2018

A Staff Education Project and Screening Tool to Identify Calciphylaxis

Janice Pennington
Walden University

Walden University

College of Health Sciences

This is to certify that the doctoral study by

Janice Pennington

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Sue Bell, Committee Chairperson, Nursing Faculty
Dr. Casey Cole, Committee Member, Nursing Faculty
Dr. Francisca Farrar, University Reviewer, Nursing Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
2018

Abstract

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by

Janice M. Pennington

MSN, Walden University, 2007

BS, University of the State of New York, 1984

Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Nursing Practice

Walden University

May 2018

Abstract

Calciphylaxis is a deadly disease seen primarily in patients with end stage renal disease. Literature indicated that improved patient outcomes are seen with routine screenings. Many dialysis providers lack fundamental knowledge that would enable early identification of calciphylaxis in patients with renal disease. The purpose of this project was to design a screening instrument and develop a staff education program that would transform calciphylaxis management by promoting early identification and treatment of the disease. Knowles's theory of andragogy was used as the theoretic framework for the project. Dialysis center staff (n = 26) participated in the education. The number of participants was based on the number of staff working at the partner dialysis site. There were no exclusions as all members of the interdisciplinary team play an important role in calciphylaxis management. Surveys conducted following the education were used to determine whether dialysis staff believed they had acquired the knowledge and skills necessary to identify early signs of calciphylaxis. Descriptive data collected by the surveys indicated 60% of participants were not at all comfortable identifying patients at risk for developing calciphylaxis prior to attending the education presentation. Following the presentation, 68% of participants felt very comfortable identifying at-risk patients, an increase of 82.3%. This project exemplified that calciphylaxis detection is a secondary prevention nursing intervention that has potential for promoting positive social change by improving patient outcomes, reducing mortality rates in the end stage renal disease population, and providing empirical data to inform evidence-based therapies for at-risk patients.

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Dedication

This doctoral project is dedicated to my husband, who stood by me through this entire educational journey and sacrificed so much so that I might realize my scholastic vision. You are always here for me through good times and bad. I am truly lucky to have you in my life.

This project is also dedicated to the memory of my mother. She always had the confidence that I could accomplish anything that I set my mind to do. She is my strength and determination. I miss her so much. I know she is proud.

Acknowledgments

I wish to thank my project committee for all the support and guidance through every step of this project: Dr. Sue Ellen Bell (committee chair), Dr. Casey Cole (committee member), and Dr. Francisca Farrer (URR committee member). I also want to thank Dr. Hazel Dennison, Director of Continuing Nurse Education for assisting me in providing continuing education credits to my participants and for managing the online platform that was used to collect project data. I would not have accomplished this milestone without the help and support of everyone involved.

Second, I want to thank all the dialysis staff who encouraged and supported me in my clinical practicum experiences and those who participated in my DNP project. Without you, this project would not have been possible.

Finally, I want to thank my mentor and preceptor Jacqueline Gallagher, DNP, for all the time, support, encouragement, and guidance that she provided throughout my classes, practicum experiences, and this doctoral project. Jackie, your words of encouragement helped me through some tough times. Thank you!

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Section 1: Nature of the Project

Introduction

End-stage renal disease (ESRD) occurs when the kidneys can no longer clear the body of uremic toxins. ESRD is the most severe stage of chronic kidney disease and requires renal replacement therapy to sustain life (National Kidney Foundation, 2002). The U.S. Renal Data System (USRDS) reported 703,243 prevalent ESRD cases in the United States at year end in 2015 (Saran et al., 2017). This represents 0.21% of the U.S. population, an increase of 2.4% from the previous year and a 58% increase from the year 2000 (Saran et al., 2017). Likewise, the incidence of ESRD has also been on the rise. As reported by the USRDS, there were 112,114 newly diagnosed ESRD cases in 2015 (Saran et al., 2017). Chronic kidney disease and ESRD not only affect population health but can also represent a health-related quality of life (HRQOL) burden for the individual. Frequent hospitalizations and increased mortality risks have been associated with poor HRQOL (Chen, Mawed, & Unruh, 2016). Multiple comorbid conditions such as anemia, disordered bone metabolism, cardiovascular disease, and infections are all factors that negatively impact a person's HRQOL. As the incident and prevalent rates of ESRD have continued to rise, there has been an increased demand upon health care resources to manage the life-sustaining needs of the ESRD population as well as treating the many associated comorbidities (Saran et al., 2017).

Calciphylaxis is a serious disease seen predominately in the ESRD population. The disease process has been described as calcifying panniculitis, necrotizing panniculitis, calcific uremic arteriolopathy (CUA), nonuremic calcific arteriolopathy, and

calcinosis cutis. Hans Seyle first described calciphylaxis in 1962 as an anaphylactic reaction to calcium (Nigwekar et al., 2015). While this description does not accurately describe the pathology of calciphylaxis, the term is universally known. For this reason, the term *calciphylaxis* will be used throughout this paper.

Brandenburg et al. (2016) described calciphylaxis as a "challenging disease with a dismal prognosis urgently requiring adequate strategies for diagnosis and treatment" (p. 1211). Calciphylaxis is a form of extraskeletal calcification characterized by the deposition of calcium salts in the subcutaneous tissues (Zacharias, Fontaine, & Fine, 1999) and thrombosis of the small arterioles of the skin (Moorthi & Moe, 2011). In advanced stages, calciphylaxis can lead to tissue ischemia, necrosis, and pain (Jeong & Dominguez, 2016). Calciphylaxis has been reported to affect from 1% to 4% of the ESRD population (Brandenburg et al., 2016). According to Nigwekar et al. (2014), actual epidemiological counts are difficult to quantify because there is no unique International Classification of Diseases (ICD) code specific for calciphylaxis. Under ICD-10, calciphylaxis is coded as E83.59 – other disorders of calcium metabolism. This nonspecific classification has led to a lack of precise epidemiological data, making it difficult to fully appreciate the prevalence of calciphylaxis or to track disease trends accurately. Additionally, as Nigwekar et al. argued,

> lack of data on fundamental issues such as incidence, prevalence, or mortality for any condition seriously impairs future patient-oriented translational research and limits investigators' abilities to examine temporal trends, epidemiological

> associations, and development of diagnostic biomarkers and novel therapy targets. (pp. S924-S925)

For this reason, there seems to have been a void in evidence-based research to guide the treatment of calciphylaxis. One prevalent theme in the literature indicated that routine screening, early identification, and early intervention of calciphylaxis could improve patient outcomes. Despite this, research regarding any screening process has been lacking. There is a practice gap with regards to conducting routine screenings and, as Brandenburg et al. noted, many providers lack the knowledge and skills necessary to identify early signs of calciphylaxis. For this DNP project, I have looked to fill the practice and knowledge gaps by developing a calciphylaxis screening tool to use in clinical practice and developing a staff education project to provide dialysis staff with the knowledge and skills necessary to identify calciphylaxis in the ESRD population. Positive social implications could be realized through early detection and treatment of calciphylaxis, thereby reducing the physical burden of advanced disease and reducing health care spending.

Problem Statement

As reported by the USRDS, the nephrology community has seen an alarming increase in the incident and prevalent dialysis population in the 35-year period from 1980 through 2015. Trends in incident and prevalent ESRD populations are documented annually by the USRDS. In 1980, there was a reported incident ESRD count of 17,902 with an adjusted rate (million/year) of 87 and a reported prevalence count of 56,434 with an age-sex-race standardization per million of 273.7 (Saran et al., 2017). Compare this to

current trends in 2015. In 2015, there was a reported incident ESRD count of 124,114 with and adjusted rate (million/year) of 357 and a reported prevalence count of 703,243 with an age-sex-race standardization per million years of 2,023.6 (Saran et al., 2017). This rapid growth in the ESRD population coupled with increased awareness of the disease process is likely responsible for an increasing number of patients now being diagnosed with calciphylaxis.

Late stages of calciphylaxis are characterized by vascular calcification, tissue necrosis, and the ensuing development of painful skin ulcers (Magro, Simman, & Jackson, 2010). While calciphylaxis pathogenesis remains a mystery (Bliss, 2002), researchers do know that the ulcerative lesions are associated with considerable pain, suffering, and a mortality rate 2.5 to 3 times higher than in ESRD patients without calciphylaxis (Nigwekar et al., 2014). Although there are no data on the number of patients who are misdiagnosed or whose diagnosis is delayed, the importance of early diagnosis and treatment is well documented. The lack of evidence regarding routine calciphylaxis assessment and screening has clearly indicated that there is gap in clinical practice that calls for action. Parker, Mouton, Young, and Espino (2003) reported a calciphylaxis associated mortality rate of 86%, while Wangen, Anderson, Fencl, and Mangan (2014) reported a median survival of 2.6 months following diagnosis. Calciphylaxis lesions are often seen as soft tissue calcifications or ulcerative wounds of the skin. The underlying pathology of calciphylaxis is related to endoluminal calcification of the vasculature and, as such, calciphylaxis can affect any other organ system. Calciphylaxis has been noted to affect the heart and gastrointestinal tract (Magro et al.,

2010). Not all calciphylaxis is ulcerative or systemic. As Fine and Zacharias (2002) noted, calciphylaxis can be nonulcerating and often goes undiagnosed. Herein lies the need for routine calciphylaxis screening in the ESRD population. With the current trends in ESRD epidemiology, routine screening for calciphylaxis becomes crucial.

Patients with chronic kidney disease carry a higher burden for cardiovascular disease than the general population (Saran et al., 2017). According to the USRDS, cardiovascular death is the largest category of known cause mortality in the ESRD population (Saran et al., 2017). In 2015, cardiovascular deaths were broken down into the following categories: 40% arrhythmia and cardiac arrest, 6% acute myocardial infarction and arteriosclerotic heart disease, 3% congestive heart failure, 3% cerebral vascular accident, and 3% other cardiac causes (Saran et al., 2017). Systemic calciphylaxis has been implicated as contributing to the high rate of cardiovascular death among patients with chronic kidney disease due to cardiac artery calcifications (Lee, Belozeroff, Song, Diakun, & Goodman, 2013). Evidence-based treatment of calciphylaxis has remained elusive. Literature supported improved outcomes if calciphylaxis was identified and treated prior to the onset of ulcerative lesions (Feeser, 2011; Sprague, 2014). A practice void has persisted because the literature is devoid of evidence or even expert opinions that would inform a process for conducting routine calciphylaxis screening.

As a nurse practitioner practicing in the outpatient hemodialysis unit, I have personal experience to indicate that the incidence of calciphylaxis with ulcerative lesions is becoming more prevalent than in previous years. This is no doubt a reflection of a growing ESRD population and increased clinical awareness. Fine and Zacharias (2002)

found a high prevalence of nonulcerating calciphylaxis in their dialysis population and concluded that the incidence of calciphylaxis is much higher than described in the literature. If this is true, then health care teams are doing a disservice to the ESRD population and need to become more proactive in early screening and disease detection.

Whether due to underdiagnosis or a growing ESRD population, calciphylaxis presents a population health challenge. There is a knowledge gap in hemodialysis clinical practice as well as the absence of any screening tool to inform clinical assessment. Filling this gap may assist nurses and advanced practitioners to recognize the early signs of calciphylaxis that, if left unchecked, could potentially lead to advanced disease. This presupposes a need for educational training to provide dialysis nurses with the foundations and skills necessary to recognize impending serious sequela. Despins, Scott-Cawiezell, and Rouder (2010) recognized that quality care could be improved if nurses had the tools available to help them identify risk factors or early signs of impending injury.

This DNP project has the potential to transform calciphylaxis management by nephrology nurses. With development of a calciphylaxis screening tool and education of nurses on how to use the tool in clinical practice, this DNP project could lead to the transformation of nephrology nurses into clinical nurse leaders in calciphylaxis management.

Purpose

A gap analysis of calciphylaxis management revealed a knowledge gap, as many nephrology nurse providers do not know how to identify physical signs of calciphylaxis.

There also exists a practice gap in that routine calciphylaxis screenings are not being conducted.

The purpose of this DNP project is twofold: first, to design a calciphylaxis screening tool that could be used in clinical practice and second, to develop a continuing nurse education activity that would provide dialysis staff with the education and skills necessary to conduct a clinical screening for the purpose of identifying calciphylaxis in the clinical setting.

This DNP project addressed two practice focused questions:

1. What are the best practices based on literature evidence and expert opinion to be incorporated in a calciphylaxis assessment and screening tool?
2. Will dialysis staff who participate in a staff education activity, regarding calciphylaxis assessment and screening, acquire the knowledge and skills necessary to effectively identify calciphylaxis in the clinical setting?

It is clear from the research that there is a lack of evidence or opinions regarding best practices in the management of calciphylaxis. Brandenburg et al. (2016) acknowledged unmet medical needs in calciphylaxis management that are due to the scarcity of evidence. Brandenburg et al. identified an urgent need for clinical guidance in this area of medicine. With this DNP project, I addressed the practice void by developing an assessment tool that, once validated, could be used to guide the process of routine calciphylaxis screening.

A successful calciphylaxis screening program is dependent on nurses who possess a fundamental knowledge of calciphylaxis and can apply this knowledge in clinical

practice. This DNP project addressed the knowledge gap with the development of a staff education activity that provided dialysis staff with the fundamental knowledge and the core competencies to conduct a calciphylaxis screening and identify calciphylaxis lesions in clinical practice.

The Nature of the Doctoral Project

A literature search failed to produce any nursing protocol related to screening, identification, or treatment of calciphylaxis in the ESRD population. There have been numerous case studies, some anecdotal evidence, and expert opinion, but there was a dearth of solid evidence. The literature search was replete with references to the lack of evidence or best practices. What I derived from the evidence was that early identification, diagnosis, and intervention is paramount to improving outcomes and minimizing complications (Feeser, 2011; Fine & Zacharias, 2002; Sprague, 2013).

There were two components to the DNP project. The first was to design a calciphylaxis screening tool that could be easily integrated into clinical practice without being unduly burdensome or disrupting unit workflow. The assessment and screening tool was designed to incorporate the current monthly diabetic foot exam and pain assessment. Development of the assessment and screening tool was based on current evidence and expert opinion regarding calciphylaxis pathophysiology; best practices in skin and wound assessment, screening, and surveillance; and a multidimensional pain assessment. Once developed, the assessment and screening tool was offered to participants during the continuing education activity for evaluation and to solicit

recommendations for improvement. The tool was not validated as part of the DNP project but is expected take place outside of the DNP project.

The second element of the DNP project involved working with a partner dialysis organization to provide dialysis staff with the knowledge and skills necessary to conduct a routine calciphylaxis screening. The staff education activity offered attendees 1.5 hours of continuing education credits. The objectives of the presentation were to educate participants (a) to understand the pathophysiology of calciphylaxis, (b) to identify patients at risk of developing calciphylaxis, and (c) to provide the skills needed to identify calciphylaxis lesions in the clinical setting. This staff education project was designed to incorporate an interdisciplinary approach for achieving early intervention by empowering frontline nurses to assume a proactive leadership role, apply critical assessment skills, assess risk factors, and identify potential signs of calciphylaxis in the dialysis patient population.

I used several evaluation techniques for data analysis. A retrospective pre/post self-assessment was developed to evaluate the participants' perceptions of learning and competence in caring for patients with calciphylaxis. A posttest was conducted to evaluate knowledge transfer, retention, and application of calciphylaxis principles that would be needed to conduct a calciphylaxis screening. The activity specific outcome measure assessed what changes participants could implement into practice. A shared enduring activity evaluation was used to evaluate the effectiveness of teaching strategies. Finally, an evaluation of the calciphylaxis screening tool helped examine functionality, usefulness, and relevance to practice.

Significance

Calciphylaxis is a disease that can adversely affect the health and wellbeing of the affected individual. Calciphylaxis is said to affect 1% to 4% of the dialysis population (Brandenburg et al., 2016), but this may not be an accurate epidemiological measure (Fine & Zacharias, 2002; Nigwekar et al., 2014). As the nephrology community sees increasing numbers of ESRD patients, it is likely that there will be an increased number of calciphylaxis cases diagnosed. Calciphylaxis is associated with a high mortality rate (Parker et al., 2003; Wangen et al., 2014) and a reduced HRQOL (Jeong & Dominguez, 2016). Yet, despite the gravity of the disease, there is very little evidence available to guide therapy. The evidence pointed to early recognition and treatment as being paramount to reducing complications and improving outcomes (Fine & Zacharias, 2002). The goal of this DNP project was to fill a practice gap limiting frontline dialysis staff from critically assessing the patient for attendant risk factors and identifying early stages of the disease. The ultimate outcome would be to educate frontline nurses with the knowledge they need to lead clinical practice change and improve health care outcomes for the ESRD patient.

Summary

The landscape of medicine was transformed by two important reports published by the Institute of Medicine: *To Err is Human, Building a Safer Health Care System* (1999) and *Crossing the Quality Chasm: A New Health System for the 21st Century* (2001). The onus is on health care providers to deliver safe, quality, and patient-centered care. Nurses are being called upon to become leaders in clinical practice and at the

bedside (Grindel, 2016). Nephrology nurses are ripe for assuming clinical leadership roles to improve outcomes for the ESRD population who are at risk of developing calciphylaxis.

A calciphylaxis diagnosis comes with a high price tag in terms of patient outcomes, quality of life, morbidity, and mortality (Chen et al., 2016; Nigwekar et al., 2014; Sprague, 2014). The aggressive treatments and multimodal therapy associated with the treatment of advanced disease often result in considerable health care costs. Routine calciphylaxis assessment and screening could lead to early identification and intervention before the development of ulcerative lesions or other systemic complications. Aggressive management of the disease in its early stages could ultimately save health care dollars and improve clinical outcomes. The development of a calciphylaxis assessment and screening tool and instituting routine calciphylaxis screening could be one process that changes the landscape of health care in nephrology through disease prevention.

Calciphylaxis is most prevalent in the ESRD population, but it is not exclusive to this population. Cases have been reported in patients with chronic kidney disease, primary hyperparathyroidism, multiple myeloma or other plasma cell proliferative disorders, cirrhosis, and rheumatoid arthritis (Magro et al., 2010). This DNP project focused on the ESRD population, but the lessons learned can easily be applied to any of the vulnerable populations.

In Section 2, I will address how Knowles's www.amsn.org (1984; Knowles, Holton, & Swanson, 2005) theory of adult learning was integrated into the staff education project.

