  $n=329$  articles were evaluated and excluded because they were not full-text,  $n=163$  articles with 74 being NCTs and 50 did not evaluate CCDSS, 14 were only supplemental reports, 9 were deemed to have severe methodological flaws, 7 did not meet the definition of a CCDSS, 4

did not report outcomes that the author viewed as interesting, 4 had only the abstracts that were published, 1 included a previous review studies, n=166 studies that were included in the review met the TDMD criteria, n=33 (Nieuwlaat et al., 2011). In order for the CCDSS to be deemed effective, patient outcomes much improve  $\geq 50\%$  (Nieuwlaat et al., 2011). As for data analysis and synthesis, CCDSS effectiveness was analyzed and a meta-analysis was performed in comparison of at least 2 studies to compare (Nieuwlaat et al., 2011). The risk ratios were analyzed with a Review Manager. The possibility of bias was assessed with a mismatch of clinicians and patients and was compared with the utilization of a chi-square test (Nieuwlaat et al., 2011). The chi-square test did not find any difference in process of care or patient outcomes (Pearson X<sup>2</sup> evaluated the likelihood of the difference in outcomes which equaled 1.12, 2p=0.29 or patient outcomes PX<sup>2</sup>=1.35, 2p=0.53 (Nieuwlaat et al., 2011). Likewise, the review exhibited that 18 out of the 30 studies did reveal improvement in the process of care and 4 of 19 (21%) displayed improvement in patient outcomes (Nieuwlaat et al., 2011). Likewise, “all evaluable studies assessing insulin dosing for glycemic control exhibited an improvement” (Nieuwlaat et al., 2011, p. 13). It was concluded that decision makers at healthcare organizations should contemplate and assess the possibility of a CCDSS. CCDSSs have displayed how patient outcomes and the burden of cost can improve when it is implemented.

### **Discussion of Findings in the Context of Framework**

The Chronic Care Model (2017), was utilized as the theoretical framework for this project. This model utilizes: the community, resources and policies, self-

management, delivery system designs, health systems, organization of health care, decision support, and clinical information systems (Improving Chronic Illness Care Group Health Research, 2017). Each article addressed how resources and policies would need to be changed in order to implement a computer-based glucose management system. The articles explained how the delivery system design would have to be altered in order to improve outcomes. This could be done by steering from the traditional paper protocol to a computer-based glucose management system. Each article discussed how computer-based glucose management software would integrate into the EHR, meaning clinical information systems will be affected. Lastly, the model employs that self-management support is imperative. This is accomplished through education and training. Please see Appendix F for visual representation of the study findings and support and/or non-support of the utilization of CBGMS.

### **Recommendations**

As healthcare organizations continue to advance in technology, it is critical for leadership to take the initiative to research best practices and present it to upper leadership (administration). This would aid in advocating for advancement within their organizations information health systems. Furthermore, informatics leaders need to conduct research. In doing so, these disciplines could aid in providing that support to back the adoption of a computer-based glucose management system. Likewise, more research needed to be conducted and published to exhibit the benefits of a computer-based glucose management system versus the traditional paper protocol. Also, organizations need to develop a performance reporting system so that data can easily be

extracted to measure performance and outcomes of inpatient diabetics. Additionally, further research that demonstrates the cost implications for computer-based glucose management systems in the inpatient setting is imperative. Lastly, this systematic review illustrates the potential need for healthcare organizations to have an evidence-based committee that are consistently researching and looking for ways to improve current processes and provide care based on evidence of best practices.

### **Project Strengths and Limitations**

#### **Strengths**

One of the major strengths of the systematic review is being able to present the review to the DSC and the IDC at the practicum site. Being able to provide the knowledge and research to support computer-based glucose management systems is a plus for the practicum site. The practicum site sister facility already has this tool and being able to present this systematic review will aid the site in presenting this information to the appropriate party to push it forward.

#### **Limitations**

The main limitations of the systematic review were the lack of available research sources available. There was not enough evidence to accurately come up with a definite conclusion as to the evidence-based benefits of a computerized management system. However, the evidence discovered did support the initiative to, at the minimum, consider adopting a computer-based glucose management system in the inpatient care setting. One must also consider the potential for bias and all the studies had to be interpreted with great caution.

## Section 5: Dissemination Plan

### **Analysis of Self**

Kavanoz and Yuksel (2016) identified the following skills one must possess to become a scholar:

- effective writing and oral communication skills to present one's research,
- the ability to think critically and outside the box,
- the ability to argue one's point when conducting research,
- the ability to critically appraise and interpret literature and extract data,  
and
- skills to integrate and synthesize research.

Conducting this systematic review provided me with the opportunity to use all the skills outlined by Kavanoz and Yuksel. I did so by identifying the research question, defining the inclusion and exclusion criteria, searching for different studies on CBGMS, deciphering and choosing studies based on the inclusion criteria, extracting data, and evaluating the studies for bias. Dissemination of the systematic review will entail presentation of the review to my practicum site's DSC and the IDC. While working with the IDC and serving as a member of the organization's DSC, I discussed the possibility of presenting the systematic review to these parties and gained feedback that this would be more useful. Making the end-product of my project work a review would allow for my findings and conclusions to be shared among key organizational stakeholders in their entirety. Dissemination at the practicum organization is tentatively set for November 9, 2017, pending approval by my committee chair, co-chair, and URR member. My goal for

the future is for this systematic review to be shared with the organization's other facilities.

As I reflect on all my courses and practicum experiences, I realize I have grown significantly in relation to research. My courses and practicum experiences have given me the ability to understand the concept of researching a topic or issue. For example, in my current role as supervisor of day surgery and pre-assessment departments at my organization, I confront many different issues. For example, when it comes to changing current processes, I first go to the literature to see if there is evidence to support that change.

Furthermore, my professional growth has enhanced tremendously in relation to my leadership style and communication competence and capability. For example, I have noticed that I do not possess just one type of leadership style. My courses and practicum experiences have enabled me to distinguish the type of leader I truly am. I now know that my leadership style changes due to different circumstances or situations. For example, there are times when I should be autocratic (e.g., when staffing or meeting the needs of the unit), participative and/or democratic (e.g., in situations of shared governance, where I always try to obtain input from the staff regardless of whether I am the final decision maker or not), and transformational (e.g., by constantly communicating).

