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Elevated Blood Glucose Levels in the Emergency Department: Missed Opportunity for Informing and Referring

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by

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Abstract

The purpose of this research was to examine (1) the rates of elevated blood glucose ≥ 150 mg/dL in adults without a prior history of diabetes, receiving care for a non-diabetes related visit to the ED and (2) Emergency Department provider patterns for informing and referring discharged Emergency Department patients for follow-up of elevated random blood glucose levels. A descriptive, correlational, cross-sectional design, with purposive sample was used. Retrospective chart review was done for patients age 18 and older, treated in two EDs from March 1, 2010 through March 22, 2010. Significant relationships were found between blood glucose level and BMI, previous blood glucose level ≥150 mg/dL, age, and reason for visit. Twenty five hundred and fifty five patients were seen over the 9-day study period. Fourteen hundred and forty patients had a random blood glucose level resulted by the lab. 106 patients had a blood glucose level ≥150 mg/dL without a history of diabetes. Forty-two and a half percent (n=45) of the 106 patients were discharged, 50% (n=53) were admitted, and the rest (n=8) were transferred to another hospital or a psychiatric unit for admission. Of those discharged (n=45), only one patient (2.2%) was informed about the elevated blood glucose level and referred for follow-up.

Dedication

This dissertation is dedicated to the special people in my life who allowed me time to work on this, gave me the words of encouragement to keep going and the support to keep it all together!

To my Holy Father in Heaven: Thank you for all the gifts you have given me as well as the opportunities to use them in so many ways, to give you Glory!

To my mother, Mary M. Alexander: Thank you for always believing in me and encouraging me. Thanks for the "You can do it!" and "Way to go girl!" responses to all my endeavors and accomplishments. Thanks for being my editor on this work.

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CHAPTER I

STATEMENT OF THE PROBLEM

Prediabetes is prevalent, continues to increase, and costs the United States over $25 billion annually (Zhang et al., 2009). A patient may have prediabetes and its adverse micro- and macro-vascular complications for up to seven years before diabetes is diagnosed (Aroda & Ratner, 2008; Harris, Klein, Welton, & Knulman, 1992). Early identification and treatment of patients who may have undiagnosed prediabetes is essential in preventing or delaying progression to type 2 diabetes (Bergman, 2010; Hsueh, Orloski, & Wyne, 2010). In 2011, 79 million Americans had prediabetes, and seven million were undiagnosed (American Diabetes Association [ADA], 2011b). Incidence is expected to increase to 472 million people worldwide by 2025 (Shehab Eldin, Emara, & Soker, 2008). Mitigating this global public health issue requires identifying those with undiagnosed prediabetes and initiating measures to stop or delay progression to type 2 diabetes (Bergman, 2011).

Background and Significance

The National Diabetes Data Group (1979) originated the concept of impaired glucose tolerance (IGT), a condition exemplified by an elevated blood glucose level that

was not diabetes but increased a person's risk for diabetes (Abdul-Ghani & DeFronzo, 2009). In 1997, the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus further elaborated this phenomenon to include another category called impaired fasting glucose (IFG). They argued an elevated IGT or IFG, or both, indicated increased risk for type 2 diabetes mellitus and constituted prediabetes (Abdul-Ghani & DeFronzo, 2009; Buysschaert & Bergman, 2011).

Prediabetes mellitus, a term coined over a decade ago by the U.S. Department of Health and Human Services and the ADA (Shehab Eldin, Emara, & Shoker, 2008), is defined as a state in which cells no longer respond appropriately to insulin, a hormone that regulates blood sugar (Vagnini, 2010). Prediabetes is considered a diagnosis, but it is also considered a risk state that warrants consideration of lifestyle changes and medication to reduce the risk of progression to type 2 diabetes (Shaw, 2011).

Normal blood glucose levels increase after eating a meal but should not exceed 135-140 mg/dL (Charfen, Ipp, Kaji, Saleh, Qazi, & Lewis, 2009). A review of the literature finds a lack of consensus in what constitutes a blood level indicative of elevated blood glucose. For example, a random non-fasting blood sugar level in a person without diabetes should be in the low to mid-100's mg/dL (Virginia Mason Team Medicine, 2013).

Other sources argue a random blood sugar in a healthy person without diabetes, should be less than 125 mg/dL (WebMD, 2011). In contrast, Ginde, Savaser, and Camargo (2009) defined anything less than 140 mg/dL to be a normal glucose level. The ADA defines hyperglycemia in the hospital setting, which includes the emergency department (ED), as a blood glucose >140 mg/dL (ADA, 2012). Although a recent meal,

stress, medications, infections, and pain may result in an elevated blood glucose level (Davidson & Moreland, 2009), the elevated level may also be an indicator of prediabetes, which warrants further testing (Ginde, Delaney, Pallin, & Camargo, 2010).

Prediabetes risk or diagnosis is determined by performing specific tests such as a fasting blood glucose test. The result is impaired fasting glucose (IFG). Prediabetes is defined as elevated blood glucose levels with IFG between 100 and 125 mg/dL (Abdul-Ghani & DeFronzo, 2009). However, others argue an IFG level with anything greater than 90 mg/dL puts a patient at risk and should be considered the level for prediabetes (Nichols, Hiller, & Brown, 2008; Shaw, Zimmet, & Hodge, 2000). IGT levels between 140 and 200 mg/dL or elevated IFG and IGT are considered to be indicative of prediabetes (Biuso, Butterworth, & Linden, 2007; Fonseca, 2007; Zhang et al., 2009). In prediabetes, the serum blood glucose levels are elevated but are not high enough to be diagnosed as type 2 diabetes (Canadian Diabetes Association, 2012; Fonseca, 2007), nonetheless if left untreated, people with elevated blood glucose levels are predisposed to develop type 2 diabetes (Biuso, Butterworth, & Linden, 2007; Fillman, 2010; Fonseca, 2007; Gossaine & Aldosouqi, 2010; Shehab Eldin, Emara, & Soker, 2008).

In 2010, the ADA recommended another important lab test for identifying prediabetes, the glycolated hemoglobin A1c (Also known as: A1c, HgA1c or HbA1c). This blood test provides a snapshot of what the blood glucose concentration has been over a period of time (Dugger & Clark, 2011), specifically the average plasma glucose from the prior 90 days. An A1C of 5.7% to 6.4% is considered to be indicative of prediabetes (ADA, 2010; Buysschaert & Bergman, 2011; Dugger & Clark, 2011; Silverman et al., 2011).

Access to Care

For many, the Emergency Department (ED) is the only source of medical care or interaction with a health care provider. This makes the ED an ideal place to identify those with elevated random blood glucose levels and refer them for more specific testing for prediabetes and diabetes (Charfen et al., 2009; Ginde et al., 2010; Silverman et al., 2006). Because ED patients may have had oral intake before arriving in the ED, the serum blood glucose level is considered random (unknown last oral intake; Fonseca, 2007).

In 2004, the ADA recommended early detection of prediabetes (Charfen et al., 2009). This suggests screening of the general population for prediabetes would be beneficial. Norris, Kansagara, Bougatsos, and Fu (2008) published a review of the evidence debating the benefits or harm of screening and found a lack of evidence to support universal screening. In 2011, the ADA revisited the issue and recommended standardized protocols for screening. Unfortunately, screening for prediabetes is not routinely done.

Health care professionals regularly care for patients experiencing the phenomenon of elevated blood glucose in a variety of settings, including hospitals, emergency departments, doctor's offices, and clinics. In 2008, the American Association of Clinical Endocrinologists urged physicians to identify prediabetes and begin treatment, such as lifestyle changes, including diet, exercise, and possible medication use. Lifestyle modification has been shown to prevent or delay the risk of progression from prediabetes to type 2 diabetes by up to 58% (Diabetes Prevention Program Research Group, 2002; Tuomilehto et al., 2001). With the incidence of diabetes increasing each year, a chance to

identify patients with possible prediabetes who could make lifestyle changes to prevent progression to type 2 diabetes is an important health promotion opportunity that should not be missed.