Section 2: Review of the Evidence

Introduction

Early recognition of calciphylaxis is paramount to early intervention and treatment in order to minimize complications and disease progression. A gap analysis found that education regarding identification of calciphylaxis wounds was necessary to groom dialysis providers to perform a routine calciphylaxis screening. A practice gap analysis found no available calciphylaxis assessment tools to inform routine screening or a problem-focused assessment.

Dialysis nurses, as integral members of the interdisciplinary team, are best positioned to assume a leadership role at chairside and positively impact quality outcomes in the ESRD population. Because of the close contact between ESRD patients and nephrology providers, the ensuing patient–provider bond can facilitate an open two-way communication channel. A nurse properly trained to preform calciphylaxis screening is in an excellent position to recognize early calciphylaxis lesions and avert the complications associated with advanced disease.

The first purpose of this DNP project was to develop a calciphylaxis screening tool that could be used in clinical practice. The second purpose was to create a staff education activity that would educate dialysis nurses how to conduct a calciphylaxis screening and assessment in the ESRD population. This DNP project addressed two practice focused questions:

1. What are the best practices based on literature evidence and expert opinion to be incorporated in a calciphylaxis assessment and screening tool?

2. Will dialysis staff who participate in a staff education activity, regarding calciphylaxis assessment and screening, acquire the knowledge and skills necessary to effectively identify calciphylaxis in the clinical setting?

The staff education activity and draft calciphylaxis screening tool were offered to staff at the partner dialysis facility. While the calciphylaxis screening tool is important, it requires validation before it can be disseminated. Validation is expected to take place outside of this DNP project.

In this section, I will discuss the application of Knowles's (1984; Knowles et al., 2005) theory of adult learning to the staff education activity. I will examine the gaps in practice that prompted this DNP project. Further, I will examine how my experiences at my partner organization helped to shape my role as an educator, interprofessional collaborator, and leader to transform care at the chairside and improve population health in the ESRD population.

Concepts, Models, and Theories

Malcolm Knowles (1913-1997) was a U.S. educator renowned for developing the theory of adult learning (Bates, 2009). Knowles's first book, published in 1973, described the unique needs of the adult learner. This book is now in its eighth edition. Knowles differentiated the learning needs of children from those of the adult. Pedagogy, or the teaching of children, is a teacher-centric model of education (Knowles et al., 2005). Under a pedagogical model, the teacher determines the subject matter, the manner of instruction, and the evaluation methods (Knowles et al., 2005). Student participation is passive as the teacher leads the learning experience (Knowles et al., 2005). In contrast,

andragogy is defined as the "art and science of helping adults learn" (Knowles et al., 2005, p. 61). In an andragogic model, the focus shifts from a teacher-centric emphasis on learning to a learner-centered approach that motivates learning. In andragogy, the role of the teacher shifted from leading learning to facilitating learning (Knowles et al., 2005).

The andragogic model is based on six assumptions of adult learning (Knowles, 1984; Knowles et al., 2005):

- *Need to know*: Adult learners need a reason for learning. If knowledge acquisition is meaningful, then the learner will find benefit in learning.
- *Self-concept*: Mature adults assume responsibility for making their own decisions. They become self-directed, goal directed, and independent learners.
- *Prior life experience*: The varied backgrounds and experiences present in a group promote a "rich resource for learning" (Misch, 2002, p. 154) that can be capitalized upon to enhance the learning experience.
- *Motivation*: Motivators for learning can include job advancement, monetary incentives, grades, self-improvement, self-satisfaction, or personal fulfilment.
- *Readiness to learn*: Readiness to learn occurs when learning coincides with need-to-know situations, managing life challenges, or achieving life goals (Misch, 2002).
- *Relevance*: Learning must be relevant and life-centered. Adult learning is problem centered and geared toward knowledge that is situationally applicable (Misch, 2002).

To integrate the principles of adult learning in an educational offering, the role of the teacher must shift to one of a process manager rather than focusing on only disseminating information (Knowles, 1984). Teaching strategies should be fashioned to facilitate participant interaction. Interactive teaching strategies could include discussion, case studies, work groups, brainstorming, problem solving, polling, and self-reflection. Such interactions tend to stimulate thinking, promote active participation, and most importantly can capitalize on varying life experiences of each participant.

The application of Knowles's andragogic principles can be applied to any adult learning situation whether in the live classroom, virtual classroom, distance learning, self-study, continuing education, or human resource development. In this DNP project, Knowles's theory of adult learning was used to develop an interactive staff education project that focused on the pathophysiology of calciphylaxis, identification of calciphylaxis wounds, treatment, and outcomes. While the staff education project was a live event, it could easily be adapted and delivered as a webinar or in an online forum.

Relevance to Nursing Practice

Calciphylaxis is a disease that carries a high mortality rate. Fine and Zacharias (2002) concluded that nonulcerating calciphylaxis carried a mortality rate of 33% at 6 months and increased to greater than 80% with the development of ulcerative lesions. The findings by Fine and Zacharias suggested that nonulcerating plaque lesions likely represented early calciphylaxis and, if treated, could prevent progression to advanced disease, which is characterized by ulcerative lesions. Fine and Zacharias's findings also indicated that because nonulcerative calciphylaxis is often undiagnosed or misdiagnosed,

the incidence of calciphylaxis is much higher than what has actually been published in the literature.

The precise pathophysiology of calciphylaxis remains a mystery, but there are certain known risk factors. A disordered calcium and phosphorus metabolism is implicated as one of the leading predisposing factor to calciphylaxis (Rudolph & Lerma, 2012). The cardiovascular disease that is seen in the ESRD population can be exacerbated by calciphylaxis as a result of calcium deposition in the large vessels (Chandra et al., 2012; Magro et al., 2010) or with metastatic calcification in the myocardium (Mana, Sanguineti, Unterseeh, Bouvier, & Garot, 2012). A literature search produced no evidence of existing nursing protocols for routine calciphylaxis screening. During my search, I was only able to locate a single study with discussion of routine calciphylaxis screening. In their study, Fine and Zacharias (2002) found that most of their newly diagnosed calciphylaxis cases presented with dense plaques in the calf. They concluded that (a) nonulcerating calciphylaxis lesions were more prevalent than ulcerative lesions, (b) nonulcerating calciphylaxis lesions probably represented early disease, and (c) an experienced clinician could easily identify these calciphylaxis plaques during a routine screening (Fine & Zacharias, 2002). While often misdiagnosed as cellulitis, the plaques were often due to calcium deposition in the subcutaneous tissue, were tender on palpation, and could usually be seen on bone scan (Fine & Zacharias, 2002). Fine and Zacharias stated that they did routinely conduct screening for nonulcerative calciphylaxis at their peritoneal dialysis clinic. Unfortunately, they did not provide any specific recommendations on how to conduct a screening or offer a clinical screening instrument.

Despite the growing awareness of this horrific disease process, there remains insufficient scientific evidence to guide treatment or routine screening. But, as Fine and Zacharias (2002) indicated, experienced practitioners could easily identify nonulcerative calciphylaxis lesions with routine screenings. A nurse-driven calciphylaxis screening protocol conducted by nurses trained to identify nonulcerative lesions could potentially improve patient outcomes in patients with calciphylaxis. A screening protocol proven to be effective in the ESRD population could be implemented in the general population to screen patients at risk for developing calciphylaxis. Addressing this practice gap in the local ESRD population could also provide an opportunity for developing empirical data to inform evidence-based therapies for all patients at risk.

Local Background and Context

During my practicum experience, I worked with my partner facility as a member of the core team. The core team comprised a group of interdisciplinary professionals who provided direct patient care. The core team fulfilled several functions. I will review those that were directly applicable to my practicum experience and DNP project.

Quality Outcome Measures

The core team was responsible for reviewing patient and facility quality outcome measures as established by the Centers for Medicare & Medicaid Services (CMS). These quality measures are used to assess unit-specific quality and performance outcomes. They include dialysis adequacy, anemia management, mineral and bone disorders, nutritional status, infection rates, hospitalization rates, and standard mortality rates. The core team identified trends and developed a plan to correct any measures that did not meet goals.

Organizational Goals

Nursing staff competencies and staff retention rates were integral to good patient outcomes. The core team identified a problem with high staff turnover, resulting in a higher ratio of inexperienced nurses in relation to experienced nurses. As a result, the core team identified nursing education as a priority. During my tenure on the core team, I assumed the role of educator and presented on topics such as fall prevention, adverse drug events, and medication nonadherence. These presentations were also developed using a Knowles's framework.

According to Chaghari, Saffari, Ebadi, and Ameryoun (2017), staff education is necessary to maintain core competencies, quality outcomes, patient outcomes, and job satisfaction. Staff education in nursing can help strengthen the health care organization by improving employee productivity, fostering innovative thinking, improving patient outcomes through best clinical practices, and stimulating a desire for lifelong learning (Chaghari et al., 2017). In the case at hand, dialysis staff was motivated to learn how to apply evidence-based principles and transform care at the bedside to improve patient outcomes. They were able to immediately apply what they learned to problems encountered in clinical practice. This resulted in increasing self-confidence building skills. Increased self-confidence leads to job security, job satisfaction, and ultimately staff retention.

Calciphylaxis as a Focus for my DNP Project

The core team identified a trend in the increasing number of patients with calciphylaxis. Patients with calciphylaxis require an aggressive multimodal and

multidisciplinary treatment plan. Treatments can include (a) increasing the dialysis time and frequency, (b) managing serum phosphate levels using one or more phosphate binders, (c) suppressing the parathyroid gland with calcimimetics and bisphosphonates, (d) preventing hypercalcemia by limiting exposure to extrinsic calcium and vitamin D, (e) administering intravenous sodium thiosulfate to chelate calcium deposits in the subcutaneous tissue, and (f) managing pain. If indicated, surgical interventions could include parathyroidectomy for hyperparathyroidism and wound debridement to facilitate wound healing. Adjuvant hyperbaric oxygen therapy has also been used for wound healing. Patients with calciphylaxis are often comanaged by specialists in infectious disease, wound care, and pain management. Calciphylaxis can negatively impact a number of the quality outcome measures set out by CMS. Calciphylaxis screenings are not typically performed, and in my literature review I was unable to uncover any validated clinical assessments available to conduct a routine calciphylaxis screening. To address this practice gap, I developed a calciphylaxis assessment and screening tool that could be used in clinical practice.

Despite all that is known about the devastating effects of calciphylaxis, there remains a practice void and absence of tools to effectively screen patients for calciphylaxis. This DNP project was one approach in bridging the local calciphylaxis knowledge gap and could potentially address the knowledge and practice gaps identified in the nephrology community at large.

Role of the DNP Student

As a nurse practitioner practicing in the outpatient hemodialysis setting, I found an increased incidence of advanced ulcerative calciphylaxis cases being diagnosed outside of the dialysis unit. This prompted a question of why calciphylaxis was not recognized in the dialysis setting. Two themes came to light. First, dialysis staff was not looking for calciphylaxis and second, dialysis nurses were not prepared to identify calciphylaxis wounds or conduct routine screenings for calciphylaxis.

Patients who reach advanced stages of calciphylaxis have poorer outcomes and higher mortality rates. To improve outcomes, calciphylaxis needs to be diagnosed in its early stages. Most hemodialysis patients receive treatments several times a week. This frequent contact puts dialysis professionals in the best position to screen for early manifestations of the disease. Currently, dialysis nurses conduct monthly foot inspections in their diabetic patients and a monthly pain assessment on all patients. Calciphylaxis management should become an integral part of dialysis care and should start with routine screenings. A calciphylaxis screening program could be implemented without a significant disruption in nursing workload and for a minimal cost simply by building upon the diabetic foot exam and pain assessment. My proposal to design a calciphylaxis screening tool and develop a contemporaneous staff education program has the potential to improve patient outcomes, reduce calciphylaxis-related hospitalization, and reduce health care spending.

My role as the DNP student was to develop the screening tool and the staff education project. I designed the education to include the topics of calciphylaxis

pathophysiology, individual risk factor assessment, typical skin changes, staging of lesions, treatment strategies, and pain assessment. I stressed the role of nurse leader to effectively transform care at the chairside and to spearhead practice changes that could improve outcomes subsequent to disease prevention. Several evaluation methods were employed to determine knowledge transfer and application to nursing practice. These are fully discussed in Section 4.

Summary

While previously under recognized, the burden of calciphylaxis is now coming to the forefront. Calciphylaxis is a fatal disease. More research is needed to determine if a nurse-driven calciphylaxis screening program could improve calciphylaxis-related outcomes, but first nurses need the tools to accomplish this task. A logical source in which to find such screening tools should be in the published literature. However, a diligent search revealed that there was little to no relevant material available. Therefore, it became necessary to develop a calciphylaxis screening tool from the ground up. No matter how effective or successful this tool may be, it is useless in the hands of an untrained provider. Therefore, provider education plays an integral part in calciphylaxis management.

Section 3: Collection and Analysis of Evidence

Introduction

Calciphylaxis is a disease frequently referenced in literature, but it has been poorly studied and there is little evidence to inform practice. One message consistently threaded throughout the literature was that early identification and treatment of calciphylaxis is paramount to improved patient outcomes and quality of life. There was no evidence to inform recommendations for routine screening. Fine and Zacharias (2002) found that calciphylaxis was nonulcerative in the early stages and could be identified through routine screening. Fine and Zacharias indicated that routine screenings were performed in their peritoneal dialysis patients. Unfortunately, Fine and Zacharias did not provide any information regarding how to screen for the disease nor did they provide a screening tool. Despite this evidence, now 15 years later, best practices are still lacking. This DNP project focused on two objectives. The first objective was to design an evidence-based calciphylaxis screening and assessment tool that could be used in clinical practice to inform routine calciphylaxis screenings in the ESRD population. The second objective was to develop a staff education activity to provide dialysis nurses with the baseline knowledge that would enable them to screen for early calciphylaxis and identify nonulcerative calciphylaxis lesions.

A literature search failed to produce any existing calciphylaxis screening instrument. There were no randomized control trials, systematic reviews, or clinical practice guidelines to inform a calciphylaxis screening. Therefore, I needed to design a screening instrument from the ground up. To determine best evidence to be included in a

calciphylaxis screening tool, I had to rely on general search terms to locate data and design a calciphylaxis screening tool.

In this section, I review evidence regarding wound management, screening for diabetic Charcot foot, foot assessment in the dialysis patient, and pain assessments. Such topics laid the groundwork for developing the calciphylaxis screening instrument. I was then able to use the tool as a template to inform the staff education project and educate dialysis nurses to conduct a calciphylaxis screening.

Practice-Focused Questions

This DNP project addressed two practice focused questions:

1. What are the best practices based on literature evidence and expert opinion to be incorporated in a calciphylaxis assessment and screening tool?
2. Will dialysis staff who participate in a staff education activity, regarding calciphylaxis assessment and screening, acquire the knowledge and skills necessary to effectively identify calciphylaxis in the clinical setting?

The nephrology community has agreed that calciphylaxis is a population health concern. Unfortunately, there has been very limited evidence to guide screening, evaluation, or treatment. Nephrology nurses with the proper training and assessment tool could be positioned to assume a leadership role, proactively perform a calciphylaxis screening, and make appropriate referrals for medical management.

The purpose of this DNP project was to address gaps in practice and knowledge and improve clinical outcomes through staff education. Using Knowles's (1984; Knowles et al., 2005) model of andragogy as the theoretical framework, nursing staff were

educated on calciphylaxis prevention, screening, identification of early calciphylaxis lesions.

Sources of Evidence

A literature search was conducted electronically using the Walden University Library, University of New York at Buffalo Library, and a general Internet search. Databases searched included EBSCO, Medline, CINAHL, ProQuest, Thoreau, Google Scholar, Google, and the American Nephrology Nurses Association online library. Search terms included *nursing protocol, skin care protocol, ulcers, diabetic ulcers, wounds, wound assessment, wound management, skin lesions, dermatology, calciphylaxis, calcific uremic arteriolopathy, CUA, non-uremic calciphylaxis, metastatic calcification, panniculitis, end-stage renal disease, renal failure, chronic kidney disease, ESRD, calciphylaxis pain assessment,* and *pain assessment*. In addition, I queried the American Nephrology Nurses Association ANNA Connected Advanced Practice Specialty Practice Network regarding any existing nursing protocols for the early recognition of calciphylaxis lesions. This query failed to produce any existing nursing protocols, making this uncharted territory.

Russo et al. (2015) underscored the importance of early diagnosis and found calciphylaxis is undiagnosed in its early stages. Rather, calciphylaxis is usually diagnosed in the late stage following the development of cutaneous ulcers. The ensuing multimodal therapy can include medical wound care, surgical wound care, off-label use of sodium thiosulfate, cinacalcet, hyperbaric oxygen therapy, and parathyroidectomy (Russo et al., 2015). In my clinical practice, treatment also included an increase in dialysis frequency,

aggressive reduction in serum phosphorus utilizing multiple phosphate binders, use of bisphosphonates, frequent laboratory monitoring, and often an infectious disease referral. The cost associated with multimodal therapy in terms of HRQOL, morbidity and mortality, health care costs, and clinical outcomes can be nothing more than staggering. Burdette-Taylor (2015) reported an annual cost of $1.6 billion for the care of new diabetic foot ulcers and as high as $6 billion inclusive of prior ulcer care. It is conceivable that these costs pale in comparison with expenditures related to calciphylaxis multimodal therapy. Burdette-Taylor's teachings regarding proactive interventions focused on preventing diabetic ulcers are undeniably applicable to the ESRD population and calciphylaxis screening.

Feeser (2011) stated, "[p]revention and early diagnosis are essential to successful management of CUA. Once ulcers develop, there is a dramatic twofold increase in mortality, strongly suggesting that all possible means should be employed in an attempt to prevent ulceration" (p. 381). A diagnosis of calciphylaxis is often based on clinical presentation and patient history (Feeser, 2011). Cutaneous biopsy is the gold standard for diagnosis, but the biopsy itself can lead to complications such as ulceration, infection (Feeser, 2011), and poor wound healing of the biopsy site (Wheeler & Singh, 2008). In actual practice, it has been my experience that health care providers avoid cutaneous biopsy for these exact reasons. There are several noninvasive studies (plain radiograph, xeroradiography, soft tissue mammogram, ultrasound, and computerized tomography) available that can be used to screen for vessel calcification and provide a clinical picture supporting a diagnosis of nonulcerative calciphylaxis (Feeser, 2011). Wheeler and Singh

(2008) examined the use of a bone scan to identify soft tissue calcifications as another noninvasive diagnostic that can confirm a clinical suspicion of early onset calciphylaxis.