I decided to pursue my DNP degree for several reasons. One reason was to grow as a leader. Without a doubt, my courses and practicum experiences have provided me with opportunities to develop leadership skills. My practicum setting is one that is very welcoming. My preceptor as well as the IDC I work with are also very welcoming and

make me feel a part of their team. The DNP program at Walden University has also taught me how to be a well-rounded scholarly nurse leader. I have adopted traits that I admire from my preceptor and practicum site, and I have received recognition from my own organization for doing so. I have been awarded the opportunity to be a part of several committees at my practicum site. Some of these committees are the Ethics Committee, Professional Development Committee, Performance Improvement Committee, and the Diabetes Steering Committee. Being a part of these committees has enabled me to be a welcoming voice and given me the opportunity to use the knowledge and skills I have gained from my DNP courses, coursework, and project work.

Moreover, I have become competent in many areas. Some of the competencies I have developed to aid in successful evidence-based project implementation, evaluation, and dissemination are enhanced interpersonal skills, conflict resolution, time management skills, organizational skills, enhanced cognitive skills, and critical thinking skills. Likewise, my courses and practicum experience have given me the opportunity to work on several different projects alongside my preceptor and the IDC. Working with the IDC is very important to me, because my DNP project was centered on diabetes and diabetes management. Working on many different projects at my practicum setting has aided me in learning the different processes involved in disseminating information to the staff; the role that education, quality, and executive leadership play in making organizational changes; and how to prepare my doctoral finished product.

### **Summary**

Throughout the remainder of my professional career, I plan to continue to collaborate with other leaders of the interdisciplinary team. As a leader, I will continue to be engaged in many different committees in order to make changes in my organization as well as in my community. I will continue to be exposed to different processes and implementations at my current organization. Likewise, I will also collaborate with other leaders at different organizations to gain knowledge on what works best for them and what has not worked. For example, in working with the DMP throughout my practicum experience, I found that there were constant changes being made to optimize the DMP; I continuously worked to address these changes with my preceptor and the IDC. In conclusion, I will also continue to be a part of the Performance Improvement Committee within my own organization to aid in disseminating information when changes occur within my organization and the community.

## References

- American Diabetes Association. (2013). *New standards of care reflect trend toward individualized care*. Retrieved from <http://www.diabetes.org/newsroom/press-releases/2013/new-standards-of-care-2014-1.html>
- American Diabetes Association. (2016a). *The cost of diabetes*. Retrieved from <http://www.diabetes.org/advocacy/news-events/cost-of-diabetes.html>
- American Diabetes Association. (2016b). Standards of medical care in diabetes-2016- a bridged for primary care providers. *Clinical Diabetes*, 34(1), 3-21.  
doi:10.2337/diaclin.34.1.3
- American Diabetes Association. (2016c). *Statistics of diabetes*. Retrieved from <http://www.diabetes.org/diabetes-basics/statistics/?loc=db-slabnav>
- Badlani, S., Ford, Jr., W. T., Yu, D. J., Brogan, Jr., G. X., Pollack, Jr., C. V., & Volturo, G. A. (2014). Evidence for basal bolus insulin versus slide scale insulin. *Current Emergency and Hospital Medicine Reports*, 2, 26-34. doi:10.1007/540138-013-0032-4
- Bero, L. (2017). Systematic review: A method at risk for being corrupted. *American Journal of Public Health*, 107(1), 93-96.
- Blair, D., Zamora, L. Brumbelow, R., & Mercer, L. (2012). Glucose management “a must”: Computerized software systems help boost outcomes, reduce cost. *Nursing Management*, 43(12),10-12. doi:10.1097/01.NUMA,0000423781.61161.91
- Boumans, N. P. G., & Dorant, E. (2014). Double-duty caregivers: Healthcare professionals juggling employment and informal caregiving. A survey on personal

health and work. *Journal of Advanced Nursing*, 70(7), 1604-1615.

doi:10.1111/jan.12320

Crockett, S. E., Suarez-Cavelier, J., Accola, K. D., Hadas, L. A., Harnage, D. L., Garrett, P. R., Mulla, Z. D. (2012). Risk of postoperative hypoglycemia in cardiovascular surgical patients receiving computer-based versus paper-based insulin therapy.

*Endocrine Practice*, 18(4), 529-537. doi:10.4158/EP11337.OR

Diabetics epidemic enormous research shows. (2016). *Australian Nursing & Midwifery Journal*, 23(10), 26-26.

Elkins, M. Y. (2010). Using PICO and the brief report to answer clinical questions.

*Nursing*, 40(4), 59-60.

Fillmore, C. L., Bray, B. E., & Kawamoto, K. (2013). Systematic review of clinical decision support interventions with potential for patient cost reduction. *BMC Medical Informatics & Decision Making*, 13(135), 1-20. doi:10.1186/1472-6947-13-135.

Freeman, H., Prud'homme-Genereux, C., Schiller, A., Herreid, N. A., Ky, F., & Wright, C. (2016). What makes a good case, revisited: the survey monkey tells all.

*Journal of College Science Teaching*, 45(1), 60-65.

Gallup. (2017). Methodology center. Retrieved October 27, 2017 from

<http://www.gallup.com/178685/methodology-center.aspx>

Gillaizeau, F., Chan, E., Tringuart, L., Colombet, I., Waton, R. T., Rege-Walther, M., Burnand, B., & Durieux, P. (2013). Computerized advice on drug dosage to improve prescribing practice. *The Cochrane Library*, 11, 1-269.

Gough, D., Oliver, S., & Thomas, J. (2012). An introduction to systematic reviews.

London: SAGE Publications.

Gregg, E. W., Li, Y., Wang, J., Burrows, N. R., Ali, M. K., Rolka, D., Williams, D. E., &

Geiss, L. (2014). Changes in diabetes-related complications in the United States 1990-2010. *England Journal of Medicine*, 370(16), 1514-1523.

Guthrie, D. W., Guthrie, R. A., Hinnen, D., & Childs, B. P. (2011). It's tie to abandon the sliding scale. *Journal of Family Practice*, 60(5), 266-270.

Haltiwagner, E. P. & Brutus, H. (2012). A culturally sensitive diabetes peer support for older Mexican-Americans. *Occupational Therapy*, 19(2), 67-75.

Ham-Baloyi, W. T. & Jordan, P. (2016). Systematic review as a research method in post graduate nursing education. *Health SA Gesondheid*, 21, 120-128.

Houghton, N., Casal, R., Fortuna, S., & Larsen, T. (2015). DNPs: collaboration and practice. *Ohio Nurses Review*, 90(4), 12-14.