Several landmark studies have shown the efficacy of lifestyle modifications such as diet, exercise, and even the addition of medication to prevent advancement from prediabetes to diabetes (Diabetes Prevention Program Research Group, 2002; Lindstrom et al., 2003; Pan et al., 1997). The health care system is burdened with patients who present with multiple comorbidities. Prevention of health care complications is necessary, but impossible unless patients are educated about their risk and informed if they have abnormal laboratory results. The Affordable Care Act addresses the need for prevention, including the need to identify and prevent diseases (Koh & Sebelius, 2010).

Early identification will give patients the opportunity to make lifestyle choices to prevent or delay progression to type 2 diabetes, thus preventing negative impact on the individual, society, health care system, and health care costs (Biuso et al., 2007; Cali & Caprio, 2008; Fonseca, 2007; Hoerger et al., 2007; James et al., 2011). Lifestyle modification has been shown to prevent or delay the risk of those with prediabetes from progressing to type 2 diabetes by up to 58% (Diabetes Prevention Program Research Group, 2002; Tuomilehto et al., 2001).

Notably, the ED may be an opportune location for identifying patients with prediabetes (Ginde, Delaney, Lieberman, Vanderwell, & Camargo, 2007), which is key in gaining control of this growing epidemic (Colagiuri, 2011). Although previous studies have reported conflicting findings regarding the percentage of patients presenting to the Emergency Department with blood glucose levels suggesting prediabetes, the ED is

recognized as an ideal place to identify, inform, and refer patients for follow-up (Ginde et al., 2007).

The purpose of this study was to examine (1) the rates of elevated blood glucose levels ≥150 mg/dL in adults without a history of diabetes, receiving care for a non-diabetes related emergency room visit and (2) Emergency Department provider patterns of informing and referring discharged patients without a history of Diabetes Mellitus (DM) for follow-up of elevated random blood glucose levels.

Conceptual Framework

To study the importance of recognizing and responding to elevated blood glucose levels in the emergency department, Pender's Health Promotion Model is the conceptual framework guiding this study (Figure 1). Nola J. Pender, a health promotion advocate, created the health promotion model in 1982 and revised it in 1996 (Nursing Planet, 2012). According to Pender, health promotion and disease prevention should be the primary focus in health care. Health promotion, an approach to wellness, is defined as behavior motivated by the desire to increase well-being and actualize human health potential. This model was created to show the relationships between individual characteristics and experiences, behavior specific conditions and affects, and behavioral outcomes. Pender advocated addressing health issues and behaviors in an effort to promote health and prevent disease (Nursing Planet, 2012).

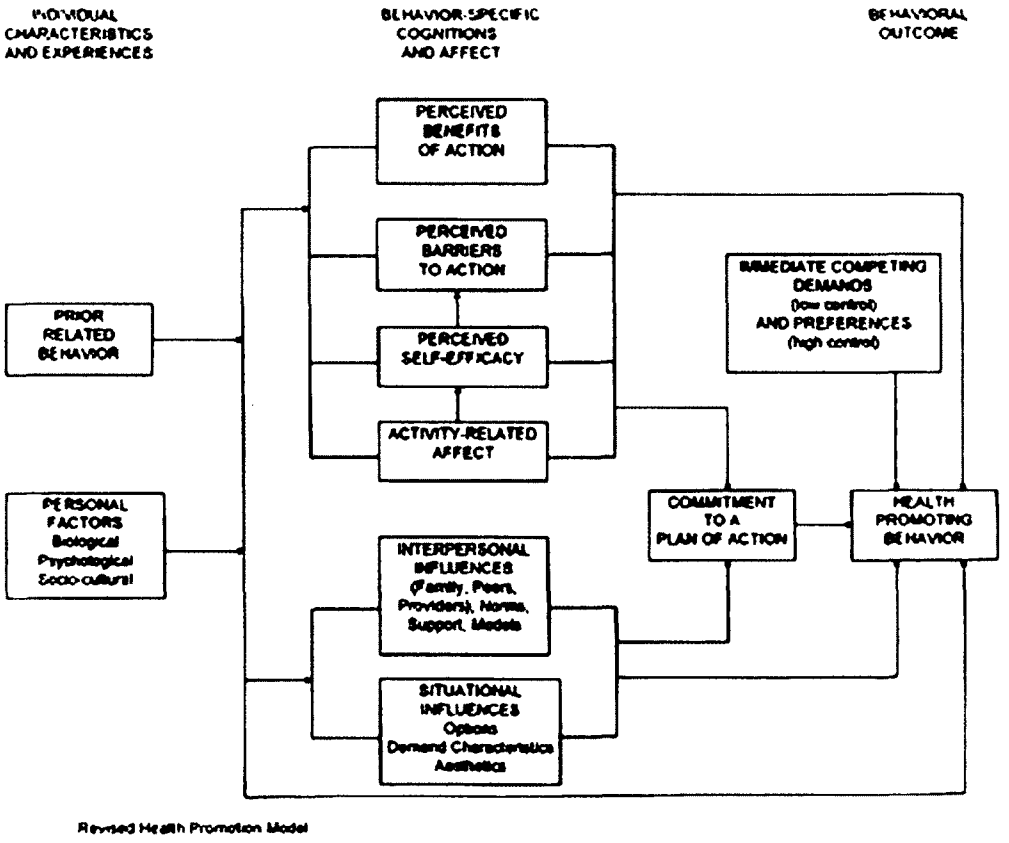

Figure 1. The revised health promotion model (Pender, 1996).

Identification of an elevated blood glucose level (≥150 mg/dL), during a non-diabetes related visit to the ED fits into Pender's Conceptual Model. The middle column labeled "Behavior-Specific Conditions and Affect" shows an opportunity for an interpersonal influence. An example occurs when a provider informs a patient about an elevated blood glucose value and refers him or her for follow-up testing. When the patient follows up with another provider, he or she is making a "commitment to a plan of action" as listed on the model. If follow-up testing shows the patient has prediabetes, he or she will be able to make lifestyle changes and start a treatment regimen to change the course of the disease process.

Research Questions

The research questions to be answered in this study are

1. What are the characteristics of a group of adults (random blood glucose, Body Mass Index [BMI], blood pressure [BP]), and select demographic characteristics (age, gender, race/ethnicity) receiving care for a non-diabetes related visit to the ED?
2. What are the relationships between and among the dependent variable of blood glucose level and independent variables (BMI, elevated BP [≥130/80], history of hypertension, previous blood glucose ≥150 mg/dL and selected demographic characteristics) in a group of adults receiving care for a non-diabetes related visit to the ED?
3. What are the rates of elevated blood glucose ≥150 mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit?
4. What are emergency department provider patterns of informing and referring discharged emergency department patients without a history of diabetes for follow-up of elevated random blood glucose in a group of adults receiving care for a non-diabetes related visit to the ED?

Specific Aims

1. To characterize a group of adults (random blood glucose, Body Mass Index [BMI], blood pressure [BP]), and select demographic characteristics (age, gender, race/ethnicity) receiving care for a non-diabetes related visit to the ED.

2. To describe the relationships between and among the dependent variable of blood glucose level and independent variables (BMI, elevated BP [≥130/80], history of hypertension, previous blood glucose ≥150 mg/dL, and selected demographic characteristics) in a group of adults receiving care for a non-diabetes related visit to the ED.
3. To examine the rates of elevated blood glucose ≥150 mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit.
4. To examine emergency department provider patterns of informing and referring discharged emergency department patients without a history of diabetes for follow-up of elevated random blood glucose in a group of adults receiving care for a non-diabetes related visit to the ED.

Nursing Implications

Nurse scientists are focusing on research to improve patient health and outcomes. Pender's Health Promotion Model theorizes health care providers, which for the purpose of this study include nurses, physicians, and physician assistants, have interpersonal influence through their communication with patients. Communication about lab tests and findings can help influence and encourage patients to take an active role in improving health and well being.

It is highly probable the ED visit may be the only opportunity for some patients to interface with a health care provider. This makes the ED an ideal place to identify elevated blood glucose levels, refer patients for follow-up of the elevated blood glucose level, and stress the importance of follow-up. ED nurses and providers play a key role in

affecting the opportunity for patients to make important choices about health and well-being. With proper referral and follow-up to diagnose prediabetes, the patient will be able to make important decisions and changes in lifestyle to prevent further progression of this risk state.