The literature search failed to produce any nursing protocols that specifically addressed identification of early onset calciphylaxis. For that reason, I searched for information regarding nursing protocols that addressed wound surveillance in diabetic wounds and conducting a meaningful pain assessment. The theoretical underpinnings of these disease processes could be applied to a calciphylaxis specific assessment and screening tool.

Burdette-Taylor (2015) stressed a proactive approach for the assessment, early identification, and intervention of diabetic patient with lower extremity arterial disease and lower extremity neuropathic disease. Burdette-Taylor proposed a model to utilize certified foot and nail care nurses to conduct regular basic foot and lower extremity examinations for the early identification and treatment of diabetic foot ulcers. While Burdette-Taylor did not provide any hard evidence to validate the model, the concept of being proactive can lead to early identification and timely intervention, which can improve health outcomes and quality of life.

The 1st Consensus Conference on CUA convened in Leuven, Belgium on September 25, 2015. Thirteen experts in the field of calciphylaxis joined together to form a consensus opinion regarding standards that could be applied in the prevention, identification, and treatment of calciphylaxis (Brandenburg et al., 2016). Several important opinions emerged that are directly applicable to this project and are outlined below (Brandenburg et al., 2016) and were incorporated in the staff education activity:

- The presence of painful lesions in a setting of ESRD and/or other risk factors should raise a high suspicion for calciphylaxis.
- Common findings in calciphylaxis include pain and firm calcified lesions that are palpated in the subcutaneous tissues.
- Many providers lack the knowledge and skills necessary to identify the early signs of calciphylaxis.
- The use of warfarin is associated with the development of calciphylaxis.
- Calcium loading and hyperphosphatemia are not necessarily predictors of calciphylaxis.
- Patients who develop large calciphylaxis lesions have the worst prognosis.

Foot Assessments

I was able to locate two existing DNP projects that could inform development of the calciphylaxis assessment and screening tool.

Robertson (2013) identified lower extremity amputations in the ESRD population as a population health problem. To address this problem, Robertson developed a lower extremity algorithm to guide lower extremity assessment. A short 3-month pilot study was conducted using the algorithm. Interestingly, by the second month, the patients were asking staff to assess their feet and actively participated in the exam. The Robertson study was limited in respect to sample size and study period. There were no correlations made between the foot assessments and referrals. Despite these limitations, it seemed that the foot algorithm served to educate and engage patients to participate in self-care (Robertson, 2013). Robertson also commented that, following the 3-month trial, the

algorithm was adopted by the dialysis facility for inclusion in their monthly foot assessment protocol.

Wade (2016) developed an assessment and screening tool to be used by nurse practitioners in identifying Charcot foot. The tool was developed but not implemented and therefore utility of the tool was not studied. The tool was validated by two expert reviewers and Wade disseminated the information among a limited number of nurse practitioners. Although there has been no evidence supporting actual utility of the tool, I used it as a model to design the calciphylaxis assessment and screening tool in this DNP project.

Wound Management Protocols

Catania, Huang, Madison, Moran, and Ohr (2007) discussed how a cancer hospital improved pressure ulcer quality indicators by engaging and empowering the clinical team to implement a pressure ulcer prevention protocol intervention (PUPPI). Prior to implementing the PUPPI, an initial 2003 survey reported a prevalence rate of 19.47% for all ulcers and 12.39% for hospital acquired ulcers (n = 113). National Database of Nursing Quality Indicators (NDNQI) benchmarks at that time were 12.65% and 6.84% respectively (Catania et al., 2007). These nurse sensitive indicators exceeded the national benchmarks by > 50%. Initial efforts to improve pressure ulcer management were marginally effective (Catania et al., 2007). These improvements, however, proved to be short lived. After forming a quality improvement (QI) team, a root cause analysis showed that nursing staff were not fully on board with the intervention. Nursing implicated a lack of specialty equipment and skin care products (Catania et al., 2007).

Further analysis by the QI team found inconsistencies in nursing assessments and documentation that contributed to the poorer outcomes. With this knowledge in hand, the QI team implemented strategies to engage the nursing staff in this quality improvement initiative (Catania et al., 2007). In addition, the team evaluated the organizational commitment to improvement. The resultant PUPPI incorporated specialty patient care equipment, developed a nurse-driven protocol intervention, actively engaged patient care technicians who provided direct patient care, incorporated weekly monitoring, and integrated staff education (Catania et al., 2007). Following implementation of the PUPPI in September 2004, the hospital realized quality indicators that were well below NDNQI benchmarks. The study reported outcomes into June 2006. During the report period, not only did NDNQI benchmarks fall, but so did the hospital's prevalence data (Catania et al., 2007). This study underscores that protocols in and of themselves are not enough to bring about change. Stakeholders must be empowered through education, teamwork, and organizational commitment.

Aalaa, Malazy, Peimani, and Mohajeri-Tehrani (2012) found that 85% of lower extremity amputations in diabetics could be prevented with routine nurse-driven patient education, routine screening, and early intervention of identified diabetic foot complications. The authors stressed that "education of health care provider is a crucial issue" (Aalaa et al., 2012, "Nurse's Role in Education," para. 4).

Pain Assessment

Acute and chronic pain has been described as prevalent in the ESRD population, which can negatively affect an individual's quality of life. Brkovic, Burilovic, and Puljak

(2016) conducted a systematic review of pain in the hemodialysis population and found that causes for pain in this population are multifactorial. The authors found that 82% of participants suffered with acute pain and 92% suffered with chronic pain (Brkovic et al., 2016). Davison (2007) recognized that the presence of "extremely painful, well-demarcated nonulcerating plaques" (p. 1278) could represent early calciphylaxis. If left untreated, these wounds could develop into the cutaneous ulcerations seen in progressive disease. This indicates that the pain associated with calciphylaxis is an important symptom and that an accurate pain assessment is integral to calciphylaxis screening.

Farahani, Alhani, and Mohammadi (2014) conducted a study to evaluate the pain assessment skills of pediatric nurses. Pain assessment in pediatrics can be challenging as infants may not be able to communicate their pain, or young children may not accurately communicate pain (Farahani et al., 2014). The researchers conducted a quasi-experimental study to determine if a pain committee improved nursing skill sets in pain evaluation, assessment, and management. The initial needs assessment revealed that, in general, nurses lacked the knowledge to conduct a systematic pain evaluation (Farahani et al., 2014). To address this knowledge gap, the researches convened a pain committee charged with educating the nurses how to conduct a systematic pain assessment. Following implementation of the pain committee, statistical analysis indicated nurses in the intervention group possessed superior assessment skills as compared to the nurses in the control group ($P \leq 0.001$) (Farahani, 2014).

The lessons learned from the Farahani et al. (2014) study are applicable to the dialysis population. As Brkovic et al. (2016) noted, acute and chronic pain is prevalent in

the hemodialysis population. The multifactorial nature of pain can make pain assessment an arduous process. Pain is recognized as the fifth vital sign by the American Pain Society (Farahani et al., 2014). As the fifth vital sign, it is imperative that dialysis nurses possess a strong pain assessment skill-set as part of the calciphylaxis screening.

Evidence Generated for Doctoral Project

The staff education project was the focus of this DNP project. I obtained site specific approval to conduct my research at my partner dialysis facility. Approval at the partner dialysis facility was granted to include 25 dialysis staff members in the study.

Participants

The number of participants was based on the number of staff working at the unit. There were no exclusion criteria. Registered nurses and advanced practice nurses would exclusively conduct routine screenings. Other interdisciplinary team members could provide education on topics such as dietary management, reduction of complications, wound care, smoking cessation, and reporting of symptoms. Calciphylaxis management could be integrated into the interdisciplinary patient care plan of care. Each dialysis staff member plays an important role in calciphylaxis management and therefore all staff members were included in the participant pool.

Recruitment of study participants was accomplished through flyers posted within the dialysis unit. I also extended personal invitations to nurse practitioners who were credentialed at the partner dialysis facility. Scheduling of the educational activity was flexible to accommodate staff schedules and maximize staff participation with minimal disruption in unit activity or patient care.

Procedures

Any interested dialysis staff member was eligible to participate in the study. Continuing education credits were provided through Walden University. In order to claim continuing education credits the participants were required to attend the entire live presentation, sign on to the website, achieve a passing score on the posttest, complete an activity specific outcome measure, and complete a shared enduring activity evaluation. In addition, participants were asked to complete two paper based evaluations following the live presentation, a retrospective pre/post self-evaluation and an evaluation of the calciphylaxis assessment and screening tool.

Posttest. The posttest was a method of evaluation to obtain subjective data regarding knowledge transfer and retention that occurred following the staff education project. It was completed online and participants were required to obtain a score of 80% to pass.

Activity specific outcome measure. The activity specific outcome measure determined what changes the participants could implement into practice that would foster sustainability and improved patient outcomes. This was completed online and was required to claim continuing education credit.

Activity evaluation. An activity evaluation was required to claim continuing education credit. The activity evaluation assessed the effectiveness of the teaching strategies and provided insight program effectiveness. The feedback obtained can be used to guide future educational activities.

Retrospective pre/post self-evaluation. I chose the retrospective pre/post self-evaluation to assess the participants' subjective perception of competence in managing calciphylaxis. The retrospective pre/post self-evaluation tool is a validated method for assessing subjective data. Because this was a blinded study I was not able to conduct a standard pre/post evaluation designed to measure change as a resulting from staff education.

Calciphylaxis screening and assessment tool evaluation. This was a paper based evaluation that was conducted immediately following the live presentation. I used this evaluation as a means to determine the screening tool's usefulness, functionality, and relevance to practice. I also used the evaluation to elicit feedback for improvements and enhancements to revise the tool.

Protections

I structured my DNP project as a single center, blinded, quasi-experimental design. Approval was obtained through Walden University Investigational Review Board. Because of the nature of the study, a signed consent was not required. Participant anonymity was required by Walden and also by the partner site. All staff members were provided with a copy of the consent prior to the start of the educational activity. The consent was reviewed at the beginning of the PowerPoint presentation and an electronic version of the consent was posted on the online platform. Following the live presentation the participants were asked to complete the paper based evaluations in my absence. One participant was designated to collect the completed evaluations and place them in a manila envelope for delivery to the DNP student. Additional evaluations were completed

on the online continuing education platform, which was administered by the director of continuing nurse education at Walden University. This director provided me with the raw data that was collected while the online platform was active. In this way, participant anonymity was maintained.

Participants were advised that all project activities were voluntary. Conversely certain assessments were mandatory for claiming continuing education credits. In this instance, participants were assured that raw data would be collected in a manner that maintained anonymity.

Analysis and Synthesis

The project began by designing a calciphylaxis assessment and screening tool based on the literature evidence and expert opinion. The tool was divided into three sections: (a) a calciphylaxis risk assessment, (b) a multidimensional pain assessment using the PEG pain scale, and (c) a skin assessment diagram. I then developed an educational program and presented this at the partner dialysis site. Utilizing Knowles's (1984; Knowles et al., 2005) framework, the educational component focused on the pathophysiology of calciphylaxis, risk factor identification, wound identification, and application of the assessment tool in clinical practice. The effectiveness of the education program was evaluated through a series of assessments to determine knowledge transfer, the participant's objective assessment of competence in calciphylaxis management, strategies for implementing and sustaining change, and finally the feasibility to implement calciphylaxis screening in clinical practice.

Summary

I conducted a literature search that failed to produce any nursing protocols specific to the early identification of calciphylaxis or for conducting a routine calciphylaxis screening. Yet, calciphylaxis remains a significant health care challenge for the ESRD population. The concepts related to skin breakdown and diabetic foot ulcers were applicable to caring for the patient with calciphylaxis. Research in these areas revealed a benefit to screening and nurse-driven protocols that could easily be integrated into a calciphylaxis screening protocol. Successful implementation of a calciphylaxis screening protocol will be dependent upon knowledgeable providers with the skill sets to effectively conduct comprehensive assessments. To address the practice gap, I designed a calciphylaxis screening tool that could be implemented into clinical practice. The tool has yet to be validated. Validation is expected to take place outside of the DNP project.

Calciphylaxis is a deadly disease. There is a need for generating evidence that can be applied to clinical practice and transform care delivery for patients with calciphylaxis. In this project, I proposed that calciphylaxis screenings could easily be integrated into practice by building upon current foot and pain assessments. This could easily be accomplished with minimal disruption to workflow or interruptions in patient care. I have addressed the practice and knowledge gaps that would act as barriers to implementation. Implementation of a calciphylaxis screening has the potential to transform care at the chairside by applying evidence to improve outcomes in the ESRD population and other vulnerable populations.

I sought to determine if a staff education activity would provide dialysis nurses with the knowledge and skills necessary to identify calciphylaxis in the clinical setting. In Section 4 I analyzed the data to determine the answer to this question.

Section 4: Findings and Recommendations

Introduction

Calciphylaxis is estimated to affect 1% to 4% of the ESRD population (Brandenburg et al., 2016). Poor outcomes and high mortality rates are associated with calciphylaxis. Research uncovered an abundance of literature describing risk factors, case studies, recommendations for treatment, and disease trajectories. The one predominant theme threaded throughout the literature was that patients experience improved outcomes if the health care provider diagnoses calciphylaxis in the early stages and initiates treatment prior to the development of ulcerative lesions. While literature supported routine screening for calciphylaxis, there were no nursing protocols, guidelines, or clinical instruments that informed routine screening.

One challenge seen in health care models today is the transformation of health care delivery from treatment to prevention (Ronco, Mason, Karopadi, Milburn, & Hegbrant, 2014). This DNP project focused on calciphylaxis prevention developing a screening tool and a staff education program. The goal of the educational activity was to educate dialysis staff about risk factors, pathogenesis, pain assessment, and wound identification. Ultimately, dialysis staff should be able to use this knowledge to implement a screening protocol and calciphylaxis management program in clinical practice.

Calciphylaxis Screening Tool

Despite an exhaustive literature search and reaching out to other nephrology providers, I was not able to discern any evidence to guide a routine calciphylaxis

screening. Likewise, I was unable to discover any nursing protocols or existing screening instruments. My research found considerable evidence to support screenings for diabetic wounds, pressure ulcers, and other skin breakdown. Aalaa et al. (2012) found that nurse-driven protocols, routine screenings, and early intervention could significantly reduce the number of lower extremity amputations in the diabetic population. The nephrology community is lagging in calciphylaxis wound screening, early intervention, and disease prevention. It is time that the nephrology community fills this practice void. Designing a calciphylaxis screening instrument can be one avenue to address this void.

The 1st Consensus Conference on CUA opined that many nephrology providers lack the knowledge and skills necessary to identify early signs of calciphylaxis (Brandenburg et al., 2016). Any screening instrument lacks value if the provider using it lacks a fundamental knowledge of the underlying disease process. For this reason, an important aspect of this DNP project was not only to design the screening tool, but also to provide dialysis staff with a foundation to use the assessment form effectively in clinical practice.

Pain and metastatic calcifications with or without skin ulceration are hallmark signs of calciphylaxis. The assessment tool focuses on three key aspects in calciphylaxis pathogenesis: (a) risk factors, (b) a multidimensional pain assessment, and (c) wound identification. In developing the tool, I was cognizant of the fact that a potential barrier existed if routine calciphylaxis screenings proved to be burdensome or disrupted unit workflow. With this in mind, I fashioned a screening tool that capitalized on an opportunity to expand the current practice of monthly diabetic foot exams and pain

assessments. After the original design was completed, the screening tool was introduced during a staff education activity. The participants were asked to evaluate the tool on its general format, content, relevance to practice, and functionality. Any suggestions for improvements were incorporated into the final tool (Appendix A). I revised the tool based on participant suggestions. The tool requires validation before it can be placed into clinical practice.

Staff Education Program

The primary study was approved by the IRB at Walden University (Approval Number 06-21-17-0103266). I received formal approval from the clinical research department at my partner dialysis organization and collected data from dialysis staff for this project. The project was a single center, blinded, quasi-experimental, mixed method design. The research question was as follows: Will dialysis staff who participate in a staff education activity regarding calciphylaxis assessment and screening acquire the knowledge and skills necessary to effectively identify calciphylaxis lesions in the clinical setting? The staff education activity, titled "Calciphylaxis: The Dialysis Medusa," offered 1.5 continuing education contact hours, including 1.5 hours of pharmacology content through Walden University, an American Nurses Credentialing Center–approved provider. Inclusion criteria were broad and included anyone interested in learning about calciphylaxis. There were no exclusion criteria. To claim contact hours, participants were required to (a) attend the entire live presentation; (b) sign on to an activity-specific website by November 3, 2017 to complete a posttest, answer an activity specific outcome measure evaluation, and complete the shared enduring activity evaluation. Participants

were required to achieve a score of 80% on the posttest and were afforded three opportunities for successful completion. The website was administered by the director of clinical nurse education at Walden University.

The Live Activity

Working in conjunction with the director of continuing nurse education at Walden University, we developed the continuing education activity in accordance with the accredited provider planning template and educational planning table (Appendix B). Once finalized, I presented the program dialysis staff at the partner dialysis facility. The PowerPoint deck that I prepared appears in Appendix C. Content included the history of calciphylaxis, pathogenesis, cutaneous calciphylaxis, systemic calciphylaxis, identification of lesions, treatment of calciphylaxis, assessment and disease prevention. I designed the education to be interactive using Knowles's (1984; Knowles et al., 2005) assumptions of adult learning. I scheduled six separate sessions to accommodate the staff schedules and maximize the participant pool. Each session lasted about 1.5 hours. There were a total of 26 participants who attended from all job classifications. This was a student-centered activity and I fostered student engagement by including interactive case discussions, risk factor identification, question periods, wound identification exercises, risk factor identification, case study analyses, and incorporated participant lived experiences in caring for patients with calciphylaxis.

Although assessments, such as screening for calciphylaxis, are typically within the scope of practice of the registered nurse, I opted to include any member of the interdisciplinary team in the training. According to Nancarrow et al. (2013), the

interdisciplinary team includes all professional and nonprofessional staff. The interdisciplinary team collaborates and brings individual and disciplinary attributes for the improvement of patient care. The dynamics of the interdisciplinary team include communication, respect, vision, a shared mental model, and the delivery of patient-focused care (Nancarrow et al., 2013). It is for these reasons that I encouraged all members of the dialysis team to participate in this education project. The interdisciplinary team breakdown can be seen in Table 1; registered nurses included 54% of the participants.