John Hopkins Medicine Center for Evidence Based Practice. (2017). *John Hopkins Nursing Evidence-Based Practice Model*. Retrieved April 27, 2017 from [http://www.hopkinsmedicine.org/evidence-based-practice/\\_docs/Appendix%20C%20image.jpg](http://www.hopkinsmedicine.org/evidence-based-practice/_docs/Appendix%20C%20image.jpg)

- John Hopkins Medicine Center for Evidence Based Practice. (2017). *John Hopkins Nursing Evidence-Based Practice Model*. Retrieved April 27, 2017 from [http://www.hopkinsmedicine.org/evidence-based-practice/\\_docs/Appendix%20E%20image.jpg](http://www.hopkinsmedicine.org/evidence-based-practice/_docs/Appendix%20E%20image.jpg)
- Kavanoz, S. & Yuksel, H. G. (2016). Developing and validating a self-efficacy scale for scholarly writing in English. *International Online Journal of Educational Sciences*, 8(2), 71-82.
- Lachman, V. P., Swanson, E. O., & Windland-Brown, J. (2015). The new code of ethics for nurses with interpretive statements (2015): practical clinical application: part II. *MEDSURG Nursing*, 24(5), 363-368.
- Mann, E. A., Allen, D. A., Serio-Melvin, M. L., Wolf, S. E., & Salinas, J. (2012). Clinician satisfaction with computer decision support in the intensive care unit. *Dimensions Critical Care Nursing*, 31(1), 31-36.  
doi:10.1097/DCC.0b013e31823a5553
- Mann, E. A., Jones, J. A., Wolf, S. E., & Wade, C. E. (2011). Computer decision support software safely improves glycemic control in the burn intensive care unit: a randomized controlled clinical study. *Journal of Burn Care & Research*, 32(2), 246-255. doi:10.1097/BCR.0b013e31820aaebf
- Medical City of Plano. (2017). *Medical City of Plano*. Retrieved April 21, 2017 from <http://medicalcityplano.com>
- Medical Device Daily. (2013). Vidant shows promise of EndoTool glucose system. *ADA 2013 Meeting Notebook*, 17(123), 4.

- Merriam-Webster. (2016). *Ameliorate*. Retrieved October 21, 2016 from <http://www.merriam-webster.com/dictionary/ameliorate>
- Miller, T. A. & Dimatteo, R. M. (2013). Importance of family/social support and impact on adherence to diabetic therapy. *Diabetes Metabolic Syndrome and Obesity: Targets and Therapy*, 6, 421-426. doi:102147/DMSO.S36368. Retrieved October 16, 2016 from [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3825688/#\\_ffn\\_sectitle](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3825688/#_ffn_sectitle)
- Monarch Medical Technologies. (2015). Monarch medical technologies receives FDA 510(k) clearance for EndoTool subq.
- Monarch Medical Technologies. (2013). Study EndoTool glucose management system boosts Vidant Medical Center's surgical care improvement project scores doubles cost savings in hospital acquired conditions.
- Morris, P. J. (2015). What, how, and why. *North Carolina Medical Journal*, 76(4), 228-229.
- Nieuwlaat, R., Connolly, S., Mackay, J. A., Weise-Kelly, L., Navarro, T., Wilczynski, N. L., & Haynes, R. B. (2011). Computerized clinical decision support systems for therapeutic drug monitoring and dosing: a decision-maker-researcher partnership systematic review. *Implementation Science*, 6(1), 90-103.
- Rodbard, D. (2016). Continuous glucose monitoring: a review of successes, challenges, and Opportunities. *Diabetes Technology & Therapeutics*, 18(2), S3-S13. doi:10.1089/dia.2015.0417. Retrieved September 7, 2017 from <https://www.ncbi.nlm.nih.gov/m/pubmed/26784127>

- Romero, L. F. (2016). Diabetes: the current state of affairs from a population management view. *MILQ: Medical Laboratory Observers*, 48(8), 12-20.
- Stellefson, M., Dipnarine, K., Stopka, C. (2013). The Chronic Care Model and diabetes management in US primary care settings: a systematic review. *Preventing Chronic Disease*, 10(1), 1-21. doi:<http://dx.doi.org/10.5888/pcd10.120180>. Retrieved from [http://www.cdc.gov/pcd/issues/2013/12\\_0180.ht](http://www.cdc.gov/pcd/issues/2013/12_0180.ht)
- Tanenberg, R. J., Hardee, S., Rothermel, C., & Drake, A. J. (2017). Use of a computer-guided glucose management system to improve glycemic control and address national quality measures: a 7-year retrospective observational study at a tertiary care teaching hospital. *Endocrine Practice: Official Journal of The American College of Endocrinology and the American Association of Clinical Endocrinologist*, 23(3), 331-441.
- The Chronic Care Model. (2017). Model elements. Retrieved September 7, 2017 from [http://www.improvingchroniccare.org/index.php?p=Model\\_Elements&s=18](http://www.improvingchroniccare.org/index.php?p=Model_Elements&s=18)
- Thompson, R. (2011). Comprehensive case study diabetic ketoacidosis. *MEDSURG Nursing*, 20(6), 338-339.
- Trotter, B., Conaway, M. R., Burns, S, M. (2013). Relationship of glucose values to sliding scale insulin (correctional insulin) dose delivery and meal time in acute care patients with diabetes mellitus. *MEDSURG*, 22(2), 99-135.
- Windland-Brown, J., Lachman, V. P., & Swanson, E. O. (2015) The new code of ethics for nurses with interpretive statements (2015): practical clinical application; part I. *MEDSURG Nursing*, 24(4), 268-271.

## Appendix A: Approval to Use Johns Hopkins Appraisal Tool

# JOHNS HOPKINS NURSING EVIDENCE- BASED PRACTICE MODEL AND TOOLS

Thank you for submitting the requested information. You now have permission to use the JHN EBP model and tools.

Click [here](#) to download the tools. Reminder: You may not modify the model or the tools. All reference to source forms should include “©The Johns Hopkins Hospital/The Johns Hopkins University.”

We offer an excellent online course about our model/tools. It is an engaging online experience, containing interactive elements, self-checks, instructional videos, and demonstrations of how to put EBP into use. The course follows the EBP process from beginning to end and provides guidance to the learner on how to proceed, using the tools that are part of the Johns Hopkins Nursing EBP model. [Take a sneak peek of the course.](#)

Click [here](#) for more information about our online course. Group rates available, email [ijhn@jhmi.edu](mailto:ijhn@jhmi.edu) to inquire.