The results of this study will inform nurses and providers about this patient population who may have undiagnosed prediabetes or type 2 diabetes. It will increase their awareness of the current missed opportunities for educating patients to allow them to make choices to delay or prevent progression to type 2 diabetes. The results will increase ED provider awareness of the rate of patients with a blood glucose level greater than or equal to 150 mg/dL and encourage them to refer patients for follow-up. Follow-up for discharged patients could entail further assessment of lab values such as a fasting blood glucose, a glucose tolerance test, or an A1C.

The health care system is already burdened with the number of patients with multiple comorbidities. Prevention of health care complications is critical but impossible unless patients are informed of their risk. The Affordable Care Act addressed the need for prevention, which includes the need to identify and prevent diseases (Koh & Sebelius, 2010). While screening patients for diabetes is not recommended (Norris et al., 2008), it is recommended that patients with an elevated blood glucose level be informed and referred (Bergman, 2010; Hsueh et al., 2010).

With the growing numbers of prediabetics each year, EDs need to adopt protocols to inform and refer patients with elevated blood glucose levels. Nurses must partner with ED providers (physicians and physician assistants) to educate patients about the risks and complications of prediabetes and the opportunity to make changes to prevent or delay

progression to type 2 diabetes. ED nurses and providers play an integral role in affecting the ability for patients to make important choices about their health and well-being.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this chapter is to provide a summary of the literature about elevated blood glucose levels and prediabetes. It will include methods for testing (fasting glucose test, glucose tolerance test, and A1c) for this risk state that predisposes patients eventually to progress to type 2 diabetes. Risk factors for elevated blood glucose levels such as body mass index (BMI), elevated blood pressure, age, gender, and race/ethnicity will also be presented. Studies will be presented that support the importance of identifying patients with elevated blood glucose levels and informing and referring them for follow up testing in an effort to identify the risk state of prediabetes. Although there is support for testing, it is unclear what blood glucose level should be used as the cutoff point for referring patients. Gaps in the literature are identified to establish the need for this study.

Conceptual Framework

Pender's Health Promotion Model (Figure 1) was the conceptual framework guiding this study. This framework was chosen because the premise is patients will respond to the interpersonal influences of an ED provider informing and educating them

about an elevated random blood glucose level. When the provider explains the risks involved, refers the patient for follow up, and urges the patient to follow up for further testing, this will lead to the patient to making a commitment to action. The patient will follow up for further testing and then if they do, in fact, fit the criteria for the prediabetes risk state, the patient can make important decisions about lifestyle modifications to improve his or her health and well-being.

In a study conducted by Ginde et al. (2007), patients were supportive of the idea of screening for diabetes. Two-thirds (n=604) of their patients were willing to have their blood drawn and tested to screen for diabetes. Ninety five percent said they would follow up if their value was abnormal and wanted to be informed. Nearly all stated they wanted to be referred for outpatient follow-up. This work provides support for the use of this framework for the study conducted here.

Principal Literature Review

A comprehensive literature search was conducted using Cumulative Index to Nursing Allied Health Literature (CINAHL) Plus with full text, Google Scholar, and evidence-based medical reviews: Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA and NHSEED, Ovid SP, and PubMed. Key search terms were *prediabetes, elevated glucose, diabetes, A1C, BMI*, and *prediabetes screening*. Additional articles were found using the reference list from cited articles.

Elevated Blood Glucose Levels

Normal blood glucose levels increase after eating a meal but should not exceed 135-140 mg/dL (Charfen et al., 2009). A review of the literature finds a lack of consensus in what constitutes a blood glucose level indicative of "elevated blood glucose." For

example, a random blood glucose level in a person without diabetes should be in the low to mid-100's mg/dL (Virginia Mason Team Medicine, 2013). For Ginde et al. (2009), any level less than 140 mg/dL is considered a normal glucose level. Others argue a random blood sugar, even in a healthy person without diabetes, should be less than 125 mg/dL (WebMD, 2011). The American Diabetes Association defines hyperglycemia in the hospital setting, which includes the Emergency Department, as any blood glucose >140 mg/dL (ADA, 2012). Although a recent meal, stress, medications, infections, and pain may result in an elevated blood glucose level (Davidson & Moreland, 2009), the elevated level may also be an indicator of prediabetes, which warrants further testing (Ginde et al., 2010).

An elevated blood glucose level is a warning there may be a problem, but follow-up tests are critical. Patients diagnosed with both impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) are twice as likely to develop type 2 diabetes as those with isolated IFG or isolated IGT (Nathan et al., 2007). The term *impaired fasting glucose*, coined in 1997, refers to fasting plasma glucose (FPG) levels greater than 110-125 mg/dL (Expert Committee on the Diagnosis & Classification of Diabetes Mellitus, 1997). In 2003, the same committee lowered the FPG level to 100 mg/dL (Expert Committee on the Diagnosis & Classification of Diabetes Mellitus, 2003). The term *impaired glucose tolerance* was defined by the National Diabetes Data Group as an IFG level ≥ 100 to < 126 mg/dl and an IGT ≥ 140 to <200 mg/dL (1979).

In 2010, the ADA recommended another important lab test for identifying prediabetes called the glycolated hemoglobin A1c (also known as: A1c, HgA1c or HbA1c). This blood test shows the average plasma glucose from the prior 90 days. It is a

snapshot of what the blood glucose concentration has been over a period of time (Dugger & Clark, 2011). An A1c of 5.7% to 6.4% is considered to be indicative of prediabetes (ADA, 2010; Buysschaert & Bergman, 2011; Dugger & Clark, 2011; Silverman et al., 2011).

Early identification is the first step at preventing those with prediabetes from progressing to type 2 diabetes (Gossaine & Aldosouqi, 2010). Previous studies have indicated the ED is the ideal place to identify, inform, and refer patients for follow-up care and patients are receptive to this information and want to be notified (Ginde et al., 2007).

Ginde et al. (2009) examined if ED patients with blood glucose levels >140 mg/dL were informed of their elevation and if recommendation for follow-up was provided. Twenty-one percent of the ED patients had glucose levels >140 mg/dL, yet when written discharge instructions were reviewed, less than 10% were informed about their elevated blood glucose level or were referred for follow up and further testing. A prior study by Ginde et al. (2007) showed 95% of ED patients want to be informed if they had an elevated blood glucose level.

Ginde et al. (2010) recognized the ED is an ideal place to identify patients with undiagnosed diabetes. They conducted a study of 152 ED physicians to examine prediabetes screening of asymptomatic patients in the ED, what glucose threshold ED physicians thought warranted treatment and referral, and the barriers to referral. Findings indicated 53% supported screening and 92% endorsed they should inform non-diabetic patients about an elevated blood glucose level. Respondents indicated a blood glucose value greater than or equal to 200 mg/dL warranted referral, but 71% believed they

should refer for a lower blood glucose value. Approximately 25% thought they should refer as low as 160 mg/dL and 5% thought they should refer for a blood glucose level of 125 mg/dL in a non-diabetic patient.

The physicians cited several barriers to referral. Barriers for not informing and referring patients about elevated glucose levels included insufficient time and resources, outside their scope of practice, and lack of clearly defined blood glucose levels for referral and follow-up. The providers thought the Emergency Department was a good place to identify those at risk of prediabetes or those with uncontrolled diabetes, they did not feel screening those without symptoms was necessary (Ginde et al., 2010).

Combined, these studies demonstrate a knowledge gap among practitioners. Specifically, those patients who had elevated blood glucose levels and who should have been referred often were not. More basic in this process, blood glucose levels warranting referral and follow up are not clearly defined.

Risk factors for prediabetes have been identified by the Canadian Diabetes Association (2012) and the American Diabetes Association (2011): obese patients are at increased risk (Fonseca, 2007; Gossaine & Aldosouqi, 2010; Kenealy, Elley, & Arroll, 2007) and assessment is recommended for asymptomatic patients with a BMI greater than or equal to 25 kg/m2, high blood pressure, and belonging to a high risk population (e.g., Aboriginal, Hispanic, Asian, South Asian, or African descent) (Canadian Diabetes Association, 2012).