Table 1

Participant Breakdown

	Number of Participants	Percentage
Nurse Practitioners	2	7.7%
Registered Nurses	14	53.8%
Licensed Practical Nurses	2	7.7%
Patient Care Technicians	2	7.7%
Social Workers	2	7.7%
Dieticians	2	7.7%
Administrative Assistants	2	7.7%

In addition to the live presentation, there was a website created and administered by the director of continuing nurse education at Walden University. This website was created for participants to apply for continuing education credits. Participants were required to attest to attending the entire live presentation, achieve a score of 80% on a

posttest, answer an activity specific/outcome measure evaluation, and complete an activity evaluation in order to claim for continuing education credit. The online platform was active from October 4, 2017 to November 3, 2017. A total of 23 participants signed on to the website. Sixteen participants completed the posttest. Twelve participants completed all requirements and claimed continuing education credit.

Evaluation of the Educational Activity

I used several evaluation strategies to determine if participants acquired the knowledge to identify calciphylaxis lesions and to evaluate the effectiveness of teaching strategies.

Retrospective pre/post self-assessment. The retrospective pre/post assessment has been found to be an effective method to evaluate learning and knowledge transfer (Bhanji, Gottesman, de Grave, Steinert, & Winer, 2012). I administered the retrospective pre/post self-assessment following the live presentation. I used this evaluation to determine if the participants perceived learning occurred and if they felt confident applying their new knowledge in the clinical setting. I manually entered participant responses into the electronic equivalent survey design created online at Survey Monkey for further analysis.

P**osttest.** The posttest evaluated knowledge transfer, retention, the application of calciphylaxis principles, and wound identification. The test comprised 21 questions covering topics such as pathophysiology; diagnostic criteria; types and stages of calciphylaxis lesions; systemic calciphylaxis; pharmacological and nonpharmacological

therapies; and pain assessment. The posttest was administered via the online platform. The posttest was required to claim continuing education credit

Activity-specific/outcome measure evaluation. The online activity-specific outcome measure was designed to determine (a) if participants acquired knowledge that could be applied to assess, identify, and implement procedures that may improve outcomes for patients with calciphylaxis, and (b) if participants would implement changes to their practice after attending the educational activity. This evaluation was a requirement to claim continuing education credit

Shared enduring activity evaluation. Finally, participants completed the share enduring activity evaluation via the online platform. This evaluation was a requirement to claim continuing education credit.

Evaluation of the Calciphylaxis Screening Tool

I introduced the initial calciphylaxis screening tool during the educational activity. Following the presentation, participants were asked to complete a paper based evaluation of the tool. The evaluation consisted of 10 questions focusing on general appearance, functionality, usability, relevance to practice, anticipated barriers to implementation, and an overall rating. I manually entered participant responses into the electronic equivalent survey created online at Survey Monkey for further analysis.

Findings and Implications

Calciphylaxis is a disease process that has far reaching implications for individuals and the health care system. Calciphylaxis is associated with a high mortality rate and has a negative impact on the patients' HRQOL. The multimodal therapies can

result in considerable health care expenditures. Yet, as Fine and Zacharias (2002) concluded, there is a high prevalence of nonulcerative calciphylaxis that goes undiagnosed, which ideally could be identified with routine screening. Despite their supposition, 15 years later, there still remains a practice void in terms of calciphylaxis screening. This DNP project may provide the means for health care transformation from treatment to prevention.

As discussed above, I conducted several assessments and evaluations throughout the project. I detailed the findings of each assessment below.

Retrospective Pre/Post Self-Assessment

The retrospective pre/post self-assessment comprised 14 questions. Participants were asked to evaluate their baseline knowledge and comfort level subjectively prior to attending the staff education activity. They then compared these answers with their subjective feelings of learning and competence in identifying calciphylaxis following the educational activity. Tables 2 to 8 outline participant responses. Overall, there seemed to be a subjective increase in functional knowledge and feelings of confidence following the live activity.

Table 2

Pre/Post Self-Assessment: Response to Questions 1 and 2

Question 1: Describe your level of knowledge about calciphylaxis PRIOR to attending this presentation.			Question 2: Describe your level of knowledge about calciphylaxis AFTER attending this presentation.		
Answer Choice	Number	Percent	Answer Choice	Number	Percent
I never heard of it.	0	0%	I learned nothing new.	0	0%
I've heard of it, but I don't know much about it.	8	32%	I learned some new information about the disease.	2	8%
I've taken care of a patient with calciphylaxis, but I don't understand much about the disease.	4	16%	I have a better understanding of the disease, but I am NOT comfortable caring for a patient with calciphylaxis.	1	4%
I've taken care of a patient with calciphylaxis and I have some understanding of the disease.	13	52%	I think I can take care of a patient with calciphylaxis.	1	4%
I've never taken care of a patient with calciphylaxis, but I have some understanding of the disease.	0	0%	I have a better understanding of the disease and I am comfortable caring for a patient with calciphylaxis.	20	80%
I have advanced knowledge.	0	0%	I had advanced knowledge of the disease, but I did learn some things that I did not know previously.	1	4%

From the responses above, prior to attending the educational activity, only 52% of participants stated they had some understanding of calciphylaxis. However, after attending the educational activity, 80% of participants felt they had a better understanding of the disease and could care for a patient with calciphylaxis. Only one participant (4%) felt she did not acquire enough knowledge to care for a patient with calciphylaxis.

The next few sets of questions (see Tables 3, 4, and 5) queried how comfortable participants felt in identifying patients at risk for developing calciphylaxis and their comfort levels in identifying different stages of calciphylaxis lesions.

Table 3

Pre/Post Self-Assessment: Comparison Between Questions 3 and 4

Answer choices	Question 3: Describe how comfortable you were at identifying patients at risk of developing calciphylaxis PRIOR to attending this presentation.		Question 4: Describe how comfortable you feel you are at identifying patients at risk of developing calciphylaxis AFTER attending this presentation.	
	Response	Percent	Response	Percent
Not at all.	15	60%	0	0%
A little comfortable.	7	28%	6	24%
Very comfortable.	3	12%	17	68%
I am very knowledgeable.	0	0%	2	8%

Sixty percent of participants were not at all comfortable identifying patients at risk of developing calciphylaxis prior to attending the presentation. Following the presentation 68% of participants felt “very comfortable,” an increase of 82.3%.

Table 4

Pre/Post Self-Assessment: Comparison Between Questions 5 and 6

Answer choices	Question 5: Describe how comfortable you were at identifying nonulcerative calciphylaxis lesions PRIOR to attending this presentation		Question 6: Describe how comfortable you feel you are at identifying nonulcerative calciphylaxis lesions AFTER attending this presentation	
	Response	Percent	Response	Percent
Not at all.	16	64%	1	4%
A little comfortable.	8	32%	8	32%
Very comfortable.	1	4%	14	56%
I am very knowledgeable.	0	0%	2	8%

Only one participant (4%) felt very comfortable identifying nonulcerative calciphylaxis lesions prior to attending the presentation as compared to 56% following the presentation, an increase of 92.85%.

Table 5

Pre/Post Self-Assessment: Comparison Between Questions 7 and 8

Answer choices	Question 7: Describe how comfortable you were at identifying ulcerative calciphylaxis lesions PRIOR to attending this presentation		Question 8: Describe how comfortable you feel you are at identifying ulcerative calciphylaxis lesions AFTER attending this presentation	
	Response	Percent	Response	Percent
Not at all.	16	64%	0	0%
A little comfortable.	8	32%	9	36%
Very comfortable.	1	4%	14	56%
I am very knowledgeable.	0	0%	2	8%

Likewise, only one participant (4%) felt “very comfortable” identifying ulcerative calciphylaxis lesions prior to attending the presentation as compared with 14 participants (56%) who felt “very comfortable” after the presentation, an increase of 92.85%.

One aspect of the calciphylaxis assessment is to conduct a multidimensional pain assessment. The PEG pain scale was selected as the multidimensional tool because it is easily administered at chairside and can evaluate the long-term effects of therapy.

Table 6 examines how comfortable participants felt in conducting a multidimensional pain assessment using the PEG pain scale to assess calciphylaxis related pain.

Table 6

Pre/Post Self-Assessment: Comparison Between Questions 9 and 10

Answer choices	Question 9: Describe how comfortable you were at conducting a multidimensional pain assessment (such as the PEG pain scale) BEFORE attending this presentation.		Question 10: Describe how comfortable you feel you are conducting a multidimensional pain assessment (such as the PEG pain scale) AFTER attending this presentation.	
	Response	Percent	Response	Percent
Not at all.	7	28%	0	0%
A little comfortable.	13	52%	2	8%
Very comfortable.	5	20%	21	84%
I am very knowledgeable.	0	0%	2	8%

Prior to attending the presentation, all registered nurses conducted a monthly pain assessment using the Wong Baker FACES pain rating scale, a unidimensional pain scale. According to participant responses, 52% of participants felt “a little comfortable” using a multidimensional pain assessment. There was an increase of 76.19% in the percentage of participants who felt “very comfortable” conducting a multidimensional pain assessment following the presentation.

Table 7 compares how comfortable participants felt in discussing the risks factors of calciphylaxis with their dialysis population.

Table 7

Pre/Post Self-Assessment: Comparison Between Questions 11 and 12

Answer choices	Question 11: Describe how comfortable you were in discussing risks of calciphylaxis with your patients BEFORE to attending this presentation.		Question 12: Describe how comfortable you are discussing risks of calciphylaxis with your patients AFTER attending this presentation.	
	Response	Percent	Response	Percent
Not at all.	12	48%	0	0%
A little comfortable.	10	40%	4	16%
Very comfortable.	3	12%	19	76%
I am very knowledgeable.	0	0%	2	8%

Prior to the presentation, 88% of participants were “not at all” comfortable or only “a little comfortable” in discussing risk of calciphylaxis with their patient population. After the presentation 76% of participants felt “very comfortable”, indicating an increase of 84.2% after attending the presentation.

The final two questions were designed to determine how well the participants understood that calciphylaxis was not limited to cutaneous manifestations but rather was a progressive and systemic disease process. Table 8 shows that following the presentation, 92% of participants appreciated the progressive nature of the disease, an increase of 52.1%.

Table 8

Pre/Post Self-Assessment: Comparison Between Questions 13 and 14

Answer choices	Question 13: BEFORE I attended this presentation, I believed that calciphylaxis only involved the skin.		Question 14: AFTER attending this presentation, I believe that calciphylaxis only involves the skin.	
	Response	Percent	Response	Percent
I don't know.	5	20%	0	0%
I agree with this statement.	9	36%	2	8%
I disagree with this statement	11	44%	23	92%

In conclusion, the results of the retrospective pre/post self-assessment seemed to support that the educational activity had been beneficial in transferring foundational knowledge. Additionally, the assessment indicated that the staff achieved a comfort level in identifying risk factors and cutaneous manifestations of calciphylaxis, and felt they were better prepared to discuss calciphylaxis with the dialysis patient population.

Posttest

The posttest was conducted online following the live presentation. The test comprised 21 questions and participants were required to achieve a score of 80% to pass the test. Participants were afforded three attempts to achieve the target score. The posttest covered information that was discussed during the live presentation. Sixteen participants completed the posttest. Eleven participants (69%) achieved a score ≥ 80% on the first attempt. Four other participants (24%) achieved a score ≥80% on their second attempt.

One participant (6%) did not achieve the target score on the first attempt and did not re-take the test. The average test score by attempt was 81.8% on the first attempt and 85.5% on the second attempt. Tables 9 and 10 show the test score distribution on the first and last attempt.

Table 9

Test Score Distribution: First Attempt

Test Score %	Count	Percent
29%	1	6%
52%	1	6%
76%	3	19%
81%	3	19%
86%	2	13%
90%	1	6%
95%	1	6%
100%	4	25%

Table 10

Test Score Distribution: Last Attempt

Test Score %	Count	Percent
29%	1	6%
81%	5	31%
86%	2	13%
90%	3	19%
95%	1	6%
100%	4	25%

As noted above, scores improved for those four participants who opted to remediate and retake the posttest. There remained only one outlier as that participant opted out of retesting.

Tables 11 to 31 summarize the responses to the test questions based on the last attempt. There were a total of 16 responses for each question. In each question, the correct answer is denoted by the star symbol (*).

Table 11

Responses to Question 1 of Posttest

Question	Responses	Percent
1. The Seyle concept of calciphylaxis described a synthesizer/challenger interaction. Introduction of a synthesizer such as_____, resulted in increased calcium and phosphorus. After a latency period, exposure to a challenger, such as _____ produced inflammation, acute tissue ischemia, and tissue necrosis.		
a. Parathyroid hormone, metallic salts or albumin*	12	75%
b. Vitamin D, parathyroid hormone	2	13%
c. Iron, hyperphosphatemia	0	0%
d. ESRD, hyperphosphatemia	2	13%

Table 12

Responses to Question 2 of Posttest

Question	Responses	Percent
2. Once ulceration develops, the mortality rate can increase to:		
a. 40%	0	0%
b. 60%	1	6%
c. 80% *	15	94%
d. 100%	0	0%

Table 13

Responses to Question 3 of Posttest

Question	Responses	Percent
3. Which is a "hallmark" sign of calciphylaxis:		
a. Indurated plaque	0	0%
b. Pain*	15	94%
c. Ulceration	1	6%
d. Bleeding	0	0%
e. Ischemia	0	0%

Table 14

Responses to Question 4 of Posttest

Question	Responses	Percent
4. The primary cause of death from calciphylaxis is from:		
a. Cardiac complications	0	0%
b. Skin necrosis	0	0%
c. Infection and sepsis*	16	100%
d. Bleeding	0	0%

Table 15

Responses to Question 5 of Posttest

Question	Responses	Percent
5. Calciphylaxis can be characterized as the cutaneous equivalent of a:		
a. Diabetic ulcer	2	13%
b. Myocardial infarction*	14	88%
c. Peripheral vascular disorder	0	0%
d. Decubitus ulcer	0	0%

Table 16

Responses to Question 6 of Posttest

Question	Responses	Percent
6. The PEG pain scale is a three-item pain scale that assesses what three indicators:		
a. Pain intensity, eating habits, and general attitude	0	0%
b. Pain frequency, energy levels, and general awareness	0	0%
c. Pill burden, exhaustion, and general alertness'	0	0%
d. Pain on average, enjoyment of life, and general activity*	16	100%

Table 17

Responses to Question 7 of Posttest

Question	Responses	Percent
7. The PEG pain scale is a useful tool to determine:		
a. Acute pain	0	0%
b. Chronic pain	1	6%
c. Response to therapy*	11	69%
d. Current pain levels	4	25%

Table 18

Responses to Question 8 of Posttest

Question	Responses	Percent
8. A number of pharmacologic agents can be used in the treatment of calciphylaxis. Which one agent is a chelating agent for calcium:		
a. Cinacalcet (Senispar)	0	0%
b. Sodium Thiosulfate*	13	81%
c. Sevelamer (Renvela)	2	13%
d. Pamidronic Acid (Aredia)	1	6%

Table 19

Responses to Question 9 of Posttest

Question	Responses	Percent
9. To minimize the risk of complications, sodium thiosulfate should be infused over:		
a. 10 minutes	1	6%
b. 30 minutes	2	13%
c. 60 minutes*	13	81%
d. 90 minutes	0	0%

Table 20

Responses to Question 10 of Posttest

Question	Responses	Percent
10. What are possible adverse effects of sodium thiosulfate?		
a. GI complaints	1	6%
b. Impaired bone integrity	0	0%
c. Metabolic acidosis	0	0%
d. None of the above	0	0%
e. All of the above*	15	94%

Table 21

Responses to Question 11 of Posttest

Question	Responses	Percentage
11. Some case reports identified calciphylaxis as an underlying cause of:		
a. GI bleeding	0	0%
b. Temporal arteritis	2	13%
c. Cardiomyopathy	2	13%
d. All of the above*	11	69%
e. None of the above	1	6%

Table 22

Responses to Question 12 of Posttest

Question	Responses	Percent
12. Acral ischemia is a(n) _____ presentation involving the ____:		
a. Typical, genitals and digits	2	13%
b. Typical, buttocks and thighs	1	6%
c. Atypical, buttocks and thighs	0	0%
d. Atypical, genitals and digits*	13	81%

Table 23

Responses to Question 13 of Posttest

Question	Responses	Percent
13. This image is an example of what type of calciphylaxis lesion? (the embedded link took the participant to an image for identification of the lesion)		
a. Acral*	15	94%
b. Distal	1	6%
c. Proximal	0	0%
d. Medial	0	0%

Table 24

Responses to Question 14 of Posttest

Question	Responses	Percent
14. Name the stage of lesion – select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Early stage	0	0%
b. Mid stage	1	6%
c. Late stage*	15	94%

Table 25

Responses to Question 15 of Posttest

Question	Responses	Percent
15. Name the stage of lesion – select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Early stage	2	13%
b. Mid stage*	13	81%
c. Late stage	1	6%

Table 26

Responses to Question 16 of Posttest

Question	Responses	Percent
16. Name the stage of lesion – select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Early stage*	15	94%
b. Mid stage	1	6%
c. Late stage	0	0%

Table 27

Responses to Question 17 of Posttest

Question	Responses	Percent
17. Identify the calciphylaxis lesion. Select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Livedo racemose – like purpura	1	6%
b. Indurated plaque	0	0%
c. Hemorrhagic patches*	11	69%
d. Subcutaneous nodules	0	0%
e. Necrotic ulceration	4	25%

Table 28

Responses to Question 18 of Posttest

Question	Responses	Percent
18. Identify the calciphylaxis lesion. Select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Livedo racemose – like purpura	0	0%
b. Indurated plaque*	13	81%
c. Hemorrhagic patches	2	13%
d. Subcutaneous nodules	1	6%
e. Necrotic ulceration	0	0%

Table 29

Responses to Question 19 of Posttest

Question	Responses	Percent
19. Identify the calciphylaxis lesion. Select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Livedo racemose – like purpura*	15	94%
b. Indurated plaque	0	0%
c. Hemorrhagic patches	0	0%
d. Subcutaneous nodules	1	6%
e. Necrotic ulceration	0	0%

Table 30

Responses to Question 20 of Posttest

Question	Responses	Percent
20. Identify the calciphylaxis lesion. Select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Livedo racemose – like purpura	1	6%
b. Indurated plaque	0	0%
c. Hemorrhagic patches	1	6%
d. Subcutaneous nodules	0	0%
e. Necrotic ulceration*	14	88%

Table 31

Responses to Question 21 of Posttest

Question	Responses	Percent
21. Identify the calciphylaxis lesion. Select the letter that corresponds to the image. (the embedded link took the participant to an image for identification of the lesion)		
a. Livedo racemose – like purpura	0	0%
b. Indurated plaque	1	6%
c. Hemorrhagic patches	0	0%
d. Subcutaneous nodules*	13	81%
f. Necrotic ulceration	2	13%

Areas of weakness on the test were mainly with identification of the different wound types. In reality, it is not important that the staff can identify the stage or severity of the wound type. Diagnosis of calciphylaxis is generally based on clinical presentation. Emphasis is placed on the identification of a wound in the clinical setting, rather than the stage or type of wound. The exemplars of wounds discussed during the live event and presented on the posttest are indications a few of the different ways in which calciphylaxis wounds can manifest in actual practice.