Do you prefer hands-on learning? We are offering a 5-day intensive Boot Camp where you will learn and master the entire EBP process from beginning to end. Take advantage of our retreat-type setting to focus on your project, collaborate with peers, and get the expertise and assistance from our faculty. Click [here](#) to learn more about EBP Boot Camp.

Institute for Johns Hopkins Nursing  
[http://www.hopkinsmedicine.org/institute\\_nursing/](http://www.hopkinsmedicine.org/institute_nursing/)  
[IJHN@jhmi.edu](mailto:IJHN@jhmi.edu)  
443-287-4745

Appendix B: Johns Hopkins Nursing Evidence-Based Practice Project Management Guide

<b>Initial EBP Question:</b>						
<b>EBP Team Leader(s):</b>						
<b>EBP Team Members:</b>						
Activities	Start Date	Days Required	End Date	Person Assigned	Milestone	Comment / Resources Required
<b>PRACTICE QUESTION:</b>						
<b>Step 1:</b> Recruit interprofessional team						
<b>Step 2:</b> Develop and refine the EBP question						
<b>Step 3:</b> Define the scope of the EBP question and identify stakeholders						
<b>Step 4:</b> Determine responsibility for project leadership						
<b>Step 5:</b> Schedule team meetings						
<b>EVIDENCE:</b>						
<b>Step 6:</b> Conduct internal and external search for evidence						
<b>Step 7:</b> Appraise the level and quality of each piece of evidence						
<b>Step 8:</b> Summarize the individual evidence						
<b>Step 9:</b> Synthesize overall strength and quality of evidence						
<b>Step 10:</b> Develop recommendations for change based on evidence synthesis <input type="checkbox"/> Strong, compelling evidence, consistent results <input type="checkbox"/> Good evidence, consistent results <input type="checkbox"/> Good evidence, conflicting results <input type="checkbox"/> Insufficient or absent evidence						
<b>TRANSLATION:</b>						
<b>Step 11:</b> Determine fit, feasibility, and appropriateness of recommendation(s) for translation path						
<b>Step 12:</b> Create action plan						
<b>Step 13:</b> Secure support and resources to implement action plan						
<b>Step 14:</b> Implement action plan						
<b>Step 15:</b> Evaluate outcomes						
<b>Step 16:</b> Report outcomes to stakeholders						
<b>Step 17:</b> Identify next steps						
<b>Step 18:</b> Disseminate findings						

Adapted from John Hopkins Medicine Center for Evidence Based Practice. John Hopkins Nursing Evidence-Based Practice Model. Retrieved April 27, 2017 from [http://www.hopkinsmedicine.org/evidence-based-practice/\\_docs/appendix\\_a\\_proj\\_management\\_guide.pdf](http://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_a_proj_management_guide.pdf)

Appendix C: Johns Hopkins Nursing Evidence-Based Practice Question Development Tool

<b>1. What is the problem and why is it important?</b>		
<b>2. What is the current practice?</b>		
<b>3. What is the focus of the problem?</b>		
<input type="checkbox"/> Clinical	<input type="checkbox"/> Educational	<input type="checkbox"/> Administrative
<b>4. How was the problem identified? (Check all that apply)</b>		
<input type="checkbox"/> Safety/risk management concerns	<input type="checkbox"/> Variations in practice compared with external organizations	<input type="checkbox"/> Evidence validation for current practice
<input type="checkbox"/> Quality concerns (efficiency, effectiveness, timeliness, equity, patient-centeredness)	<input type="checkbox"/> Unsatisfactory patient, staff, or organizational outcomes	<input type="checkbox"/> Financial concerns
<input type="checkbox"/> Variations in practice within the setting		
<b>5. What is the scope of the problem?</b>		
<input type="checkbox"/> Individual	<input type="checkbox"/> Population	<input type="checkbox"/> Institution/system
<b>6. What are the PICO components?</b>		
P – (Patient, population, problem):		
I – (Intervention):		
C – (Comparison with other interventions, if applicable):		
O – (Outcomes that include metrics for evaluating results):		
<b>7. Initial EBP question:</b>		
<b>8. List possible search terms, databases to search, and search strategies:</b>		
<b>9. What evidence must be gathered? (Check all that apply)</b>		
<input type="checkbox"/> Literature search	<input type="checkbox"/> Standards (regulatory, professional, community)	<input type="checkbox"/> Patient/family preferences
<input type="checkbox"/> Guidelines	<input type="checkbox"/> Expert opinion	<input type="checkbox"/> Clinical expertise
		<input type="checkbox"/> Organizational data

Adapted from John Hopkins Medicine Center for Evidence Based Practice. John Hopkins Nursing Evidence-Based Practice Model. Retrieved April 27, 2017 from [http://www.hopkinsmedicine.org/evidence-based-practice/\\_docs/appendix\\_B\\_final.Question\\_Development\\_PICO.pdf](http://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_B_final.Question_Development_PICO.pdf).

Appendix D: Johns Hopkins Nursing Evidence-Based Practice Evidence Level and  
Quality Guide

Evidence Levels	Quality Guides
<b>Level I</b> Experimental study, randomized controlled trial (RCT) Systematic review of RCTs, with or without meta-analysis	<b>A High quality:</b> Consistent, generalizable results; sufficient sample size for the study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence
<b>Level II</b> Quasi-experimental study Systematic review of a combination of RCTs and quasi-experimental, or quasi-experimental studies only, with or without meta-analysis	<b>B Good quality:</b> Reasonably consistent results; sufficient sample size for the study design; some control, fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence
<b>Level III</b> Non-experimental study Systematic review of a combination of RCTs, quasi-experimental and non-experimental studies, or non-experimental studies only, with or without meta-analysis Qualitative study or systematic review with or without a meta-synthesis	<b>C Low quality or major flaws:</b> Little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn

Evidence Levels	Quality Guides
<b>Level IV</b> Opinion of respected authorities and/or nationally recognized expert committees/consensus panels based on scientific evidence  Includes: <ul style="list-style-type: none"> <li>• Clinical practice guidelines</li> <li>• Consensus panels</li> </ul>	<b>A High quality:</b> Material officially sponsored by a professional, public, private organization, or government agency; documentation of a systematic literature search strategy; consistent results with sufficient numbers of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies and definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years  <b>B Good quality:</b> Material officially sponsored by a professional, public, private organization, or government agency; reasonably thorough and appropriate systematic literature search strategy; reasonably consistent results, sufficient numbers of well-designed studies; evaluation of strengths and limitations of included studies with fairly definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years  <b>C Low quality or major flaws:</b> Material not sponsored by an official organization or agency; undefined, poorly defined, or limited literature search strategy; no evaluation of strengths and limitations of included studies, insufficient evidence with inconsistent results, conclusions cannot be drawn; not revised within the last 5 years