Risk Factors

Demographics and other factors such as elevated BMI and high blood pressure have been found to increase the risk of having an elevated blood glucose level. An

elevated BMI (Bergman, 2010), blood pressure, older age, and belonging to a high-risk racial or ethnic group further places the patient at risk (Charfen et al., 2009; Shaw, 2011; Shehab Eldin et al., 2008) and should be considered by the ED team when evaluating a patient. A study by James et al. (2011) found variables such as age, gender, race, and different prediabetes measures (IFG, OGT, and A1c) yield varying results. Their findings did not point to any specific test that was the defining test for the risk state of prediabetes.

Body mass index (BMI). Obesity, which is defined as a BMI greater than or equal to 30 kg/m2, is a known risk factor for diabetes. In fact patients with BMI >25 kg/m2, which is considered overweight, are also at risk. Recently a study by Chiu, Austin, Manuel, Shah, and Tu (2011) found BMI cutoffs for assessing diabetes risk vary depending on ethnicity. They looked at BMI 30 kg/m2 as the highest risk for Caucasian participants but discovered lower BMIs put other ethnic groups at risk. The South Asian group developed diabetes with a BMI of 24 kg/m2, the Chinese group at 25 kg/m2, and the Black group at 26 kg/m2. These findings support the idea people are at an increased risk of developing diabetes with a BMI as low as 24 kg/m2.

Hoerger et al. (2007) screened 45-74 year old overweight or obese patients with a BMI greater than or equal to 25 kg/m2 for prediabetes. They used a random capillary blood glucose test. One hundred mg/dL was used as the indicator for having a positive test. Those screening positive received either a fasting plasma glucose test (FPG) or an oral glucose tolerance test (OGT). For those with a positive FPG or OGT, a second FPG or OGT was conducted for confirmation purposes. Next, patients with prediabetes received Diabetes Prevention Program (DPP) interventions (3 lifestyle modifications such as weight loss or 150 minutes of weekly physical activity or medication –

metformin). An earlier study (Herman et al., 2005) found these lifestyle modifications were cost-effective and resulted in a reduction in risk for progressing to type 2 diabetes. Hoerger et al.'s (2007) findings supported those of Herman et al. (2005), arguing identification of predictors allows individuals to make lifestyle changes necessary to prevent the progression to type 2 diabetes.

Blood pressure. It is well documented a history of hypertension increases the risk of a patient having elevated blood glucose levels; thus, hypertension is a risk factor that should prompt screening for diabetes (Gossaine & Aldosouqi, 2010). The United States Preventative Task Force also recommends screening those who are asymptomatic with hypertension, a blood pressure greater than 135/80 mm/Hg (Gossaine & Aldosouqi, 2010). Ginde et al. (2009) studied 185 patients with blood glucose levels >140 mg/dL and of those, 54% had a history of hypertension. Elliott (2008) noted those with prediabetes should follow the same recommendation as those with diabetes, which is to maintain a blood pressure less than 130/80 mmHg.

Age. Ginde et al. (2009) found 64 to be the median age of those with blood glucose levels >140 mg/dL, which could be a sign of prediabetes. A study conducted by James et al. (2011) supported similar findings that age increases the prevalence of having elevated A1c levels, IGTs, and IFGs. Chiu et al. (2011) examined the incidence of diabetes in a multiethnic cohort study of 59,825 participants and found the median age for developing diabetes in South Asians was 49 years, Chinese 55 years, Blacks 57 years, and Whites 58 years.

The ADA recommends adults aged 45 or older be tested for elevated blood glucose levels and recommends repeat blood tests every three years. Those with other risk factors should be tested earlier (ADA, 2011a). The Canadian Diabetes Association recommends everyone aged 40 or above is tested by a fasting plasma glucose test with a retest every three years (2010). This study looked at a cohort of adult patients to see what age correlates with a blood sugar level ≥150 mg/dL.

Gender. There is a lack of clarity surrounding gender and increased risk of developing prediabetes and diabetes. Ginde et al. (2009) found no difference in risk related to gender. James et al. (2011) found no significant gender differences in elevated A1c and IGT levels; however, men were more likely than women to have elevated IFG. In contrast, Chiu et al. (2011) found men had diabetes more often than women. Their study focused on ethnic differences and found the exception was with Black patients; women were 33% more likely to have diabetes as compared to men.

Race/ethnicity. Race and ethnicity have been cited as increased risk factors for prediabetes and diabetes but studies vary in their findings about which groups are at the greatest risk. Ginde et al. (2009) found 67% of their study participants with elevated blood glucose levels greater than 140 mg/dL were White, 17% Black, 4% Hispanic, and 12% listed as "Other." Chiu et al. (2011) conducted a multiethnic cohort study of 59,824 participants (White, South Asian, Chinese, and Black). Their findings indicated the South Asian group had the highest incidence of developing diabetes, followed by the Black, White, and Chinese groups.

The major limitation of this study was the number of participants in the non-White groups was significantly smaller than those in the White group. A study by James et al. (2011) found when A1c was used to test for prediabetes, non-Hispanic Blacks were almost twice as likely as non-Hispanic Whites and Mexican Americans to test positive. When IFG and IGT were used to measure risk, non-Hispanic Whites and Mexican Americans were twice as likely as Non-Hispanic Blacks to have elevated levels indicative of prediabetes. Prediabetes prevalence was similar between non-Hispanic Whites and Mexican Americans. The various findings among groups leaves a knowledge gap about which group is at the greatest risk. This study looked at race/ethnicity in the population at two EDs to see which group has the highest rate of elevated blood glucose levels ≥150 mg/dL.

Informing and Referring

This study is founded on the assumption that an ED patient should be informed about an elevated random blood glucose level so he or she can follow up for further testing to determine prediabetes status. Charfen et al. (2009) conducted a study to identify patients with elevated blood glucose in the ED and refer them for follow-up testing. Their findings indicated patients with a random blood glucose level >155 mg/dL and two risk factors end being diagnosed with diabetes or prediabetes.

Ginde, Cagliero, Nathan, and Camargo (2008) conducted a study in the Emergency Department to look for prevalence of undiagnosed diabetes and examined the correlation between random point of care (POC) glucose levels and A1c. A total of 265 participants had A1c levels tested by point of care (POC) device and lab processing. If

the A1c level was elevated, the participants were referred for an oral glucose tolerance test. For the correlation between serum glucose level in the Emergency Department and the A1c, they controlled for age, gender, and race/ethnicity.

Findings indicated 29% of ED patients without prior diagnosis of diabetes had abnormal A1c levels and when tested further, prediabetes or diabetes was confirmed in 72% of those that had follow-up oral glucose testing. This finding was limited because only 38% of those referred went for the recommended follow up testing. Although this number is high, it does not give an accurate percentage of the population who had prediabetes (14%). This study was, however, helpful in supporting the idea of the ED being an ideal setting to access those who may have prediabetes or diabetes. Their findings indicated blood glucose values greater than 120 to 140 mg/dL have sufficient specificity to warrant further testing. This finding supports this study and the idea that identifying those with an elevated blood glucose level and referring them for follow-up testing is vital. Failure to do this is a missed opportunity to identify potentially at-risk patients.

Once a patient is referred for follow-up and is found to have prediabetes, he or she can choose to make lifestyle choices to affect their health outcomes. This is consistent with Pender's Health Promotion Model as a framework for this study. Several landmark studies have been conducted to show the efficacy of lifestyle modifications such as diet, exercise, and even the addition of medication to prevent advancement from prediabetes to diabetes. Informing patients of their risk is key for them being able to make a decision to affect their future health. The Da Qing IGT and Diabetes Study showed those who did not make any lifestyle changes had an increased risk of developing type 2 diabetes, where

those who had a change in diet, exercise, or both had a significant decrease in incidence of progressing to type 2 diabetes (Pan et al., 1997). This was supported in 2002, when the Diabetes Prevention Program found lifestyle modifications such as diet and exercise alone, and also with the addition of a medication called metformin, helped prevent progression from prediabetes to type 2 diabetes (Diabetes Prevention Program Research Group, 2002).