Activity Specific/Outcome Measure Evaluation

The activity specific/outcome measure evaluation comprised two questions.

Question 1. The first question utilized a 5-point Likert scale and asked participants to rate their responses on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*) to the following question: “After attending this educational offering, I have a

better knowledge base to assess, identify, and implement practices, which may improve outcomes for patients with calciphylaxis". Fourteen participants completed this survey. There were 13 who responded with a 5 (*strongly agree*) and one with a response of 3 (*neutral*). The mean of all respondents was 4.857. The overall response rate would indicate that the teaching strategies used for the educational activity were effective in teaching the staff to incorporate this knowledge in clinical practice.

Question 2. Thirteen participants responded to the second question, which asked them to name one thing learned that could be implemented into current practice. As Table 32 shows, participants retained concepts that were emphasized in the educational activity such as (a) high mortality rates, (b) early recognition and treatment, (c) the importance of the pain assessment, (d) patient education, and (e) the importance of calciphylaxis screening.

Table 32

One Thing I Learned by Attending This Presentation Is:

Participant	Answer
Response 1	Treatment of calciphylaxis.
Response 2	Identification and classification of different lesions.
Response 3	As a SW, I now have a greater understanding of calciphylaxis.
Response 4	Importance of a good physical exam.
Response 5	You can never ask enough questions about pain.
Response 6	Better assessment skills to screen for calciphylaxis.
Response 7	My increased knowledge on the subject will help me educate my patients.
Response 8	Calciphylaxis death.
Response 9	Being more aware of calciphylaxis and screening more for it. It is critical to catch it early and important to advocate for the patients.
Response 10	I have learned some of the benefits of the PEG Pain Scale and will be able to implement this scale into my practice. This multidimensional scale with help me understand my patient's response to treatment by assessing what my patients pain on average, enjoyment of life, and general activity is.
Response 11	How to better assess for calciphylaxis and how to determine what stage a lesion is.
Response 12	Signs and symptoms of calciphylaxis and importance of early diagnosis.
Response 13	Using a more holistic pain scale.

Shared Enduring Activity Evaluation

The shared enduring activity evaluation is an assessment to determine if the participant was able to achieve the program objectives and assure that the activity was free from commercial bias. Twelve participants completed the shared enduring activity evaluation. The evaluation contained nine questions.

Question 1. "The content of this presentation was free from bias, commercial influence and product promotion". Twelve respondents (100%) answered true.

Question 2. "Please note below if you noted bias, commercial influence or product promotion within this presentation". Four respondents' answers indicated no bias. Eight respondents made no comment.

Question 3. "I attest that I attended this activity". Twelve respondents (100%) attested affirmatively.

Question 4. Question 4 contained two queries and the respondents were asked to rate each according to the following scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*. Table 33 illustrates that all 12 respondents felt that this presenter demonstrated knowledge and expertise in the content area. The second query regarded content relevance to practice. In response to this question, one respondent (8%) rated the relevance as 3 (*neutral*). The other 11 respondents (92%) answered with a rating of 5 .

Table 33

Question 4: Please Rate the Following

Question	Scale	Count	Percent
The presenter demonstrated knowledge and expertise in the content area	1 = *Strongly Disagree*	0	0%
	2	0	0%
	3	0	0%
	4	0	0%
	5 = *Strongly Agree*	12	100%
The subject matter was relevant to my current practice	1 = *Strongly Disagree*	0	0%
	2	0	0%
	3	1	8%
	4	0	0%
	5 = *Strongly Agree*	11	92%

(1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*)

Question 5. The material in this presentation enhanced my knowledge, skills, and/or practice. Table 34, outlines the responses and showed that 67% of participants noted that they had gained knowledge as a result of the presentation.

Table 34

Question 5. The Material in This Presentation Enhanced my Knowledge, Skills, and/or Practice

Response	Count	Percent
Knowledge – I have learned	8	67%
Skills – I can perform	1	8%
Practice – I can implement or change	3	25%

Question 6. Commitment to change practice. The purpose of the commitment to change practice evaluation is multifactorial and can be a powerful measure of evaluating

how effectively the learning activity impacted the application of newly acquired knowledge and implementation of this knowledge into clinical practice (Shershneva, Wang, Lindeman, Savoy, & Olson, 2010). Table 35 demonstrates that 67% of respondents intended to make a change to their current practice as a result of this educational activity. One respondent (8%) anticipated some barriers that might hinder a change in practice.

Table 35

Question 6: Commitment to Change Practice

Response	Count	Percent
I will make a change to my current practice as a result of the educational session	8	67%
I am considering a change in my current practice as a result of the educational session	2	17%
This educational session confirms my current practice	1	8%
I am not yet convinced that any change in practice is warranted	0	0%
I perceive that there may be barriers to changing my practice (further detail can be provided in Q8)	1	8%

Question 7. What information from this session do you plan to implements in practice? This query solicited a free text entry. Six participants answered this question. Table 36 outlines the responses.

Table 36

Question 7: What Information From This Session Do You Plan to Implement Into Practice?

Participant	Answer
Response 1	How to treat calciphylaxis
Response 2	Monthly assessment
Response 3	Using screening tool
Response 4	Using the screening tool as a way to advocate to MDs for my patients
Response 5	PEG Pain Scale
Response 6	The PEG pain tool

Question 8. What are the perceived barriers to implementing information from this session into practice? This query solicited a free text response. Eight respondents commented and Table 37 outlines their responses. The responses indicated that the most perceived barrier is acceptance and incorporation into practice by the organization as the assessment tool is not validated. These are legitimate concerns that need to be addressed in future endeavors.

Table 37

Question 8: What Are Perceived Barriers to Implementing Information From This Session Into Practice?

Participant	Answer
Response 1	None
Response 2	None
Response 3	As a SW [social worker], I will direct concerns to RNs, NPs, and MDs
Response 4	Company policy and procedure
Response 5	Not approved for use
Response 6	I think others are too cautious to consider calciphylaxis as a diagnosis. I believe others just don't know enough about it. I am grateful for the education.
Response 7	N/A
Response 8	Patient's participating and being truthful on assessment

Additional comments regarding barriers were discussed during the live presentation. One nurse commented that she was afraid of over-reaching and acting outside the scope of nursing practice because she felt she was making a medical diagnosis. While this is a valid concern, I stressed that she was not making a diagnosis, but rather was conducting an assessment and reporting findings to a provider for further evaluation.

Question 9. Provide any additional feedback that you may have about the material, the author/presenter of ideas for other educational offerings that would be of interest to you. Five participants commented and their responses are outlined in table 38.

Table 38

Question 9: Provide Any Additional Feedback That You May Have About the Material, the Author/Presenter of Ideas for Other Educational Offerings That Would Be of Interest to You

Participant	Answer
Response 1	Great presentation and presenter very knowledgeable in subject
Response 2	Very informative
Response 3	It was extremely helpful and will be information I use for years to come. Thanks
Response 4	N/A
Response 5	I thought that this presentation was very informational helped me to better understand calciphylaxis and how to assess for it. The images were also helpful in order to help determine what stage the lesions were

Evaluation of the Calciphylaxis Risk Assessment and Screening Tool

The final evaluation focused on the calciphylaxis screening tool. This was a 10-question evaluation aimed at appraising the screening instrument for functionality and workability for use in the clinical setting. A total of 25 participants completed the evaluation. As tables 39 to 48 show, the assessment form overall was well received with some suggestions for improvement.

Table 39

Calciphylaxis Screening Tool: Question 1

Answer choices	Responses	Percent
Amount of Information		
A. Just right	25	100%
B. Too little	0	0%
C. Too much	0	0%
Comments		
Very Useful		

Table 40

Calciphylaxis Screening Tool: Question 2

Answer choices	Responses	Percent
The color scheme is		
A. Engaging	17	68%
B. Neutral	8	32%
C. Disruptive	0	0%
Comments		
Add color/photos for lesions possibly		

Table 41

Calciphylaxis Screening Tool: Question 3

Answer choices	Responses	Percent
Clarity of instructions		
A. Very clear	25	100%
B. Somewhat clear	0	0%
C. Not clear at all	0	0%
Comments		
There were no additional comments		

Table 42

Calciphylaxis Screening Tool: Question 4

Answer choices	Responses	Percent
Ease of use		
A. Very clear	25	100%
B. Somewhat clear	0	0%
C. Not clear at all	0	0%
Comments		
There were no additional comments		

Table 43

Calciphylaxis Screening Tool: Question 5

Answer choices	Responses	Percent
Amount of information to guide a systematic review		
A. Sufficient	21	84%
B. Helpful	4	16%
C. Insufficient	0	0%
Comments		
There were no additional comments		

Table 44

Calciphylaxis Screening Tool: Question 6

Answer choices	Responses	Percent
Relevance to practice		
A. Very relevant	24	96%
B. Somewhat relevant	0	0%
C. Not relevant at all	1	1%
Comments		
Social worker		

As noted, one participant felt that as a social worker, the assessment form was not relevant to her practice. This concern is valid; as such an assessment would only be within the scope of practice for registered nurses.

Table 45

Calciphylaxis Screening Tool: Question 7

Answer choices	Responses	Percent
Would you recommend this form to a colleague?		
A. Would recommend	24	96%
B. Might recommend	1	4%
C. Would not recommend	0	0%
Comments		
There were no additional comments		

Table 46

Calciphylaxis Screening Tool: Question 8

Answer choices	Responses	Percent
Would you anticipate any barriers that might impede incorporating this tool in your practice?		
D. No barriers	19	76%
E. Maybe	6	24%
F. Definite barriers	0	0%
Comments		
1. RN staffing on the ICHD [incenter hemodialysis] floor. Easy use in home dialysis setting		
2. Nonverbal		
3. Some MDs might not want us assessing/stepping over boundaries		
4. Engagement of staff		

Table 47

Calciphylaxis Screening Tool: Question 9

Answer choices	Responses	Percent
Amount of use		
A. Would use all the time	23	92%
B. Would use sometimes	1	4%
C. Would not use	1	4%
Comments		
Social Worker		

As previously noted, the assessment form is not appropriate for all interdisciplinary team members and, therefore, would not be a functional tool in all situations.

Table 48

Calciphylaxis Screening Tool: Question 10

Answer choices	Responses	Percent
Overall, how would you rate the assessment form? (This was a 4-star rating system)		
☆ - Poor	0	0%
☆☆ - Fair	0	0%
☆☆☆ - Good	1	4%
☆☆☆☆ - Excellent	24	96%

Weighted average = 3.96

Comments

1. Very good!
2. This was very informative, and this would be a great tool to implement.
3. You are a genius.
4. Thank you, really enjoyed the presentation. Learned a lot and one of the best presentations I have had yet.
5. Instead of hyperphos, hypercal, hypoalb, use phos >/= _____, Ca >/= _____, alb </= _____; change Coumadin (brand name) to warfarin.

Recommendations

When reviewing the subjective and objective results of all the evaluations, the educational component of this DNP project would indicate that staff did acquire the knowledge necessary to conduct a calciphylaxis screening and the skills to identify calciphylaxis lesions in the clinical setting. The screening tool was well received by the staff and many of the participants asked for a copy of the tool so they could begin performing assessments on their own. As I stressed to the staff, this tool has not yet been validated and is not approved for use at the dialysis facility. Until the tool is validated, I recommended that the tool could be used as an interdisciplinary approach to collaborate with the ESRD patient and develop a patient-centered plan of care aimed at reducing disease burden, enhancing quality of life and, ultimately, improving population health.

Strengths and Limitations of the Project

Strengths

This project is the first to evaluate effects of staff education related to the identification of early calciphylaxis. The screening tool is the first to be developed for use in clinical practice.

Limitations

This project took place in a single center with a limited and small participant sample size. Although continuing education credits (1.5 hours) were offered, there were a very small number of participants who actually claimed these credits. This low number of continuing education credits may have impacted the sample size negatively for some of the evaluations. Clearly, the sample sizes were larger for the paper-based evaluations

conducted immediately after the live event. One remedy to improve the sample size would have been to add a web-based offering through the Walden University School of Nursing Continuing Nurse Education Library and opening it to a larger participant pool.

Evaluations conducted at the end of the live activity only evaluated immediate and short-term knowledge retention. Because routine calciphylaxis screening cannot be immediately implemented, there is no evidence to evaluate long-term knowledge retention. There will need to be further studies to determine knowledge retention in the long-term and to determine whether staff are actually able to identify calciphylaxis lesions in routine screening. These questions need to be answered outside of my original DNP project. In the meantime, dissemination of my calciphylaxis education can be provided to other dialysis clinics locally.

Implementing the screening tool can be an important step to improve population health. Unfortunately, it has not been validated and, therefore, is not ready to be placed into practice. The screening tool was well received by the participants as evidenced by the evaluations. I do have plans to have the tool validated and then disseminate it to other nephrology providers. I also plan to work with my partner dialysis organization to integrate calciphylaxis into clinical practice.

Calciphylaxis detection is a secondary prevention nursing action that has potential for promoting social change by improving patient outcomes, reducing mortality rates in the end stage renal disease population, and providing empiric data to inform evidence-based therapies for all patients at risk of developing calciphylaxis.

Section 5: Dissemination Plan

The American Nephrology Nurses Association (ANNA) is an organization that can provide several avenues for dissemination. ANNA was established in 1969 and currently has a membership that exceeds 9,000 nephrology professionals (ANNA, 2018a). The *Nephrology Nursing Journal* is the official journal of ANNA. This journal is peer reviewed and publishes current research, educational articles, and manuscripts on current issues of interest to the nephrology community (ANNA, 2018b). ANNA also hosts two national seminars yearly. I submitted an abstract (Appendix D) and my application was accepted (Appendix E) to present a poster at the ANNA 2018 National Symposium. By disseminating my assessment tool, I hope to raise awareness for the need to conduct routine calciphylaxis screening. Once validated, I plan to introduce the tool to my partner organization for the purpose of conducting a pilot study and implementing a calciphylaxis screening program.

As demonstrated, education on calciphylaxis is paramount in any effort to initiate a successful screening protocol. I plan to develop a continuing education manuscript and submit this to the *Nephrology Nursing Journal* for consideration. Lastly, I can prepare a continuing education webinar add to the Walden University School of Nursing Continuing Education Library so this education can be shared on a global scale.

Analysis of Self

As I have embarked on my educational journey from the early beginnings of a registered nurse, to a master level nurse practitioner, and now a doctoral student, I have come to appreciate how lifelong learning contributes to self-efficacy and competence. I

also appreciate the value of sharing knowledge with other medical professionals and most importantly, the populations that we serve. Evidence-based medicine is now the standard of care, and as I move forward in my career, I will seek out the best evidence to support of my delivery of care. As I worked on this DNP project, I found that there has been a lack of evidence to guide the treatment of calciphylaxis, but the nephrology community is now beginning to produce research in the field that can finally provide the evidence that is needed to improve clinical outcomes in the nephrology population. Two such studies are the CALISTA study (ClinicalTrials.gov, 2017) and the VITK-CUA study (ClinicalTrials.gov, 2014).

The CALISTA study is a Phase 3 clinical trial studying the use of intravenous sodium thiosulfate in acute calciphylaxis. This research is being conducted as a multicenter, randomized, double-blind, placebo-controlled study (ClinicalTrials.gov, 2017). The evaluation of vitamin K supplementation for calcific uremic arteriolopathy (VITK-CUA) study is a pilot study examining the use of vitamin K in patients at risk to develop calciphylaxis (ClinicalTrials.gov, 2014). It was very exciting to find reference to these two studies and I will be following them closely.

As I developed my DNP project, I was able to network with several prominent nephrologists who are actively studying calciphylaxis. As I progress in my role as a DNP, I will maintain these professional relationships because I realize that research is dynamic and calciphylaxis management is an area that is now ripe for research.

Summary

This DNP journey has been one of professional fulfillment. I was able to identify a longstanding need for calciphylaxis screening and take an active role in improving patient outcomes. I expanded my professional network by aligning myself with experts in the field of calciphylaxis research. In this way, I discovered a whole new area of nephrology research. I was privileged to mentor dialysis staff at point of care and hopefully played a role in transforming care at the chairside through education.

Once fully developed and validated, the calciphylaxis assessment and screening tool can be used as an interdisciplinary approach to achieve early intervention by empowering nephrology nurses to assume a proactive leadership role in calciphylaxis disease management. Together, the nurse leader and interdisciplinary team members, collaborating with the ESRD patient, could develop a patient-centered plan of care aimed at reducing disease burden, enhancing quality of life and improving population health. The assessment and screening tool has the potential to address a longstanding practice void in the continuing care of the ESRD population. While developing the calciphylaxis screening and assessment tool is one stepping stone in calciphylaxis management, it does not stand alone. Staff and patient education remain integral to improving quality of life in the ESRD patient population, reducing symptom burden, and decreasing mortality rates.

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Appendix A: Calciphylaxis Screening Tool

Calciphylaxis Screening and Assessment Tool

Patient Name: _____

Date: _____

Risk Factors

Directions: Check all that apply.

- ☐ End stage renal disease
- ☐ Dialysis vintage (> 3 years)
- ☐ Diabetes
- ☐ Obese (BMI ≥ 30)
- ☐ Caucasian
- ☐ Female
- ☐ Hyperphosphatemia (>5.5)
- ☐ Hypercalcemia, Adj. (>10.2)
- ☐ Hyperparathyroidism (>600)
- ☐ Hypoparathyroidism (<150)
- ☐ Hypoalbuminemia (<4.0)
- ☐ Use of calcium based binders
- ☐ Use of Vitamin D or Vitamin D analog
- ☐ Current use of Vitamin K antagonists (Coumadin or generics)
- ☐ Current or past diagnosis of calciphylaxis

PEG Pain Screening

Directions - Ask the patient the following three questions and enter the response in the box.