<p><b>Level V</b> Based on experiential and non-research evidence</p> <p>Includes:</p> <ul style="list-style-type: none"> <li>• Literature reviews</li> <li>• Quality improvement, program or financial evaluation</li> <li>• Case reports</li> <li>• Opinion of nationally recognized experts(s) based on experiential evidence</li> </ul>	<p><b>Organizational Experience:</b></p> <p><b>A High quality:</b> Clear aims and objectives; consistent results across multiple settings; formal quality improvement, financial or program evaluation methods used; definitive conclusions; consistent recommendations with thorough reference to scientific evidence</p> <p><b>B Good quality:</b> Clear aims and objectives; consistent results in a single setting; formal quality improvement or financial or program evaluation methods used; reasonably consistent recommendations with some reference to scientific evidence</p> <p><b>C Low quality or major flaws:</b> Unclear or missing aims and objectives; inconsistent results; poorly defined quality improvement, financial or program evaluation methods; recommendations cannot be made</p> <p><b>Literature Review, Expert Opinion, Case Report, Community Standard, Clinician Experience, Consumer Preference:</b></p> <p><b>A High quality:</b> Expertise is clearly evident; draws definitive conclusions; provides scientific rationale; thought leader(s) in the field</p> <p><b>B Good quality:</b> Expertise appears to be credible; draws fairly definitive conclusions; provides logical argument for opinions</p> <p><b>C Low quality or major flaws:</b> Expertise is not discernable or is dubious; conclusions cannot be drawn</p>
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Adapted from John Hopkins Medicine Center for Evidence Based Practice. John Hopkins Nursing Evidence-Based Practice Model. Retrieved April 27, 2017 from [http://www.hopkinsmedicine.org/evidence-based-practice/\\_docs/appendix\\_c\\_evidence\\_level\\_quality\\_guide.pdf](http://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_c_evidence_level_quality_guide.pdf).

## Appendix E: Johns Hopkins Nursing Evidence-Based Practice Research Appraisal Tool

Article Title:		Number:	
Author(s):		Publication Date:	
Journal:			
Setting:		Sample (Composition & size):	
Does this evidence address my EBP question?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Do not proceed with appraisal of this evidence
<b>Level of Evidence (Study Design)</b>			
A. Is this a report of a single research study? <i>If No, go to B.</i>			
1. Was there manipulation of an independent variable?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
2. Was there a control group?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
3. Were study participants randomly assigned to the intervention and control groups?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
<b>If Yes to all three, this is a Randomized Controlled Trial (RCT) or Experimental Study</b>	→	<input type="checkbox"/> LEVEL I	
<b>If Yes to #1 and #2 and No to #3, OR Yes to #1 and No to #2 and #3, this is Quasi Experimental</b> (some degree of investigator control, some manipulation of an independent variable, lacks random assignment to groups, may have a control group)	→	<input type="checkbox"/> LEVEL II	
<b>If No to #1, #2, and #3, this is Non-Experimental</b> (no manipulation of independent variable, can be descriptive, comparative, or correlational, often uses secondary data) <b>or Qualitative</b> (exploratory in nature such as interviews or focus groups, a starting point for studies for which little research currently exists, has small sample sizes, may use results to design empirical studies)	→	<input type="checkbox"/> LEVEL III	
<b>NEXT, COMPLETE THE BOTTOM SECTION ON THE FOLLOWING PAGE, "STUDY FINDINGS THAT HELP YOU ANSWER THE EBP QUESTION"</b>			





***Quality Rating Based on quality appraisal***

- A High quality:** consistent, generalizable results; sufficient sample size for the study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence
- B Good quality:** reasonably consistent results; sufficient sample size for the study design; some control, and fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence
- C Low quality or major flaws:** little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn

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Appendix F: Johns Hopkins Nursing Evidence-Based Individual Evidence Summary  
Tool/Table

**EBP Question:** what is the current evidence supporting the utilization of a computer-based glucose management system for inpatient diabetic adults in the acute and critical care settings?

**Date:**

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
1	Fillmore, C. L., Bray, B. E., & Kawamoto, K. (2013).	RCT, Systematic Review with meta-analysis	7,663 articles, 78 manuscripts were included.  In a general hospital setting. MEDLINE Database utilized to retrieve studies.  <input type="checkbox"/> N/A	The findings in this systematic review exhibit that clinical decision support (CDS) systems aids as an optimizing approach to ameliorate care and reduce cost in the inpatient care setting. Encouraged to support CDS and inpatient care cost.	Data search was limited to only one database MEDLINE Extracting data from more than one source could aid in a more inclusive search and more data can be extracted.	Level 1 Quality B
2	Gillaizeau, F., Chan, E., Tringuart, L., Colombet, I., Waton, R. T., Rege-Walther, M., Burnand, B., & Durieux, P. (2013).	RCT, Systematic Review with meta-analysis	42 trials (40 randomized controlled trials (trials that allocate people at random to receive one of a number of drugs or procedures) and two non-randomized controlled trials). Data was extracted from scientific databases.	All types of study designs that met Effective Practice and Organization of Care Group (EPOC) inclusion criteria was utilized. These include: randomized controlled trials (RCTs), non-randomized controlled trials (NRCTs), controlled before-and-after (CBA), and interrupted time series (ITS) studies. The participants were healthcare professionals with responsibility for patient care. It was concluded by the researchers that computerized advice for drug	The sample size could be greater to support the qualitative research. Risk for bias was noted even with the EPOC checklist.	Level 1 Quality A

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
			<p>This was a Systematic Review.</p> <p><input type="checkbox"/> N/A</p>	dosage can benefit patients taking insulin compared to dosing where the physician sets based on observation rather than computer assistance.		
3	Nieuwlaat, R., Connolly, S., Mackay, J. A., Weiskelly, L., Navarro, T., Wilczynski, N. L., & Haynes, R. B. (2011).	RCT, Systematic review with meta-analysis	<p>Thirty-three randomized controlled trials.</p> <p>A decision maker researcher partnership systematic review was conducted. This review included studies from new studies and databases: MEDLINE, EmBASE, Evidence-Based Medicine Reviews, and Inspec.</p> <p><input type="checkbox"/> N/A</p>	An overall 60% of the studies exhibited improvement for process care and patient outcomes. Recommendations were delivered at the time of care. Recommended insulin dosing and glucose control in patients in the Intensive Care Unit (ICU) was achieved and ranged from a blood glucose level of (60-140). There was predicted glycemic risk that reduced hypoglycemic episodes.	The systematic review assessed more than glycemic control. It assessed computerized clinical decision support systems (CCDSS) regarding: management vitamin K antagonists (14), insulin (6), theophylline/aminophylline (4), aminoglycosides (3), digoxin (2), lidocaine (1), or as part of a multifaceted approach (3). This made it difficult to extract the data related to glucose management.	Level 1 Quality A