This was further supported by the Finnish Diabetes Prevention Study findings that patients can alter the course of their health with lifestyle modification (Lindstrom et al., 2003). The goal of this study is to describe the numbers of patients being seen in two EDs with elevated blood glucose levels who are not being informed. The findings will demonstrate the missed opportunity for referral, which ultimately will result in the patient not being able to make a life-altering health care decision. The intent is to heighten awareness among ED nurses and health care providers about the rate of patients potentially at risk who need to be identified and informed of their elevated blood glucose levels.

Charfen et al. (2009) conducted a two-year cohort study with 528 non-diabetic patients. Inclusion criteria were ED blood glucose levels ≥140 mg/dL or ≥126 mg/dL if more than two hours since last food intake or at least two diabetes risk factors, being a member of a high risk racial or ethnic group (African American, Hispanic, Native American, Asian American, or Pacific Islander), age 45 years or older, BMI ≥25 kg/m2, or hypertension treated with medication. These risk factors are highlighted, as they are relevant to this study. Prior researchers determined those with fasting blood glucose

levels between 100 and 149 mg/dL and A1C between 5% and 7.9% would be classified as prediabetic.

A blood glucose level of ≥150 mg/dL was selected for this study because a normal blood glucose level should be less than 125–140 mg/dL, even after eating a meal (ADA, 2012; Charfen et al., 2009; WebMD, 2011). Prior studies have used the values of >140 mg/dL as their cutoffs for those that should be referred for further testing for prediabetes (Ginde et al., 2009). The decision was also based on the prior study by Ginde et al. (2010) that found providers would refer at 200 mg/dL but thought they should refer for values greater than160 mg/dL. Some even thought they should refer for a blood glucose value greater than 125 mg/dL.

The value of ≥150 mg/dL has not been examined in any prior studies so will be used for this one as the cutoff for examining and describing those without history of DM. This study will also look to see how elevated blood glucose levels correlate with other factors such as age, gender, ethnicity/race, BMI, and blood pressure.

Summary of Literature Review

A review of the extant literature finds (1) variation in glucose threshold levels for prediabetes; (2) various risk factors such as BMI, elevated BP, age, gender, and race/ethnicity increase the likelihood of having prediabetes; (3) provider attitudes and practices involved in informing patients about their elevated blood glucose levels and if referred for follow up (notably, education and referral for elevated blood glucose levels is not commonly implemented in the ED setting); and (4) patient attitudes and preferences to be informed and intentions to follow-up on an elevated blood glucose level.

CHAPTER III

METHODS

The purpose of this study was to examine (1) the rates of elevated blood glucose levels ≥150 mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit and (2) emergency department provider patterns of informing and referring discharged ED patients without a history of DM for follow-up of elevated random blood glucose levels. In this chapter a description of the design, sample, data collection, and analytic techniques will be presented. The protection of human subjects and study limitations will also be addressed.

Specific Aims

1. To characterize a group of adults (random blood glucose, Body Mass Index [BMI], blood pressure [BP]) and select demographic characteristics (age, gender, race/ethnicity) receiving care for a non-diabetes related visit to the ED.
2. To describe the relationships between and among the dependent variable of blood glucose level and independent variables (BMI, elevated BP [≥130/80], history of hypertension, previous blood glucose ≥150 mg/dL) and selected demographic

characteristics in a group of adults receiving care for a non-diabetes related visit to the ED.

3. To examine the rates of elevated blood glucose ≥150 mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit.
4. To examine Emergency Department provider patterns of informing and referring discharged emergency department patients without a history of diabetes for follow-up of elevated random blood glucose in a group of adults receiving care for a non-diabetes related visit to the ED.

Design

A descriptive, correlational, cross-sectional design, with purposive sampling was selected for this study. *Descriptive* indicates the examination of variables to show what exists; the purpose of descriptive research is to accurately describe a phenomena (Key, 1997). Correlation designs are used to describe relationships among variables without seeking a cause and effect. This type of non-experimental design was appropriate for the current study because the intent was to assess whether or not a relationship exists between variables without concern for the original reason or cause of variables being studied. With this type of design, no manipulation or treatment of variables is necessary (Munro, 2005). According to Polit and Tatano Beck (2006), "Cross-sectional designs are especially appropriate for describing the status of phenomena or relationships among phenomena at a fixed point" (p. 192).

Sample and Setting

Participants were selected from all adult patients (18 years and older) seeking medical services for non-diabetes related reasons from two EDs located in North San

Diego County (N=2,555), March 1, 2010 through March 22, 2010. The two hospitals are part of a community-based health care system comprised of two acute care hospitals, a long-term care facility, a skilled nursing facility, and a surgery center. One ED has approximately 30,000 patient visits per year and the other approximately 70,000 patient visits per year. A purposive sample was selected based upon the inclusion criteria: blood glucose obtained and result logged in the electronic medical record (EMR).

Power Analysis

To avoid type 2 errors, strengthen statistical conclusions, and have a large enough effect size, a power analysis was completed to estimate sample size necessary for this proposed study (Polit & Tatano Beck, 2012). Using Green's (1991) formula N=50 + 8m (*m* is the number of independent variables), 50 + [8x9] = 50 + 72=122. At minimum, 122 participants were necessary for this study, to test multiple correlations.

Variables and Operational Definitions

Table 1 lists the variables and type of variables used for this study. Operational definitions are outlined as well.

Table 1

Variables and Operational Definitions

Variable/Type of Variable	**Operational Definition**
Elevated blood glucose level (continuous)	Blood glucose level ≥150 mg/dL
Body Mass Index (BMI) (continuous)	BMI is the ratio of weight in kilograms to the square of height in meters, calculated according to the Centers for Disease Control and Prevention adult charts.
Elevated Blood Pressure (nominal/categorical)	Blood pressure ≥130/80 – Yes or No

Prior blood glucose ≥150 mg/dL (nominal/categorical)	Yes, No, or N/A
Age (continuous)	Age range is 18-99 years old
Gender (nominal/categorical)	Male or female
Race/Ethnicity (nominal/categorical)	Caucasian, Hispanic, Asian or Pacific Islander, Black, Other, Unknown
History of Hypertension (nominal/categorical)	Yes or No
History of Diabetes (nominal/categorical)	Yes or No
Marital status (nominal/categorical)	Married, Single, Divorced, Widowed, Separated, Unknown
Reason for visit to the ED (nominal/categorical)	Abdominal, Cardiac, Neurologic, Respiratory, Other
Discharged from the Emergency Department (nominal/categorical)	Yes or No
Informed about elevated blood glucose level (nominal/categorical)	Yes or No
Referred for follow up of elevated blood glucose level (nominal/categorical)	Yes or No

Data Collection

Retrospective data were obtained from electronic medical records (EMRs) of ED patients 18 years or older seeking medical services unrelated to diabetes in two EDs in Southern California. An investigator-developed data abstraction form was used. Data were abstracted from the EMRs of patients seen on Monday, Wednesday, or Friday from March 1, 2010 through March 22, 2010, who had a blood glucose drawn and the result logged in the EMR (N=193).

Data Analysis

Descriptive and inferential statistics were used in this study as "an important

aspect of statistical inference involves reporting the likely accuracy or degree of confidence, of the sample statistic that predicts the value of the population parameter" (Munro, 2005. p. 5). Descriptive statistics (means, standard deviations, percentages) were employed to illustrate the characteristics of the participants. Correlations were used to examine the relationships between blood glucose level, BMI, elevated BP (≥130/80), history of hypertension, previous blood glucose ≥150 mg/dL, reason for visit, and selected demographic characteristics (age, gender, race/ethnicity, marital status). To describe the relationships among the variables, first a correlation matrix was constructed to identify the potential for multicollinearity, which can occur when there are moderate to high correlations among predictor variables. Predictor variables scrutinized for moderate to high correlations can possibility be deleted and one variable will be reported, or variables may be combined to represent one measure of a construct to delete repetition (Mertler & Vannatta, 2010).