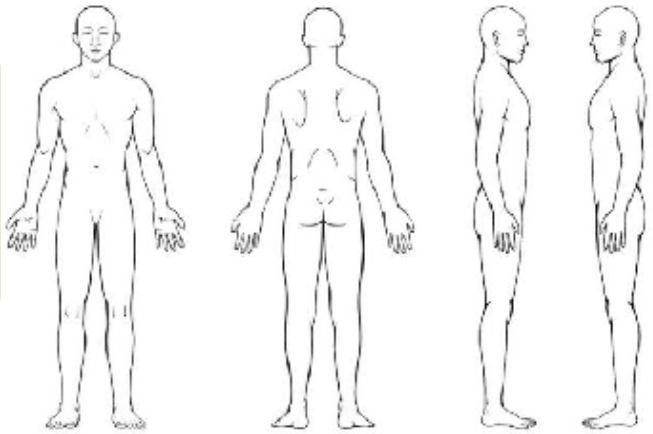
Compute the final PEG score by adding the three patient responses and divide that score by three. Round to the nearest whole number.

On a scale of 0 to 10	Score
1. What numbe best describes your ***pain on average*** in the past week? 0 = no pain 10 = pain as bad as you can imagine	☐
2. What number best describes how, during the past week, pain has interfered with your ***enjoyment of life***? 0 = did not interfere 10 = completely interfered	☐
3. What number best describes how, during the past week, pain has interfered with your ***general activity***? 0 = did not interfere 10 = completely interfered	☐
Final PEG score =	☐

Skin Assessment

Directions:
- Ask the patient if there are any new wounds, lesions, or painful nodules.
- Note the location and size of any skin lesions on the body diagrams below.
- Note if the lesions are painful.

Skin Lesion	Symbol	Associated with Pain? Y or N
Palpable nodule	⬭	
Livedo reticularis	∿	
Erythematous patches	⊕	
Ulcerations	☐	



This instrument has not yet been validated.

Appendix B: Accredited Provider Planning Template and Calciphylaxis Educational Planning Table

OPTION 2

PROVIDER'S NAME

ACCREDITED PROVIDER PLANNING TEMPLATE

A. Description of the professional practice gap (e.g. change in practice, problem in practice, opportunity for improvement)

Describe the current state:

A literature search failed to produce any nursing protocol related to screening, identification, or treatment of calciphylaxis in the dialysis population. Routine screening for calciphylaxis in the dialysis unit is not routinely performed.

Describe the desired state:

Dialysis staff will perform calciphylaxis screening and identify calciphylaxis in the clinical setting.

Identified gap:

Dialysis nurses lack the knowledge and the tools necessary to effectively perform a calciphylaxis assessment and screening.

GAP ANALYSIS WORKSHEET			
Desired Outcome for Learner	Current State of Learner	Identified Gap	Describe Gap as it relates to Knowledge (learn) Skills (implement) Practice (do or change)
To acquire the knowledge base and skills needed in order to conduct a calciphylaxis screening and identify ulcerative and non-ulcerative calciphylatic lesions	Lacks skills and tools for calciphylaxis assessment and screening	No available calciphylaxis assessment or screening tool. No formal training regarding calciphylaxis assessment.	Staff lacks basic knowledge regarding calciphylaxis pathogenesis. Staff does not conduct routine calciplyaxis assessment or screening. Staff does perform monthly diabetic foot exams and monthly pain assessment. These practices can be combined and expanded to include an assessment for the presence of calciphylactic lesions.

OPTION 2

PROVIDER'S NAME

ACCREDITED PROVIDER PLANNING TEMPLATE

Title of Activity: Calciphylaxis: The Dialysis Medusa

Date Form Completed: 7/1/2017

Activity Type:

- ☒ Provider-directed, provider-paced: Live (in person or webinar)
  - Date of live activity: Click here to enter a date.
- ☐ Provider-directed, learner-paced: Enduring material
  - Start date of enduring material: Click here to enter a date.
  - Expiration/end date of enduring material: Click here to enter a date.
- ☐ Learner-directed, learner-paced: Enduring material
  - Start date of enduring material: Click here to enter a date.
  - Expiration/end date of enduring material: Click here to enter a date.
- ☐ Blended activity
  - Date(s) of enduring materials (e.g. prework): Click here to enter a date.
  - Date of live portion of activity: Click here to enter a date.

Nurse Planner contact information for this activity.

Name and credentials: *Janice M. Pennington, MSN, ANP-BC*

Email Address: janice.pennington@waldenu.edu

The **Nurse Planner** must be a registered nurse who holds a current, unencumbered nursing license (or international equivalent) **AND** hold a baccalaureate degree or higher in nursing (or international equivalent) **AND** be actively involved in planning, implementing and evaluating this continuing education activity.

DESIGN

OPTION 2

PROVIDER'S NAME

ACCREDITED PROVIDER PLANNING TEMPLATE

Criteria for Awarding Contact Hours

Criteria for awarding contact hours for live and enduring material activities include:
(Check all that apply)

- ☒ Attendance for a specified period of time (e.g., 100% of activity, or miss no more than 10 minutes of activity)
- ☐ Credit awarded commensurate with participation
- ☐ Attendance at 1 or more sessions
- ☒ Completion/submission of evaluation form
- ☒ Successful completion of a post-test (e.g., attendee must score 80% or higher)
- ☐ Successful completion of a return demonstration
- ☐ Other - Describe: _____

IMPLEMENTATION/EVALUATION

Description of evaluation method: Evidence that change in knowledge, skills and/or practices of target audience was assessed

Short-term evaluation options:

- ☐ Intent to change practice
- ☐ Active participation in learning activity
- ☒ Post-test
- ☐ Return demonstration
- ☐ Case study analysis
- ☐ Role-play
- ☐ Other – Describe: _____

Long-term evaluation options:

- ☒ Self-reported change in practice
- ☐ Change in quality outcome measure
- ☐ Return on Investment (ROI)
- ☐ Observation of performance
- ☐ Other – Describe: _____

OPTION 2

PROVIDER'S NAME

ACCREDITED PROVIDER PLANNING TEMPLATE

Attachment 1
Individuals in a Position to Control Content

Complete the table below for each person in a position to control content of the educational activity and include name, credentials, educational degree(s), role on the planning committee, and expertise that substantiates their role. There must be one Nurse Planner and one other planner to plan each educational activity. The Nurse Planner is knowledgeable of the CNE process and is responsible for adherence to the ANCC criteria. One planner needs to have appropriate subject matter expertise for the educational activity being offered (Content Expert). **The individuals who fill the roles of Nurse Planner and Content Expert must be identified.**

Names and credentials of all individuals in a position to control content (must identify the individuals who fill the roles of Nurse Planner and content expert(s)).

Name of individual and credentials	Individual's role in activity	Planning committee member? (Yes/No)	Name of commercial interest	Nature of relationship
Example: Jane Smith, RN-BC	*Nurse Planner*	*Yes*	*None*	---
Example: Sue Brown, RNC	*Content Expert*	*Yes*	*None*	---
Example: John Doe, PhD	*Presenter*	*No*	*Pfizer*	*Speakers Bureau*
Hazel Dennison DNP FNP-BC CPHQ CNE	Lead Nurse Planner and content expert	Yes	None	N/A
Janice Pennington, MSN, ANP-BC	Planning committee and presenter	Yes	None	N/A

OPTION 2

PROVIDER'S NAME

ACCREDITED PROVIDER PLANNING TEMPLATE

Follow-Up Eval for this activity?		
Activity File completed		
Other:		

N response details:

Completed by: Janice M. Pennington, MSN, ANP-BC
Date: 7/1/2017

Walden University

Educational Planning Table – Live/Enduring Material

Title of Activity: Calciphylaxis: The Dialysis Medusa

Identified Gap(s): Dialysis nurses lack the tools and knowledge to conduct a calciphylaxis screening in the clinical setting

Description of current state: No calciphylaxis screenings are being performed

Description of desired/achievable state: Dialysis staff will have the knowledge base and an available screening tool to facilitate identification of early calciphylaxis lesions in the clinical setting.

Gap to be addressed by this activity: ☒ Knowledge ☒ Skills ☒ Practice ☐ Other: Describe: Click here to enter text.

Learning Outcome (s) Dialysis staff will be able to perform a calciphylaxis screening and identify calciphylatic lesions in the clinical setting

Select all that apply: ☒ Nursing Professional Development ☐ Patient Outcome ☐ Other: Describe _____

CONTENT (Topics)	TIME FRAME (if live)	PRESENTER/ AUTHOR	TEACHING METHODS/LEARNER ENGAGEMENT STRATEGIES
Introduction and pre-assessment	10 min	Janice Pennington for the Entire activity	Discussion
Pathophysiology of calciphylaxis	10 min	"	PowerPoint , question & answer
Risk factors/Risk assessment	5 min	"	PowerPoint, group discussion
Stages of calciphylaxis lesions	10 min	"	PowerPoint, group discussion & examples from clinical practice
Systemic calciphylaxis	5 min	"	PowerPoint
Skin and pain assessment (PEG pain scale)	10 min	"	PowerPoint, question & answer
Review of assessment/screening tool and application to clinical practice	10 min	"	Demonstration, role play, question & answer
Multidisciplinary approach to treatment	5 min	"	PowerPoint, discussion
Interdisciplinary approach to prevention	5 min	"	PowerPoint, discussion
Question & answer Post assessment – intention to change	10 min	"	Discussion
Post-test and evaluation	10 min	"	Online

List the evidence-based references used for developing this educational activity:

Brandenburg, V., Evenepoel, P., Floege, J., Goldsmith, D., Kramann, R., Massy, Z.,…Cozzolino, M. (2016). Lack of evidence does not justify neglect: How can we address unmet medical needs in calciphylaxis? *Nephrology Dialysis Transplantation, 31*(8), 1211-1219. doi:10.1093/ndt/gfw025

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Mana, M., Sanguineti, F., Unterseeh, T., Bouvier, E., & Garot, J. (2012). Petrified myocardium: The age of stone? *Circulation, 126,* 1139-1142. doi: 10.1161/CIRCULATIONAHA.112.100321

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If Live:

Note: Time spent evaluating the learning activity may be included in the total time when calculating contact hours.

Total Minutes 90 divided by 60= 1.5 contact hour(s)

If Enduring:

Method of calculating contact hours:

_____ Pilot Study _____ Historical Data _____ Complexity of Content _____ Other: Describe_____

Walden University

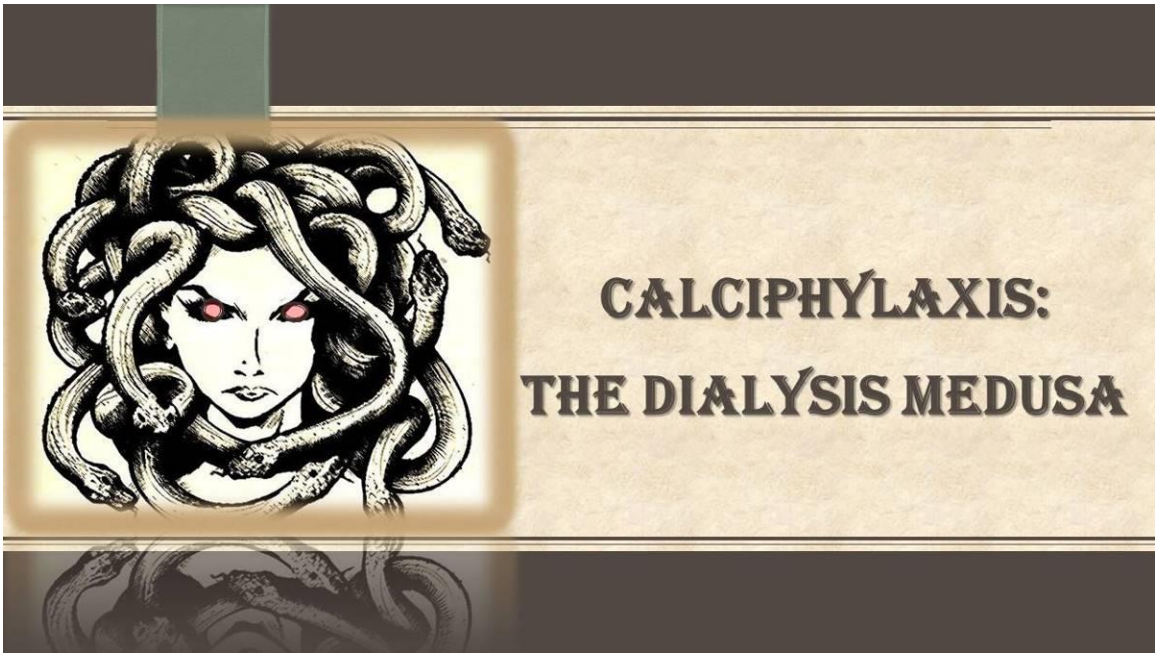
Educational Planning Table – Live/Enduring Material

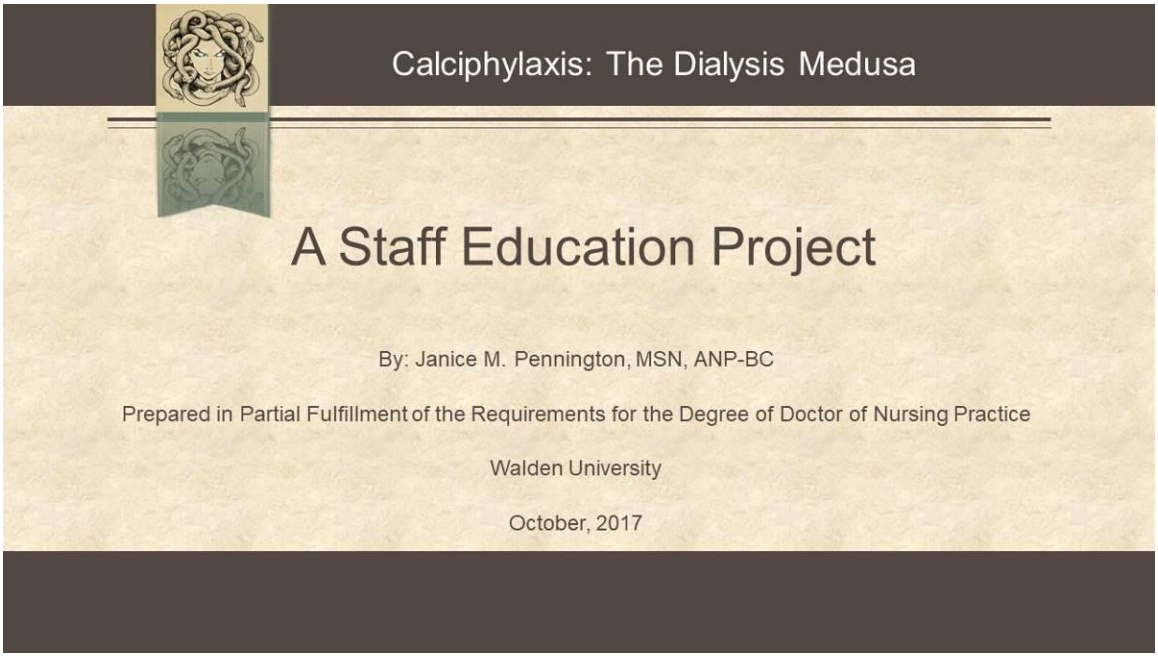
Estimated Number of Contact Hours to be awarded: _____

Janice M. Pennington, MSN, ANP-BC _____ **Completed By: Name and Credentials**

7/1/2010 _____ **Date**

Appendix C: PowerPoint Presentation





DNP Project Information

- This is a blinded quasi-experimental design.
- Approval for the study has been granted by the investigational review board at Walden University and by the clinical research department at this partner faciltiy.
  - Walden University's ethics approval number for this study is 06-21-17-0103266
- Research questions:
  - #1: What are the best practices based on literature evidence and expert opinion to be included in an assessment and screening tool that can be used to screen hemodialysis patients for clinical manifestations associated with calciphylaxis?
  - #2: Will dialysis staff who participate in a staff education activity, regarding calciphylaxis assessment and screening, acquire the knowledge necessary to effectively identify calciphylactic lesions in the clinical setting.
- Your participation in the study is voluntary.

Consent

Consent Form for Anonymous Questionnaires

To be given to the staff member prior to collecting questionnaire responses—note that obtaining a "consent signature" is not appropriate for this type of questionnaire and providing respondents with anonymity is required.

You are invited to take part in an evaluation for the staff education doctoral project that I am conducting.

Questionnaire Procedures:

If you agree to take part, I will be asking you to provide your responses anonymously, to help reduce bias and any sort of pressure to respond a certain way. Staff members' questionnaire responses will be analyzed as part of my doctoral project, along with any archival data, reports, and documents that the organization's leadership deems fit to share.

Voluntary Nature of the Project:

This project is voluntary. If you decide to join the project now, you can still change your mind later.

Risks and Benefits of Being in the Project:

Being in this project would not pose any risks beyond those of typical daily professional activities. This project's aim is to provide data and insights to support the organization's success.