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### Appendix G: Excluded Studies and Reason for Exclusion

1. Albisser, A. M. (2009). Technophobia, prescription checking and the future of diabetes management. *Diabetologia*, 52(6), 1013-1018. doi:10.1007/500125-009-1341-8
  - a. Reason for exclusion: observational study and non-control group to support evidence presented.
2. Blair, D., Zamora, L. Brumbelow, R., and Mercer, L. (2012). Glucose management “a must” computerized software systems help boost outcomes, reduce cost. *Nursing Management*, 43(12), 10-12. doi:10.1097/01.NUMA,0000423781.61161.91
  - a. Reason for exclusion: non-randomized trial, no control group, non-systematic review, research ended in 2012 nothing current within the last 5 years.
3. Cavalcanti, A. B., Silva, E., Pereira, A. J., Caldeira-Filho, M., Almeida, F. F., Westphal, G. A., Beims, R., Fernandes, C. C., Correa, T. D., Gouvea, M. R., & Eluf-Neto, J. (2009). A randomized control-trial comparing a computer-assisted insulin infusion protocol with a strict and a conventional protocol for glucose control in critically ill patients. *Journal of Critical Care*, 24(3), 371-378. doi: <https://doi.org/10.1016/j.jcrc.2009.05.005>
  - a. Reason for exclusion: not a systematic review, was a RCT but only studied 167 patients in the Medical Intensive Care Unit, non-meta-analysis.
4. Crockett, S. E., Suarez-Cavelier, J., Accola, K. D., Hadas, L. A., Harnage, D. L., Garrett, P. R., Butler, K. A., & Mulla, Z. D. (2012). Risk of postoperative

hypoglycemia in cardiovascular surgical patients receiving computer-based versus paper-based insulin therapy. *Endocrine Practice*, 18(4), 529-537. doi:

10.4158/EP11337.OR

- a. Reason for exclusion: observational study, non-systematic review, non-meta-analysis, non-RCTs, data analyzed with use of SAS software version 9.2. Kaplan-Meier survival curves, Wilcoxon test, and Cox model were utilized to provide statistical analysis. All were good analytic tools but there was not an sufficient control group.
5. Dortch, M. J., Mowery, N. T., Ozdas, A., Dossett, L. Cao, H., Collier, B., Holdes, G., Miller, R. A., & May, A. K. (2008). A computerized insulin infusion titration protocol improves glucose control with less hypoglycemia compared to a manual titration protocol in a trauma intensive care unit. *Journal of Parenteral and Enteral Nutrition*, 32(1), 18-27. doi:<https://doi.org/10.1177/014860710803200118>
    - a. Reason for exclusion: a cohort study with 552 critically ill patients.
  6. Eslami, S., Abu-Hanna, A., DeJonge, E., & DeKeizer, N., F. (2009). Tighter glycemic control and computerized decision-support systems: a systematic review. *Intensive Care Medicine*, 35(9), 1505-1517. doi:10.1007/s00134-009-1542-0
    - a. Reason for exclusion: systematic review with only 3 RCTs, data extracted from papers from 1950-2008.
  7. Frits, G. W., Cleveringa, K. J., Gorter, M., Van Gijssel, J., & Guy-Rutten, E. H. M. (2013). Computerized decision support systems in primary care for type 2

diabetes patients only improve patients' outcomes when combined with feedback on performance and case management: a systematic review. *Diabetes Technology & Therapeutics*, 15(2), 180-192. doi:<https://doi.org/10.1089/dia.2012.0201>

- a. Reason for exclusion: this paper was a systematic review with meta-analysis and RCTs, however this paper only discussed type 2 diabetes.
8. Harrison, R. L., Stalker, S. L., Henderson, R., & Lyerla, F. (2013). Use of a clinical decision support system to improve hypoglycemia management. *MEDSURG Nursing*, 22(4), 250-263.
    - a. Reason for exclusion: no control group, results were limited to one facility, non-randomized trial, not a systematic review.
  9. Huser, V., Rasmussen, L. V., Oberg, R., Starren, J. B. (2011). Implementation of workflow engine technology to deliver basic clinical decision support functionality. *BMC Medical Research*, 11(43), 1-19.
    - a. Reason for exclusion: paper did discuss clinical decision support systems but there was no control-group to compare results. Non-systematic review, non-meta-analysis, diabetes management was not specifically discussed. Objective assessed utilizing clinical decision support systems, potential bias.
  10. Kansagara, D., Fu R, F. M., Wolf, F. L., & Helfand, M. (2011). Intensive insulin therapy in hospitalized patients: a systematic review. *Annals of Internal Medicine*, 154(4), 268-282.
    - a. Reason for exclusion: more related to insulin therapy and not tools to aid in improving outcomes, inclusion criteria differ significantly to reviewers

inclusion criteria: perioperative care, myocardial infarction, stroke or brain injury settings.

11. Magee, M. C. (2012). Improving IV insulin administration in a community hospital. *Journal of Visualized Experiments*, 64, e3705.

- a. Reason for exclusion: objective assessed utilizing clinical decision support systems non-systematic review, data limited by only one community hospital.

12. Mann, E. A., Allen, D. A., Serio-Melvin, M. L., Wolf, S. E., & Salinas, J. (2012). Clinician satisfaction with computer decision support in the intensive care unit. *Dimensions Critical Care Nursing*, 31(1), 31-36.

doi:10.1097/DCC.0b013e31823a5553

- a. Reason for exclusion: data was collected by a written questionnaire to all clinical staff. A 5-point Likert scale was utilized to measure clinical satisfaction. Non-systematic, non-meta-analysis, non-RCTs, descriptive analysis was conducted.