In the data reported here, no multicollinearity was evidenced; therefore, relationships between the independent and dependent variables will be reported using Pearson's *r*, Phi, and Cramer's *V*. A correlation is a number that describes the degree of relationship between two variables. In probability theory and statistics correlation, it is also known as the correlation coefficient, a numeric measure of the strength of linear relationship between two random variables (Munro, 2005).

Pearson's correlation coefficient *r* was used to calculate the relationship between age, BMI, and blood glucose level. Phi coefficient was used to calculate the correlation between blood glucose level and gender, history of hypertension, and blood pressure ≥130/80. Cramer's *V* coefficient was used to test the correlation between blood glucose

level and a previous blood glucose level ≥150 mg/dL, race/ethnicity, marital status, and reason for visit. All analyses were conducted using SPSS statistical software, version 19.

Limitations

The findings of this study must be viewed in the context of its limitations. The sample under investigation was a small although adequately powered purposive sample of a racially and ethnically diverse (although fairly homogenous with respect to regionality) group of patients receiving care in two EDs. Data were obtained through retrospective review of patient records. Using medical records as a data source introduces potential error resulting from the quality of data entry. If the patient was informed about the elevated blood glucose level and referred for follow-up but it was not documented in the discharge instructions, it was counted as a missed opportunity. Some patients who met the criteria for this study may have had diabetes, but it may not have been documented in their medical record. The blood sugar was considered random because there is no way of knowing when the patient last ate. Blood glucose could have been elevated because of the stress response, infection, or other medical reasons.

Protection of Human Subjects

Protection of human subjects included approval by the Institutional Review Committee at the health system in which the data were collected. Institutional Review Board approval was also obtained from the University of San Diego. Data were collected retrospectively. There was no patient contact; therefore, there was no risk or benefit for the participants. Precautions were taken to protect patient privacy in accordance with the Health Insurance Portability and Accountability Act (HIPAA); data were de-identified prior to transferring the information. All data were secured in a password-protected site

on the researcher's computer. All paper records, including the codebook, are maintained in a locked drawer in the researcher's office. Data will be kept for five years then will be destroyed.

CHAPTER IV

RESULTS

The purpose of this study was to examine (1) the rates of elevated blood glucose levels ≥150 mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit and (2) ED provider patterns of informing and referring discharged patients without a history of DM for follow-up of elevated random blood glucose levels. In this chapter, the results are presented. First a descriptive profile of the study participants, including their random blood glucose level, BMI, elevated BP ≥130/80, history of hypertension, previous blood glucose ≥150 mg/dL, and select demographic characteristics (age, gender, race/ethnicity) are presented, followed by the results related to the specific research questions.

Specific Aim #1

To characterize a group of adults (random blood glucose, Body Mass Index [BMI], blood pressure [BP]) and select demographic characteristics (age, gender, race/ethnicity) receiving care for a non-diabetes related visit to the Emergency Department.

Sample Profile

A total of 2,555 patients were treated in the 2 EDs over the 9-day period. Of those, 1,410 had a laboratory-based blood glucose entered and recorded in the EMR. A purposive sample (n=193) included 106 patients with an elevated random blood glucose >150 mg/dL, without history of diabetes, and randomly selected patients who may have a history of diabetes (n=87).

Study participants (n=193) were fairly evenly distributed (Table 2) by gender, male (n=91) and female (n=102). Age ranged from 18 to 99 years with a mean (median 65, sd 20.48) age of 63.8 years. Approximately half (50.8%) were married and more than three-quarters (76.2%) were Caucasian. Abdominal complaints were the most frequent reason for visiting the ED (32.6%). Blood glucose levels ranged from 72 to 455 mg/dL (mean 159.69, sd 51.26; Table 3). BMI ranged from 18 to 44 kg/m2 (mean 26.09, sd 5.30). Twelve percent had a history of diabetes, 47% a history of hypertension, and 54% had an elevated blood pressure (≥130/80) during their ED visit. Thirty-two percent had a prior blood glucose level ≥150 mg/dL. Almost half (47.7%, n=92; Table 4) of the 193 patients were discharged, 46% (n=89) were admitted, and 6.2% (n=12) were transferred for admission to another hospital or a psychiatric unit.

Table 2

Sample Characteristics

	Total Sample	**BS ≥ 150 No History DM**	**BS in EMR With/Without History DM**
	(N = 193)	**(n = 106)**	**(n = 87)**
Age			
Mean (sd)	63.8 (20.48)	66.5 (20.79)	60.54 (19.72)
Range	18-99	20-99	18-95
Gender n (%)			
Male	91(47)	54 (51)	37 (42)
Female	102(53)	52 (49)	50 (58)
Race/Ethnicity n (%)			
Caucasian	147 (76.2)	82 (77.4)	65 (74.7)
Hispanic	28 (14.5)	14 (13.2)	14 (16.1)
Asian	6 (3.1)	5 (4.7)	1 (1.15)
Black	4 (2.1)	2 (1.9)	2 (2.3)
Other	5 (2.6)	1 (0.9)	4 (4.6)
Unknown	3 (1.6)	2 (1.9)	1 (1.15)
Marital Status n (%)			
Single	30 (15.5)	16 (15.1)	14 (16)
Married	98 (50.8)	52 (49.1)	46 (53)
Divorced	19 (9.8)	13 (12.3)	6 (6.9)
Separated	4 (2.1)	2 (1.9)	2 (2.3)
Widowed	40 (20.7)	21 (19.8)	19 (21.8)
Unknown	2 (1.0)	2 (1.9)	0
Reason for Visit to ED n (%)			
Abdominal	63 (32.6)	28 (26.4)	35 (40.2)
Chest Pain	30 (15.5)	13 (12.3)	17 (19.5)
Neurologic	40 (20.7)	18 (17)	22 (25.3)
Psychiatric	12 (6.2)	10 (9.4)	2 (2.3)
Respiratory	30 (15.5)	22 (20.8)	8 (9.2)

Other	18 (9.3)	15 (14.2)	3 (3.4)

Table 3

Health-Related Parameters

	Total Sample	**BS ≥150 No History of DM**	**BS in EMR With/Without History of DM**
	(N = 193)	**(n = 106)**	**(n = 87)**
Serum Blood Glucose level			
Mean	159.69 mg/dL	181.53 mg/dL	133.09 mg/dL
Range	72-455 mg/dL	150-288 mg/dL	72-455 mg/dL
Blood Pressure ≥130/80 **n (%)**			
Yes	105 (54)	52 (49)	53 (61)
No	88 (46)	54 (51)	34 (39)
Previous Blood Glucose ≥150 mg/dL **n (%)**			
Yes	62 (32)	42 (40)	21 (24)
No	101 (52)	34 (32)	66 (76)
N/A	30 (16)	30 (28)	0
History of Diabetes **n (%)**			
Yes	24 (12)	0 (0)	23 (26)
No	169 (88)	106 (100)	64 (74)
History of Hypertensionn (%)			
Yes	91 (47)	54 (51)	36 (41)

No	102 (53)	52 (49)	51 (59)
BMI			
Mean	26.09 kg/m2	25.83 kg/m2	26.43 kg/m2
Range	18-44 kg/m2	18-44 kg/m2	18-37 kg/m2

Table 4

Discharge Disposition

	Total Sample N = 193	**Sample n = 106**
Admitted n (%)	89 (46.1)	53 (50)
Discharged n (%)	92 (47.7)	45 (42.5)
Transferred n (%)	12 (6.2)	8 (7.5)

Specific Aim #2

To describe the relationships between and among the dependent variable of blood glucose level and independent variables (BMI, elevated BP [≥130/80], history of hypertension, previous blood glucose ≥150 mg/dL) and selected demographic characteristics in a group of adults receiving care for a non-diabetes related visit to the ED.

Research Question #2

What are the relationships between and among the dependent variable of blood glucose level and independent variables (BMI, elevated BP [≥130/80], history of hypertension, previous blood glucose ≥150 mg/dL) and selected demographic characteristics in a group of adults receiving care for a non-diabetes related visit to the ED?

Inferential statistics and correlations were applied to examine the relationships between the independent variables and the dependent variable.