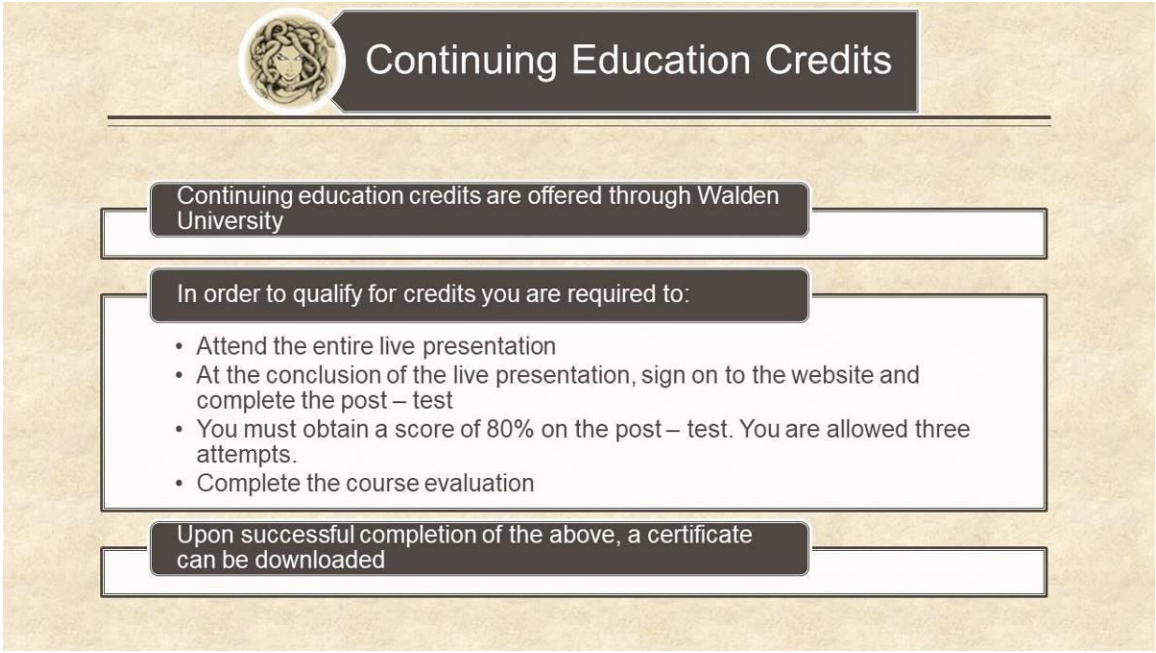
Privacy:

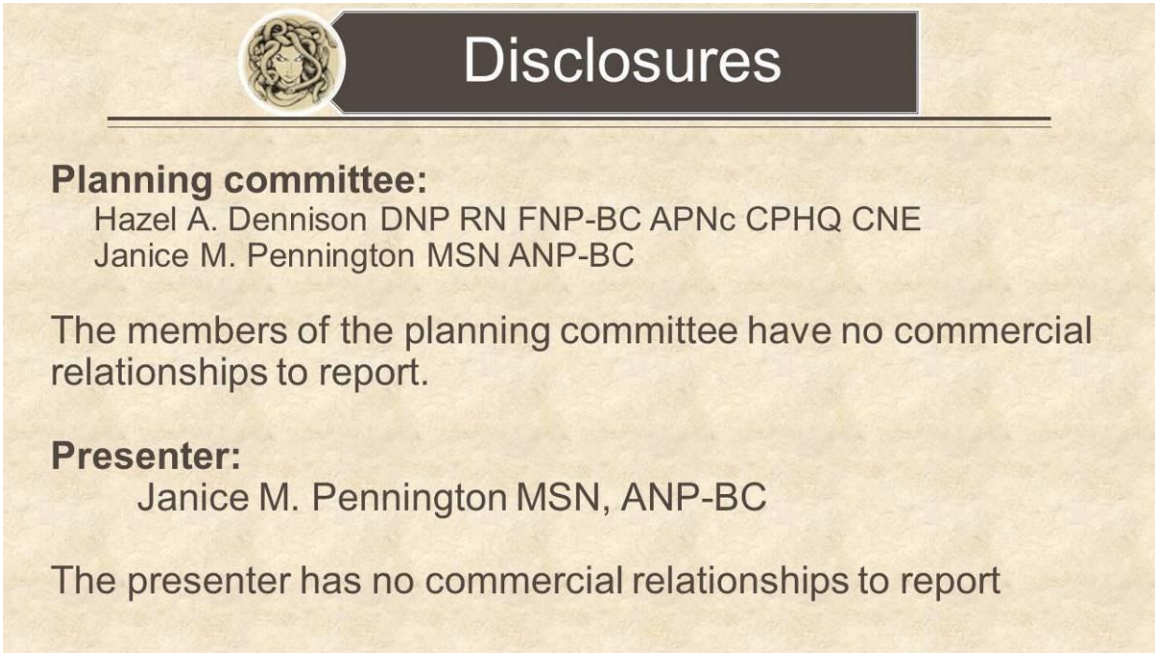
I might know that you completed a questionnaire but I will not know who provided which responses. Any reports, presentations, or publications related to this study will share general patterns from the data, without sharing the identities of individual respondents or partner organization(s). The questionnaire data will be kept for a period of at least 5 years, as required by my university.

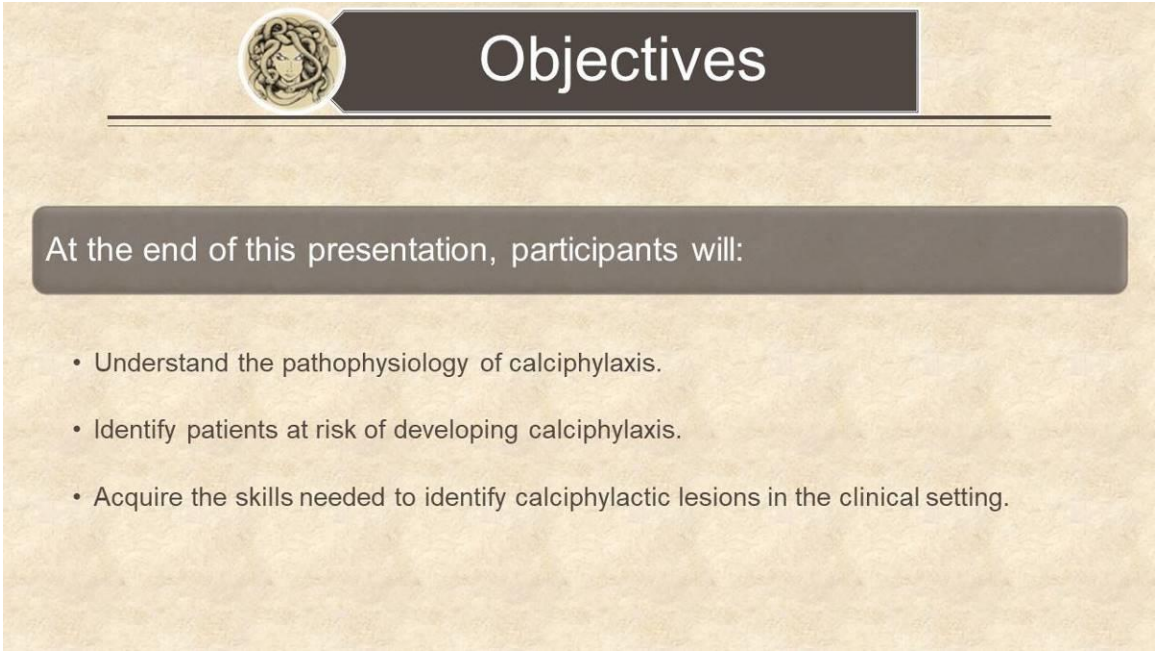
Contacts and Questions:

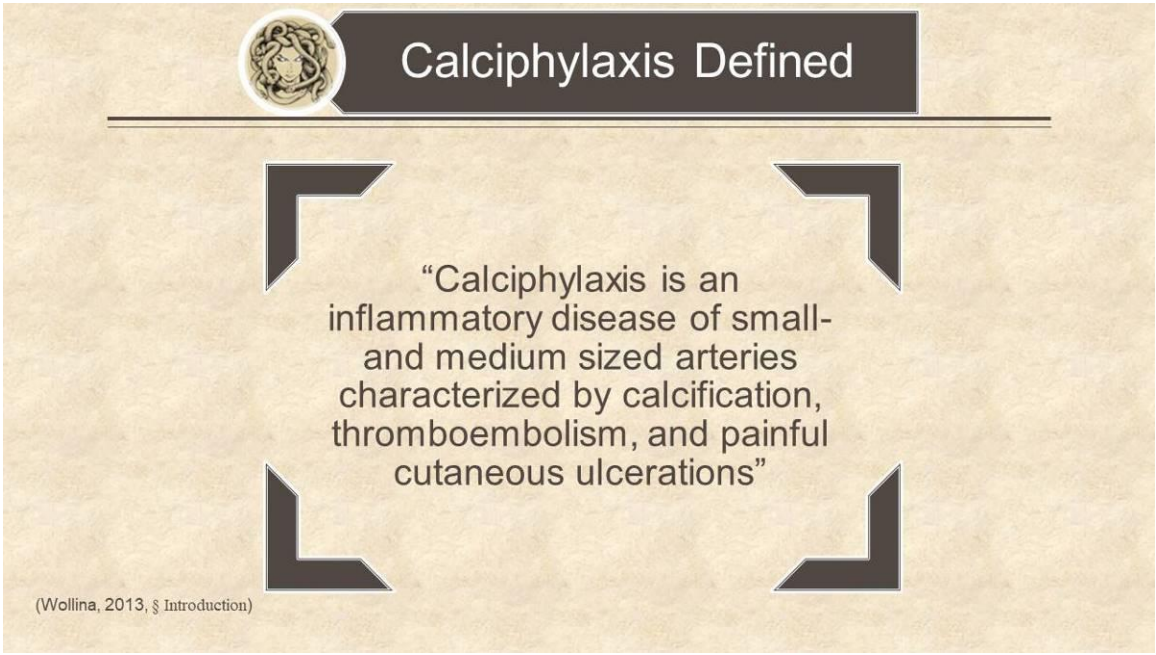
If you want to talk privately about your rights in relation to this project, you can call my university's Advocate via the phone number 612-312-1210. Walden University's ethics approval number for this study is 06-21-17-0103266.

Before you start the questionnaire, please share any questions or concerns you might have.

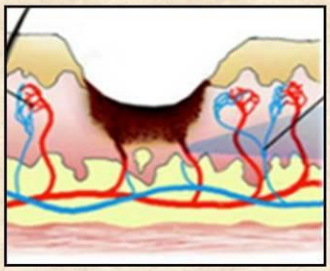

Continuing Education Credits
Continuing education credits are offered through Walden University
In order to qualify for credits you are required to:
• Attend the entire live presentation
• At the conclusion of the live presentation, sign on to the website and complete the post – test
• You must obtain a score of 80% on the post – test. You are allowed three attempts.
• Complete the course evaluation
Upon successful completion of the above, a certificate can be downloaded


Disclosures
Planning committee:
Hazel A. Dennison DNP RN FNP-BC APNc CPHQ CNE
Janice M. Pennington MSN ANP-BC
The members of the planning committee have no commercial relationships to report.
Presenter:
Janice M. Pennington MSN, ANP-BC
The presenter has no commercial relationships to report


Objectives
At the end of this presentation, participants will:
• Understand the pathophysiology of calciphylaxis.
• Identify patients at risk of developing calciphylaxis.
• Acquire the skills needed to identify calciphylactic lesions in the clinical setting.


Calciphylaxis Defined
"Calciphylaxis is an inflammatory disease of small- and medium sized arteries characterized by calcification, thromboembolism, and painful cutaneous ulcerations"
(Wollina, 2013, § Introduction)

Calciphylaxis Defined



The cutaneous equivalent of a myocardial infarction

(Rudolph & Lerma, 2012)

History of Calciphylaxis

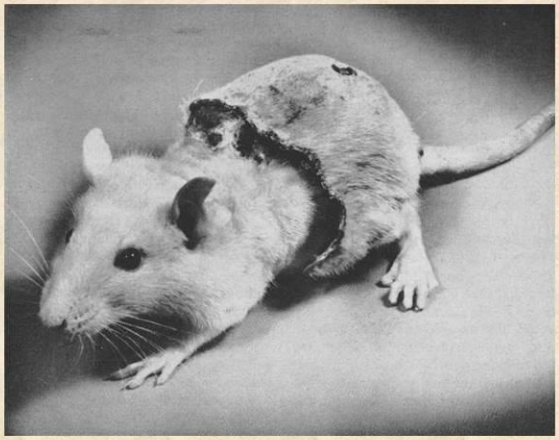
The term calciphylaxis was first explained by the endocrinologist Hans Selye in 1962 as a two-step "phylactic"response

- Experimental studies with rodents
- First introduced as an allergic reaction to calcium
- A defense mechanism by the body
- Sensitizers and challengers resulted in inflammation, tissue calcification, and necrosis of the tissues

(Nigweker et al., 2015)

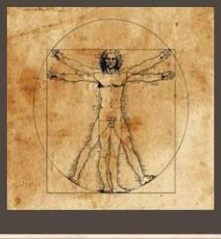
History of Calciphylaxis

Rodent studies showed that a "sensitizer" such as hyperparathyroidism and a "challenger" such as albumin or a metallic salt resulted in an acute calcification of the cutaneous tissue, much like an exoskeleton.



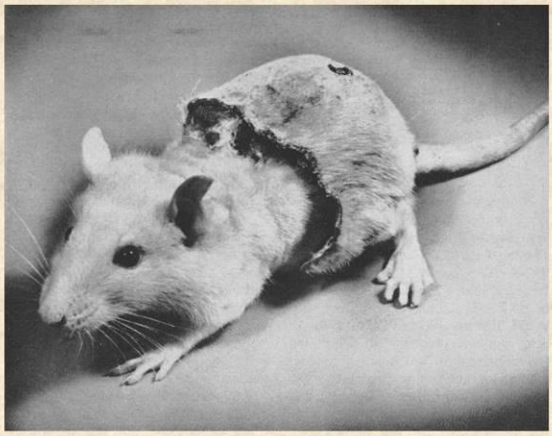
Selye, H., Gentile, G., Prioreschi, P. (1961). Cutaneous molt induced by calciphylaxis in the rat. *Science. 134* (3493). 1876-1877.doi:10.1126/science.134.3493.1876 . Reprinted with permission from AAAS

Calciphylaxis: The Dialysis Medusa



How does calciphylaxis in humans differ from the rodent model?

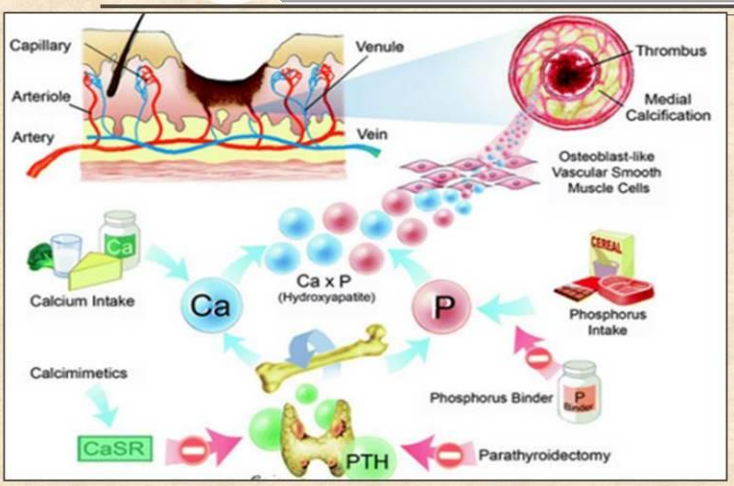
Experimental Calciphylaxis in Rodents



Selye, H., Gentile, G., Prioreschi, P. (1961). Cutaneous molt induced by calciphylaxis in the rat. *Science. 134* (3493). 1876-1877. doi:10.1126/science.134.3493.1876. Reprinted with permission from AAAS

- Acute local calcification, inflammation, and sclerosis (Selye, Gentile, & Prioreschi,1961)
- Extensive soft tissue calcification without the small artery or arteriolar calcification that is seen in human patients.
- Molting of the calcified skin allowed for formation of a new dermal layer without evidence of calciphylaxis
- Experimental calciphylaxis was prevented with the administration of glucocorticosteroids. (Nigweker, 2015)
- Pain in initial stages of calcification. No evidence of pain after the first week. (Selye, Gentile, & Prioreschi, 1961)

Etiology and Pathogenesis of Human Calciphylaxis



- Calciphylaxis is not a hypersensitivity reaction
- Complex process and not well understood
- Disturbance of calcium-phosphorus homeostasis and production
- Deposition of **hydroxyapatite** in the medial wall of arterioles and small vessels
- Vascular remodeling and vascular smooth muscle cell differentiation into **osteoblast-like cells** capable of extracellular mineralization
- Thrombotic occlusion and tissue ischemia

Rudolph, E., & Lerma, E. (2012). Calcific Uremic Arteriolopathy (Calciphylaxis). In A. Licata & E. Lerma (Eds.). *Diseases of the parathyroid glands* (pp.113-146). New York, NY: Springer. doi:10.1007/978-1-4419-5550-0_6 Illustration by Bashar Ericsoossi, MD. (Reprinted with permission from Bashar Ericsoossi, MD)