13. Mann, E. A., Jones, J. A., Wolf, S. E., & Wade, C. E. (2011). Computer decision support software safely improves glycemic control in the burn intensive care unit: a randomized controlled clinical study. *Journal of Burn Care & Research*, 32(2), 246-255. doi:10.1097/BCR.0b013e31820aaebf

- a. Reason for exclusion: a prospective, paired randomization crossover trial was utilized, non-systematic review, non-meta-analysis.

14. Mould, D. R., D' Haens, G., & Upton, R. N. (2016). Clinical decision support tools: the evolution of a revolution. *Clinical Pharmacology and Therapeutics*, 99(4), 405-418.
  - a. Reason for exclusion: not a systematic review, non-randomized trial, objective assessed the utilization of several clinical support systems non-specific to just glucose management.
15. Saager, L., Collins, G. L., Burnside, B., Tymke, W. H., Zhang, L., Jacobsohn, E., & Avidan, M. (2008). A randomized study in diabetic patients undergoing cardiac surgery comparing computer-guided glucose management with a standard sliding scale protocol. *Journal of Cardiothoracic and Vascular Anesthesia*, 22(3), 377-382. doi:10.1053/j.jvca.2007.09.013
  - a. Reason for exclusion: research is more than 9 years its 10 years old, a prospective randomized control trial, limited participants (n=40), non-systematic review, only involved diabetic patients undergoing cardiac surgery, subject characteristics did not match inclusion criteria: male, female, BMI, hypertension, chronic heart failure, myocardial infarctions, chronic renal failure, ejection fraction, oral insulin, length of diabetes, hemoglobin A1C level, and pre-operative triglycerides.
16. Wan, Q., Makeham, M., Zwar, N. A., & Petche, S. (2012). Qualitative evaluation of a diabetes electronic decision support tool: views of users. *BMC Medical Informatics and Decision Making*, 12(61), 1-7. doi: <https://doi.org/10.1186/1472-6947-12-61>

- a. Reason for exclusion: not a systematic review, objective assessed the users support of electronic decision support tools, did not present direct patient results or outcomes, qualitative study but the study design included only telephone interviews from general practitioners and practice nurses, was a non-randomized study.

## Appendix H: Risk of Bias EPOC Checklist

**Suggested risk of bias criteria for EPOC reviews****Risk of bias for studies with a separate control group**

- **Randomized trials**
- **Non-randomized trials**
- **Controlled before-after studies**

Nine standard criteria are suggested for all randomized trials, non-randomized trials and controlled before-after studies. Further information can be obtained from the Cochrane handbook section on risk of bias.

**Was the allocation sequence adequately generated?**

Score “Low risk” if a random component in the sequence generation process is described (e.g. Referring to a random number table). Score “High risk” when a nonrandom method is used (e.g. performed by date of admission). Non-randomized trials and controlled before-after studies should be scored “High risk”. Score “Unclear risk” if not specified in the paper.

**Was the allocation adequately concealed?**

Score “Low risk” if the unit of allocation was by institution, team or professional and allocation was performed on all units at the start of the study; or if the unit of allocation was by patient or episode of care and there was some form of centralized randomization scheme, an on-site computer system or sealed opaque envelopes were used. Controlled before-after studies should be scored “High risk”. Score “Unclear risk” if not specified in the paper.

**Were baseline outcome measurements similar?<sup>1,2</sup>**

Score “Low risk” if performance or patient outcomes were measured prior to the intervention, and no important differences were present across study groups. In randomized trials, score “Low risk” if imbalanced but appropriate adjusted analysis was performed (e.g. Analysis of covariance). Score “High risk” if important differences were

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<sup>1</sup> If some primary outcomes were imbalanced at baseline, assessed blindly or affected by missing data and others were not, each primary outcome can be scored separately.

<sup>2</sup> If “Unclear risk” or “High risk”, but there is sufficient data in the paper to do an adjusted analysis (e.g. Baseline adjustment analysis or Intention to treat analysis) the criteria should be re scored as “Low risk”.

present and not adjusted for in analysis. If randomized trials have no baseline measure of outcome, score “Unclear risk”.

**Were baseline characteristics similar?**

Score “Low risk” if baseline characteristics of the study and control providers are reported and similar. Score “Unclear risk” if it is not clear in the paper (e.g. characteristics are mentioned in text but no data were presented). Score “High risk” if there is no report of characteristics in text or tables or if there are differences between control and intervention providers. Note that in some cases imbalance in patient characteristics may be due to recruitment bias whereby the provider was responsible for recruiting patients into the trial.

**Were incomplete outcome data adequately addressed?<sup>1</sup>**

Score “Low risk” if missing outcome measures were unlikely to bias the results (e.g. the proportion of missing data was similar in the intervention and control groups or the proportion of missing data was less than the effect size i.e. unlikely to overturn the study result). Score “High risk” if missing outcome data was likely to bias the results. Score “Unclear risk” if not specified in the paper (Do not assume 100% follow up unless stated explicitly).

**Was knowledge of the allocated interventions adequately prevented during the study?<sup>1</sup>**

Score “Low risk” if the authors state explicitly that the primary outcome variables were assessed blindly, or the outcomes are objective, e.g. length of hospital stay. Primary outcomes are those variables that correspond to the primary hypothesis or question as defined by the authors. Score “High risk” if the outcomes were not assessed blindly. Score “Unclear risk” if not specified in the paper.

**Was the study adequately protected against contamination?**

Score “Low risk” if allocation was by community, institution or practice and it is unlikely that the control group received the intervention. Score “High risk” if it is likely that the control group received the intervention (e.g. if patients rather than professionals were randomized). Score “Unclear risk” if professionals were allocated within a clinic or practice and it is possible that communication between intervention and control professionals could have occurred (e.g. physicians within practices were allocated to intervention or control)

**Was the study free from selective outcome reporting?**

Score “Low risk” if there is no evidence that outcomes were selectively reported (e.g. all relevant outcomes in the methods section are reported in the results section). Score “High

risk” if some important outcomes are subsequently omitted from the results. Score “Unclear risk” if not specified in the paper.

**Was the study free from other risks of bias?**

Score “Low risk” if there is no evidence of other risk of biases

**Risk of bias for interrupted time series studies**

Seven standard criteria are used for all interrupted time series studies. Further information can be obtained from the Cochrane handbook section on Risk of Bias and from the draft methods paper on risk of bias under the EPOC specific resources section of the EPOC website.

Note: If the interrupted time series study has ignored secular (trend) changes and performed a simple t-test of the pre-versus post intervention periods without further justification, the study should not be included in the review unless reanalysis is possible.