Table 5

Correlations Between Independent Variables and Blood Glucose Level (n=193)

Independent Variable	**Blood Glucose Level** ***R*, Phi[(1)] or Cramer's *V*[(2)]**
BMI	.165*
BP ≥130/80	-.119[1]
History of Hypertension	.120[1]
Previous Glucose ≥150 mg/dL	.480[2**]
Age	.157*
Gender	-.084[1]
Race/Ethnicity	.160[2]
Reason for Visit	.321[2**]
Marital Status	.132[2]

Notes: r = *P*earson's correlation; *p < .05; **p < .01

Significant relationships were found between blood glucose level and BMI, previous blood glucose level ≥150 mg/dL, age, and reason for visit. Increased BMI, history of a previous blood glucose level ≥150 mg/dL, increased age, and reason for visit was significantly related to blood glucose level.

Specific Aim #3

To examine the rates of elevated blood glucose ≥ 150mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit.

Research Question #3

What are the rates of elevated blood glucose ≥150 mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit?

Research Question #4

What are the characteristics of adults without a history of diabetes who presented to the ED with an elevated blood glucose level?

A total of 1,410 patients had a blood glucose level processed by the lab during this study period. Seven and a half percent (n=106) met the research criteria of random blood glucose level ≥150 mg/dL without a history of diabetes. Age ranged from 20 to 99 years with a mean (median 69, sd 20.8) age of 66.5 years (Table 2). Approximately half (49%) were married, 51% were male (n=54), and 77% were Caucasian. Abdominal complaints were the most frequent reason for visiting the ED (26.4%; Table 3). Nonfasting blood glucose levels ranged from 150 to 288 mg/dL (sd 29.16) with a mean of 181.53. BMI ranged from 18 to 44 kg/m2 (mean 25.83, sd 5.63). Fifty-one percent of patients had a history of hypertension and 49% had a blood pressure that was elevated (≥130/80) during their ED visit. Forty percent had a prior blood glucose level ≥150 mg/dL documented in the medical record but were not diagnosed as having prediabetes or diabetes. Forty-five (42.5%) of the 106 patients were discharged, 50% (n=53) were admitted, and the rest (n=8) were transferred to another hospital or a psychiatric unit for

admission. Of those discharged (n=45), only one patient (2.2%) was informed about elevated blood glucose level and referred for follow-up.

In contrast, the additional randomly selected patients (n=87) ranged in age from 18 to 95 years, with a mean (median 61, sd 19.7) age of 60.5 years (Table 2). Approximately half (53%) were married, 42% were male (n=37), and 75% were Caucasian. Abdominal complaints were the most frequent reason for visiting the ED (40.2%; Table 3). Nonfasting blood glucose levels ranged from 72 to 455 mg/dL (mean 133.09, sd 59.37). BMI ranged from 18 to 37 kg/m2 (mean 26.43, sd 4.86). Forty-one percent of the patients had a history of hypertension and 61% had a blood pressure that was elevated (≥130/80) during their ED visit. Twenty-four percent had a prior blood glucose level ≥150 mg/dL documented in the medical record but were not diagnosed as having prediabetes or diabetes.

Specific Aim #4

To examine ED provider patterns of informing and referring discharged patients without a history of diabetes for follow-up of elevated random blood glucose, in a group of adults receiving care for a non-diabetes related visit to the ED.

Research Question #5

What are ED provider patterns of informing and referring discharged patients without a history of diabetes for follow-up of elevated random blood glucose in a group of adults receiving care for a non-diabetes related visit to the Emergency Department?

Results showed out of 106 patients, 45 were discharged and only one (2.2%) was informed and referred. Forty-four (97.8%) patients were not informed or referred.

CHAPTER V

DISCUSSION OF FINDINGS

The purpose of this study was to examine (1) the rates of elevated blood glucose levels ≥150 mg/dL in adults without a history of diabetes receiving care for a non-diabetes related emergency room visit and (2) emergency department provider patterns of informing and referring discharged patients without a history of DM for follow-up of elevated random blood glucose levels. In this chapter, a discussion of the findings and implications for nursing practice, education, and research are presented.

Study Summary

Retrospective data abstraction was used to obtain data for the study conducted here. A total of 2,555 patients were treated in the 2 EDs over the 9-day data collection period. Of those, 1,410 had a laboratory-based blood glucose recorded in the EMR. A purposive sample (n=193) included 106 patients with an elevated random blood glucose >150 mg/dL without a history of diabetes and randomly selected patients who may have a history of DM (n=87).

Study participants (n=193) were fairly evenly distributed (Table 2) by gender, male (n=91) and female (n=102). Age ranged from 18 to 99 years with a mean (median 65, sd 20.48) age of 63.8 years. Approximately half (50.8%) were married and more than three-quarters (76.2%) were Caucasian. Abdominal complaints were the most frequent reason for visiting the ED (32.6%). Blood glucose levels ranged from 72 to 455 mg/dL (mean 159.69, sd 51.26; Table 3). BMI ranged from 18 to 44 kg/m2 (mean 26.09, sd 5.30). Twelve percent had a history of diabetes, 47% a history of hypertension, and 54% had an elevated blood pressure (≥130/80) during their ED visit. Thirty-two percent had a prior blood glucose level ≥150 mg/dL. Almost half (47.7%, n=92; Table 4) of the 193 patients were discharged, 46% (n=89) were admitted and 6.2% (n=12) were transferred for admission to another hospital or a psychiatric unit.

Significant relationships were found between blood glucose level and BMI, previous blood glucose level ≥150 mg/dL, age, and reason for visit. Increased BMI, history of a previous blood glucose level ≥150 mg/dL, increased age, and reason for visit was significantly related to blood glucose level.

Approximately 7.5% (n=106) met the research criteria of random blood glucose level ≥150 mg/dL without a history of diabetes. Age ranged from 20 to 99 years with a mean (median 69, sd 20.8) age of 66.5 years (Table 2). Approximately half (49%) were married, 51% were male (n=54), and 77% were Caucasian. Abdominal complaints were the most frequent reason for visiting the ED (26.4%; Table 3). Nonfasting blood glucose levels ranged from 150 to 288 mg/dL (sd 29.16) with a mean of 181.53. BMI ranged from 18 to 44 kg/m2 (mean 25.83, sd 5.63). Fifty-one percent of the patients had a history of hypertension, and 49% had a blood pressure that was elevated (≥130/80) during their

ED visit. Forty percent had a prior blood glucose level ≥150 mg/dL documented in the medical record but were not diagnosed as having prediabetes or diabetes. Forty-five (42.5%) of the 106 patients were discharged, 50% (n=53) were admitted, and the rest (n=8) were transferred to another hospital or a psychiatric unit for admission. Of those discharged (n=45), only one patient (2.2%) was informed about their elevated blood glucose level and referred for follow-up.

There is a lack of agreement about what blood glucose value should be used to indicate further testing is needed to screen for prediabetes. Ginde et al. (2009) used >140 mg/dL for their study to identify possible prediabetics. In an earlier study Ginde et al. (2008) found random blood glucose levels greater than 120-140 mg/dL were predictive of elevated HbA1c. Further testing showed just over 1/3 of those who followed up for oral glucose tolerance testing had diabetes. The inclusion criteria of a blood glucose value ≥150 mg/dL used in this study is even higher than the values used in prior studies; therefore, it is likely even more than 1/3 of the participants in this study could have prediabetes or diabetes.

Looking at the profiles of patients with pre-diabetes, previous research has reported demographics, BMI, and history of hypertension. This is the first study to report rates of occurrence of blood pressure ≥130/80, previous blood glucose value ≥150 mg/dL, and reason for visit. The American Diabetes Association recommends diabetics maintain a blood pressure < 130/80. For that reason, this value was used to examine this population of patients. For the group with blood glucose value ≥150 mg/dL without a history of diabetes, 49% has a blood pressure ≥130/80. Further research is needed to see

if that correlates with those who end up undergoing further testing and test positive for prediabetes.