**Was the intervention independent of other changes?**

Score “Low risk” if there are compelling arguments that the intervention occurred independently of other changes over time and the outcome was not influenced by other confounding variables/historic events during study period. *If Events/variables identified, note what they are.* Score “High risk” if reported that intervention was not independent of other changes in time.

**Was the shape of the intervention effect pre-specified?**

Score “Low risk” if point of analysis is the point of intervention OR a rational explanation for the shape of intervention effect was given by the author(s). Where appropriate, this should include an explanation if the point of analysis is NOT the point of intervention. Score “High risk” if it is clear that the condition above is not met.

**Was the intervention unlikely to affect data collection?**

Score “Low risk” if reported that intervention itself was unlikely to affect data collection (for example, sources and methods of data collection were the same before and after the intervention); Score “High risk” if the intervention itself was likely to affect data collection (for example, any change in source or method of data collection reported).

**Was knowledge of the allocated interventions adequately prevented during the study?<sup>3</sup>**

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<sup>3</sup> If some primary outcomes were assessed blindly or affected by missing data and others were not, each primary outcome can be scored separately.

Score “Low risk” if the authors state explicitly that the primary outcome variables were assessed blindly, or the outcomes are objective, e.g. length of hospital stay. Primary outcomes are those variables that correspond to the primary hypothesis or question as defined by the authors. Score “High risk” if the outcomes were not assessed blindly. Score “Unclear risk” if not specified in the paper.

**Were incomplete outcome data adequately addressed?<sup>3</sup>**

Score “Low risk” if missing outcome measures were unlikely to bias the results (e.g. the proportion of missing data was similar in the pre- and post-intervention periods or the proportion of missing data was less than the effect size i.e. unlikely to overturn the study result). Score “High risk” if missing outcome data was likely to bias the results. Score “Unclear risk” if not specified in the paper (Do not assume 100% follow up unless stated explicitly).

**Was the study free from selective outcome reporting?**

Score “Low risk” if there is no evidence that outcomes were selectively reported (e.g. all relevant outcomes in the methods section are reported in the results section). Score “High risk” if some important outcomes are subsequently omitted from the results. Score “Unclear risk” if not specified in the paper.

**Was the study free from other risks of bias?**

Score “Low risk” if there is no evidence of other risk of biases.  
e.g. should consider if seasonality is an issue (i.e. if January to June comprises the pre-intervention period and July to December the post, could the “seasons’ have caused a spurious effect).

Adapted from: Cochrane Effective Practice and Organization of Care (EPOC). Suggested risk of bias criteria for EPOC reviews. EPOC Resources for review authors, 2017.  
Available at: <http://epoc.cochrane.org/epoc-specific-resources-review-authors>.

## Appendix II: Figures

**The Chronic Care Model**

Developed by The MacCall Institute  
 of ACP-ASIM Journals and Books

Figure 11: Chronic care model. Adapted from Improving Chronic Illness Care Group Health Research Institute. (2017). *The Chronic Care Model*. Retrieved from [http://www.improvingchroniccare.org/index.php?p=The\\_Chronic\\_Care\\_Model&s=2](http://www.improvingchroniccare.org/index.php?p=The_Chronic_Care_Model&s=2).

## Appendix I2: Figures

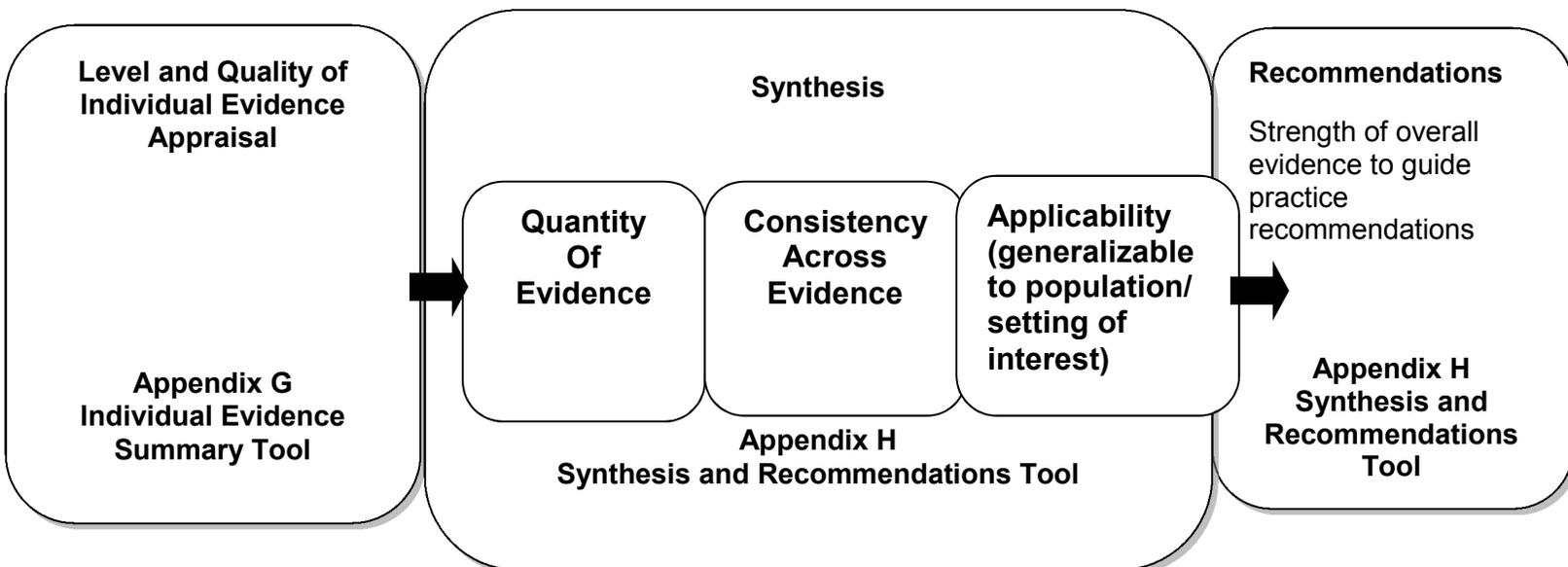


Figure I2: Adapted from John Hopkins Medicine Center for Evidence Based Practice. John Hopkins Nursing Evidence-Based Practice Model. Retrieved April 27, 2017 from [http://www.hopkinsmedicine.org/evidence-based-practice/\\_docs/appendix\\_i\\_synthesis\\_evidence\\_guide.pdf](http://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_i_synthesis_evidence_guide.pdf).

## Appendix I3: Figures