No prior studies have used a previous blood glucose value ≥150 mg/dL to screen for prediabetes. This number was selected because multiple other glucose values above and below 150 mg/dL; values as low as 125 and as high as 200 mg/dL had already been examined through research. Despite multiple studies, there is still not a guideline for ED providers to use to determine when referral is indicated. Further research is necessary to evaluate if those who present to the ED with a random blood glucose level ≥150 mg/dL without a history of diabetes get referred. Future research should provide demographics and risk factors on those referred if they pursue follow up testing and if they are diagnosed with prediabetes.

Significant relationships were found in this study. Blood glucose level correlated with BMI ($r = .165$, $p < .05$), previous blood glucose value ≥150 mg/dL (Cramer's $V = .480$, $p < .001$), age ($r = .157$, $p < .05$), and reason for visit (Cramer's $V = .321$, $p < .01$). Emergency department nurses and providers need to be aware of the significance of these relationships to help guide them as they care for patients. They show relationships between risk factors and blood glucose levels. No other studies have shown a significant correlation between history of previous blood glucose value ≥150 mg/dL and reason for visit.

It is not clear why this study did not show a significant correlation between blood glucose levels and elevated BP ≥130/80, history of hypertension, race/ethnicity, or gender, while previous studies cited in the literature have found they increase the risk of prediabetes and diabetes. Nonetheless, ED nurses and providers should have a heightened

awareness of patients with an elevated blood glucose level and any of the risk factors cited in this study or in other studies cited.

Hoerger et al. (2007) completed a study to examine cost effectiveness of screening patients to identify those with prediabetes. They screened based on BMI and looked at patients age 45-74. They used these variables because these patients are more likely to have prediabetes. This is consistent with the findings of this study. This study indicated a significant relationship between blood glucose level and age ($r = .157$, $p < .05$) and BMI ($r = .165$, $p < .05$).

In the study reported here, 32% (62/193) of the patients who had a blood glucose level documented in the EMR had an elevated random blood glucose ≥150 mg/dL. This is important information for ED nurses and providers because it will give them an increased awareness of the prevalence. Although the exact blood glucose level that warrants follow up is not defined in the literature, this study used ≥150 mg/dL as the indicator for those in need of informing and referring. Follow-up testing is necessary to confirm the risk state of prediabetes or to make a diagnosis of type 2 diabetes.

Of concern, is the finding that out of 45 patients discharged from these two EDs only one (2.2%) was informed about an elevated random blood glucose value and referred for follow up. There were 44 missed opportunities. Failing to inform and refer minimizes patients' abilities to make relevant lifestyle changes to prevent or delay progression to type 2 diabetes. This finding is significantly lower than those found by Graffeo (2001), who reported 20% of ED charts with unexplained hyperglycemia ≥160 mg/dL had documentation about referral.

Ginde et al. (2009) used >140 mg/dL for their inclusion criteria to assess retrospective data to evaluate if ED patients were being identified as possible prediabetics and informed about a plan for follow up. They found 10% were informed and 6% were referred. Even with a different and lower blood glucose value than that used in this study, they found a higher rate of informing and referring than was discovered in this study.

A patient may have prediabetes and its adverse micro- and macro-vascular complications for up to seven years before diabetes is diagnosed (Aroda & Ratner, 2008; Harris, Klein, Welton, & Knulman, 1992). Early identification and treatment of patients who may have undiagnosed prediabetes is essential in preventing or delaying progression to type 2 diabetes (Bergman, 2010; Hsueh et al., 2010).

Screening asymptomatic patients was controversial in the literature, although recommended by the ADA. This study was not done to encourage screening, but rather was founded on the idea if a provider has access to an elevated lab value, he or she should identify the abnormality, inform the patient, and refer them for follow-up. It is an opportunity not to be missed.

It is highly likely there are patients in this group of 106 who have prediabetes or diabetes. Often patients have prediabetes but are asymptomatic. With proper informing and referring, each will have the opportunity to seek follow-up and testing to confirm or reject their risk.

Many patients use the ED as a primary care setting. All ED patients are discharged with the name of a physician or clinic to follow up with; however, unless follow-up is emphasized and encouraged, many do not. If patients are asymptomatic, it is unlikely they will seek further tests or treatments. Without informing patients about an

elevated random blood glucose level, explaining what the risks are, and referring them, they may never have another opportunity to be tested and treated.

Importance to Advancement of Knowledge

This study examined data from patients in two EDs to describe elevated random blood glucose (≥150 mg/dL), BMI, elevated BP, and select demographic characteristics (age, gender, race/ethnicity) in the ED setting. It also examined the rate at which discharged ED patients were informed and referred for follow-up. This study will add to the scientific knowledge by providing data on questions not previously explored. Findings have the potential to improve ED nurses' and providers' awareness about the rates of non-diabetic patients with random blood glucose levels ≥150 mg/dL seen in the ED. Exploring the current practice in the ED for informing the patient about his or her elevated blood glucose level and referring him or her for follow-up serves as an indicator of missed opportunities for patients who are discharged. The study also examined the relationships between risk factors and elevated blood glucose levels in the ED population. These relationships are important to guide future intervention development and research.

Conclusion and Implications for Nursing

Pender's Health Promotion Model was the conceptual framework guiding this study. It was chosen because as the model suggests, patients will likely respond to the interpersonal influences of an ED provider informing and educating them about an elevated random blood glucose level. When the provider explains the risks involved, refers the patient for follow up and urges them to follow up for further testing, this will lead to the patient making a commitment to action. The next step is taking the action, in which the patient will follow up for further testing. If the patient does, in fact, fit the

criteria for a prediabetes diagnosis, he or she can make important decisions about lifestyle modifications for improved health and well-being.

Indeed, research indicates the ED visit may be the only opportunity for some patients to interact with a health care provider. This makes it an ideal place to identify patients with possible prediabetes and refer them for follow-up. Emergency departments need to adopt policies to ensure providers will inform and refer patients with elevated blood glucose levels for further evaluation and treatment of the elevated blood glucose level.

ED patients are given discharge instructions upon discharge that include their diagnosis and any findings. The provider instructs them to follow-up with a specific physician or clinic. They are typically notified about abnormal findings that require follow-up. Emergency nurses must partner with other providers to educate patients with elevated random blood glucose levels about the risks and complications of prediabetes and the importance of following up on their results. ED nurses should take an active role in advocating for informing and referring by ED providers. They should also promote protocols to enable ED nurses to provide this information. Future studies are needed to identify the ongoing barriers that prevent providers from informing patients about their elevated random blood glucose levels and referring them for follow-up.

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Appendices

Appendix A

Palomar Pomerado Health

Institutional Review Committee Approval

QUALITY MANAGEMENT

PALOMAR POMERADO HEALTH

January 31, 2012

Institutional Review Committee
Palomar Pomerado Health
555 E. Valley Parkway
Escondido, CA 92025

RE: Elevated Serum Glucose in the Emergency Department – Hospital Setting/ An Unrecognized Opportunity to Educate Patients on Possible Prediabetes mellitus or Diabetes Mellitus

This study was approved by the Palomar Pomerado Investigational Review Committee (PPH, IRC), in its meeting of September 8, 2011, the Executive Committee of Palomar Medical Center, at their meeting of September 26, 2011 and the Executive Committee of Pomerado Hospital, to be conducted at Palomar Medical Center and Pomerado Hospital.

An amendment was submitted and approved in November 2011. Permission is requested for another amendment, to increase the number of participants to 206. Data has already been collected on 103, nondiabetic patients with blood sugar >150 mg/dL. In addition to that data, I would like to randomly select 103 patients to use as a comparison group. The electronic health record will be accessed. I would also like to collect data on all 206 patients to show if they were admitted or discharged. This will be helpful in identifying missed opportunity to educate and refer for follow up of possible prediabetes.

Please accept and approve this amendment. Changes were made to pages 8 and 9 of the application.

Thank you in advance for your consideration.

Sincerely,
Sincerely,

Melissa D. Kouse, RN, MSN, CNS-BC, CEN
PPH Clinical Nurse Specialist
Quality and Patient Safety
(760) 740-6367

Cc: Cristina Shoukry

Reviewed and approved by the Palomar Pomerado Health Investigational Review Committee.

Richard G. Just, M.D., Chairman

2-9-12
Date