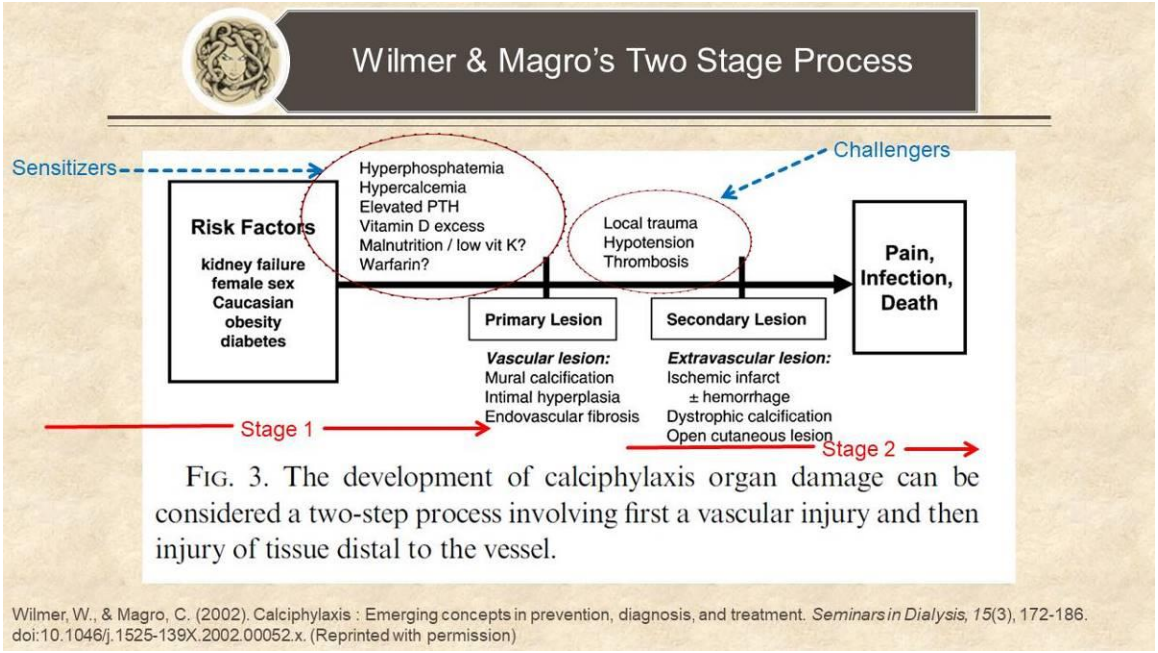
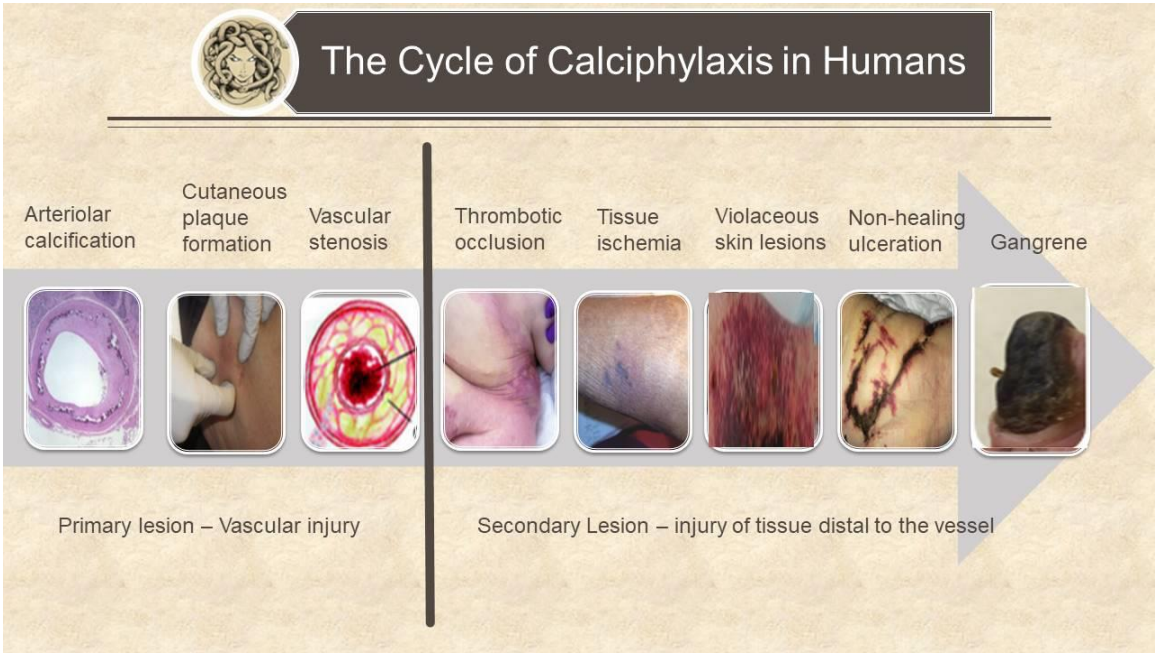


FIG. 3. The development of calciphylaxis organ damage can be considered a two-step process involving first a vascular injury and then injury of tissue distal to the vessel.

Wilmer, W., & Magro, C. (2002). Calciphylaxis : Emerging concepts in prevention, diagnosis, and treatment. *Seminars in Dialysis, 15*(3), 172-186. doi:10.1046/j.1525-139X.2002.00052.x. (Reprinted with permission)



Typical Presentation

"The typical presentation starts with intense burning or shooting pain in the extremities with subsequent appearance of tender violaceous or mottled skin lesions, as well as plaques and subcutaneous nodules. They progress to ischemic nonhealing deep ulcers with subcutaneous fat necrosis and infection. The terminal event is usually hypotension with sepsis and organ failure"

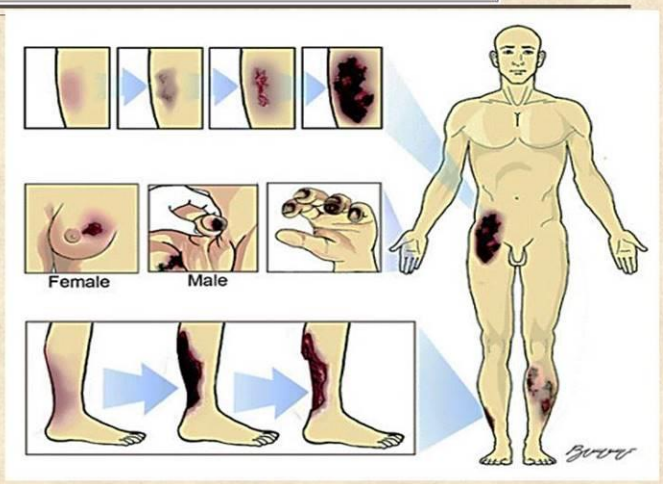
(Miceli et al., 2011, p. 84)

Locations and Progression of Calciphylatic Lesions

Proximal lesions:
- Thighs
- Buttocks
- Trunk

Acral lesions
- Fingers
- Toes
- Genitals

Distal lesions:
- Calves
- Forearms
- Acral



Rudolph, E., & Lerma, E. (2012). Calcific Uremic Arteriolopathy (Calciphylaxis). In A. Licata & E. Lerma (Eds.). *Diseases of the parathyroid glands* (pp.113-146). New York, NY: Springer. doi:10.1007/978-1-4419-5550-0_6 (Illustration by Bashar Ericsoossi, MD. Reprinted with permission from Bashar Ericsoossi, MD)

Risk Factors

General
- Uremia

Demographic
- Caucasian
- Female
- Dialysis vintage

Comorbid conditions
- Late stage kidney disease
- Hyperphosphatemia
- SHPT
- Hypocalcemia
- Diabetes
- Obesity (BMI > 30)
- Malnutrition
- Hypercoagulable state
- Autoimmune disease

Medications
- Calcium based medications (Inc. binders)
- Vitamin D
- High calcium dialysate
- Coumadin
- Iron therapy
- Trauma due to injectable medications

Laboratory Studies
- High phosphorus levels
- High calcium levels
- High CaXPo4
- High parathyroid hormone
- High alkaline phosphatase
- Low albumin
- Vitamin K deficiency

Rudolph & Lerma. (2012).

Diagnosis

Skin Biopsy

- Gold Standard
- Risks include:
  - Ulceration at the biopsy site
  - Superimposed infection
  - Development of new lesions
  - Bleeding
  - Necrosis

(Madden, Bailey & Spear, 2010)

- Should only be done if clinical features are not sufficient for a definite diagnosis

(Hayashi, 2013)

Clinical Suspicion

- Typical skin changes may be enough to lead to a clinical diagnosis
- Hallmark clinical feature is severe pain that may be refractory to standard analgesics
- Supporting lab data

(Madden, Bailey & Spear, 2010)

Calciphylaxis: The Dialysis Medusa

NON-ULCERATIVE AND ULCERATIVE LESIONS

Cutaneous Calciphylaxis

- Image removed for publication
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Subcutanous Nodule

- An example of panniculitis
- Localized area of soft tissue hardening
- Painful
- Erythematous
- Surrounding livedo rectularis may be present

Nigwekar, S., Malhotra, R., Kroshinsky, D., Nazarian, R., Kamdar, M., & Schulz, J. (2016, June 30). *Multi-disciplinary treatment approach to calciphylaxis.* Presented at Medical Grand Rounds at Massachusetts General Hospital: Boston, MA. (Image reprinted with permission of Dr. S. Nigwekar.)

Cutaneous Calciphylaxis

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Calciphylactic Lesions

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Fig. 6.2 (**a**, **b**) Biopsy-proven calciphylactic lesions in the absence of uremia of the right thigh (**a**) and leg (**b**) of a 55-year-old Caucasian female with a history of diabetes, hypertension, and morbid obesity. These full-blown lesions demonstrate characteristic nonhealing, ulcerated, necrotic tissue with eschars. PTH level was <100 ng/L and calcium–phosphorus product was <40 mg^2/dL^2 at the time of lesion manifestation and biopsy. (**c**, **d**) Subcutaneous nodules of the forearm (**c**) and ischemic necrosis of the fingers (**d**) of biopsy-proven calciphylaxis in a 47-year-old African American male with ESRD on hemodialysis and history of a failed renal transplant. PTH level was >800 ng/L and calcium–phosphorus product was >70 mg^2/dL^2 at the time of lesion manifestation and biopsy

Rudolph, E., & Lerma, E. (2012). Calcific Uremic Arteriolopathy (Calciphylaxis). In A. Licata & E. Lerma (Eds.). *Diseases of the parathyroid glands* (pp.113-146). New York, New York: Springer. doi: 10.1007/978-1-4419-5550-0_6

Calciphylactic Lesions

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Calciphylactic Lesions

A. Ischemia and dry gangrene of the left first digit

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B. Dry gangrene surrounded by visible livedo from active ischemia

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Calciphylactic Lesions

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Ulcer progression

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Early Stage Calciphylaxis Lesion

- Livedo reticularis
- Livedo racemosa
- Tissue ischemia as a result of endovascular thrombosis
- This is a secondary lesion
- Skin mottling

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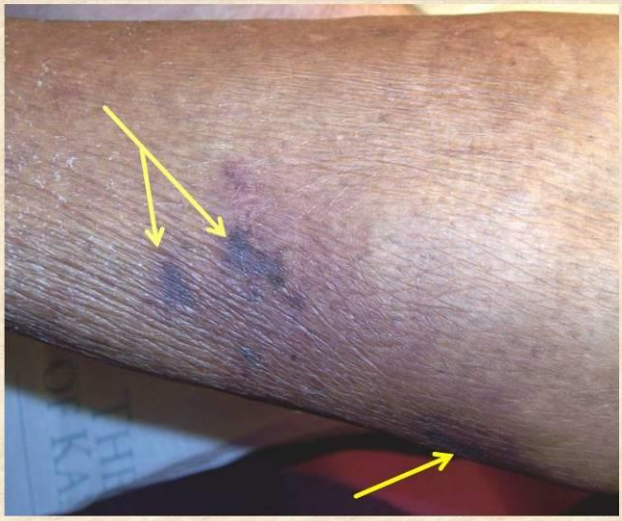
Mid-Stage Calciphylaxis Lesion



Secondary lesion or extravascular lesion as evidenced by areas of ischemic infarct (yellow arrows).

Surrounding area of livedo reticularis

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Late Stage Calciphylaxis

- Deep ulcerative wounds with eschar formation.
- Secondary lesions.
- Injury distal to the diseased vessel.
- Eschar is the slough of dead tissue

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Calciphylaxis: The Dialysis Medusa

Systemic Calciphylaxis

Systemic Calciphylaxis

- Calciphylaxis has been reported to cause organ damage and is not unique to cutaneous lesions.
- Systemic calciphylaxis can manifest internally. Calciphylaxis has been reported to affect the lungs, cardiovascular system, and gastrointestinal system (Hayashi, 2013).
- Reports of vascular calcifications in skeletal muscle, brain, lungs, intestines, eyes, and mesentary (Nigwekar et al., 2015)
- Calciphylaxis can be considered as a continuum of a systemic process leading to arterial calcification in many vascular beds (Nigwekar et al., 2015)

Heart of Stone – Case Study 1

History

- A 55-year-old woman with a history of type 1 multiple endocrine neoplasia and primary hyperparathyroidism was referred for exertional dyspnea. She had been hospitalized 18 months earlier with septic shock caused by acute peritonitis, and she underwent subtotal parathyroidectomy 1 year before admission.
- Calcium 10.8 mg/dL (historically up to 14 mg/dL)
- Phos 0.8 mg/dL
- PTH 249 pg/ml (historically up to 280 pg/ml)
- EF 46%

- Identify the risk factors.
  - Female
- Identify possible sensitizers.
  - type 1 multiple endocrine neoplasia
  - primary hyperparathyroidism (disordered calcium)
  - Hx hypercalcemia
- Identify the challengers.
  - septic shock caused by acute peritonitis

See the CT scan on the next slide

Mana, M., Sanguineti, F., Unterseeh, T., Bouvier, E., & Garot, J. (2012). Petrified myocardium: The age of stone? *Circulation, 126*, 1139-1142. doi:10.1161/CIRCULATIONAHA.112.100321

(A) Postcontrast 64-slice computed tomographic scan showing extensive subepicardial and midwall myocardial calcifications (300–500 Hounsfield Units) within the apical and posterior walls, with left ventricular apical thrombus CE indicates contrast enhanced; CT, computed tomography.
(B) Reconstructed 3-dimensional volume- rendered image with extensive apical and posterior myocardial calcifications.

Melina Mana et al. Circulation. 2012;126:1139-1142

Heart of Stone – Case Study 2

History
- 36 year old woman
- Diabetes, HTN, hemodialysis dependent renal failure
- Calcium 8.1
- Phos 7.5
- PTH 21 pmol/L (273.47 ng/L)
- Severe biventricular heart failure

See the CT scan on the next slide

- Identify the risk factors.
  - Female
  - Diabetes
  - Renal Failure
  - Hemodialysis dependent
- Identify possible sensitizers.
  - Hyperphophatemia
  - SHPT
- Identify possible challengers?
  - Not enough information to determine, but probably due to biventricular heart failure

Tom, C., & Talreja, D. (2006). Heart of stone. *Mayo Clinic Proceedings, 81*(3), 355. doi:10.4065/81.3.335

(A) Postcontrast 64-slice computed tomographic scan showing extensive subepicardial and midwall myocardial calcifications (300–500 Hounsfield Units) within the apical and posterior walls, with left ventricular apical thrombus CE indicates contrast enhanced; CT, computed tomography.
(B) Reconstructed 3-dimensional volume- rendered image with extensive apical and posterior myocardial calcifications.

Melina Mana et al. Circulation. 2012;126:1139-1142

Heart of Stone – Case Study 2

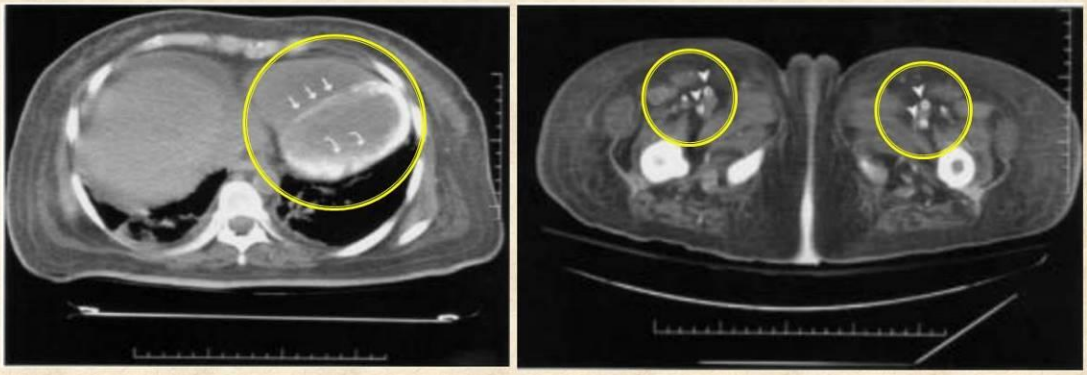
History
- 36 year old woman
- Diabetes, HTN, hemodialysis dependent renal failure
- Calcium 8.1
- Phos 7.5
- PTH 21 pmol/L (273.47 ng/L)
- Severe biventricular heart failure

See the CT scan on the next slide

- Identify the risk factors.
  - Female
  - Diabetes
  - Renal Failure
  - Hemodialysis dependent
- Identify possible sensitizers.
  - Hyperphophatemia
  - SHPT
- Identify possible challengers?
  - Not enough information to determine, but probably due to biventricular heart failure

Tom, C., & Talreja, D. (2006). Heart of stone. *Mayo Clinic Proceedings, 81*(3), 355. doi:10.4065/81.3.335

36 year old woman with history of diabetes mellitus, HTN, and dialysis dependent renal failure



Reprinted from Tom, C., & Talreja, D. (2006). Heart of stone. *Mayo Clinic Proceedings, 81*(3), 355. doi:10.4065/81.3.335 with permission from Elsevier

Visceral Calciphylaxis - Case Study

History

- 66 year old female with a past medical history of diabetes, HTN, ESRD on hemodialysis. She has a recent diagnosis of ovarian cancer. Presented to the hospital with complaints of painful rash on her bilateral extremities.
- Skin examination found black necrotic eschar on the bilateral lower extremities.
- Radiograph of the legs showed extensive calcification of the lower extremity arteries.
- No skin biopsy was done
- PTH 166 pg/ml
- Ca 7.9 mg/dL (highest 8.6 mg/dL)
- Phosphorus 2.6 mg/dL(highest 5.2 mg/dL)
- Meds included calcium based binders and vitamin D

See her wounds on the next slide

- Identify the risk factors.
  - Female
  - Diabetes
  - Ovarian cancer
  - ESRD on hemodialysis
- Identify possible sensitizers.
  - SHPT
- Identify possible challengers.
  - Calcium based binders
  - Vitamin D supplement

Visceral Calciphylaxis - Case Study

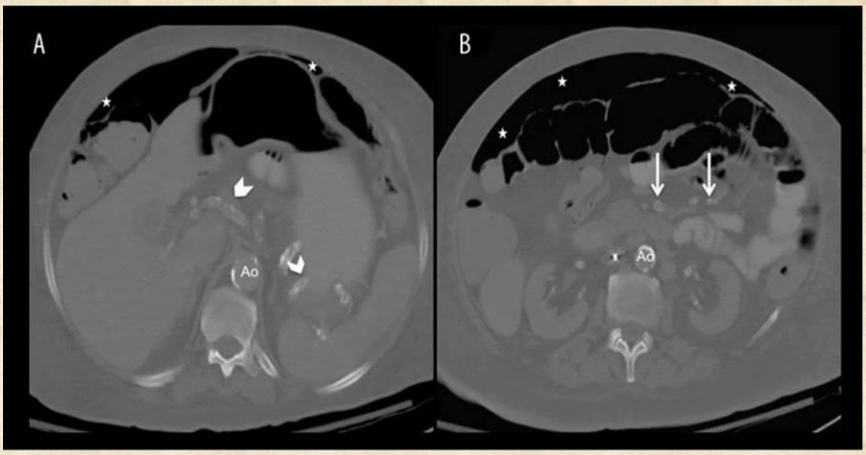
Clinical Course

- During her hospitalization, she developed recurrent episodes of profuse GI bleeding.
- CT of the abdomen showed severe circumferential calcification of the abdominal aorta, celiac artery, superior and inferior mesenteric arteries and their branches
- Colonoscopy revealed severe rectal necrosis
- She was not a candidate for surgery.

See her CT and colonoscopy images on the next slides

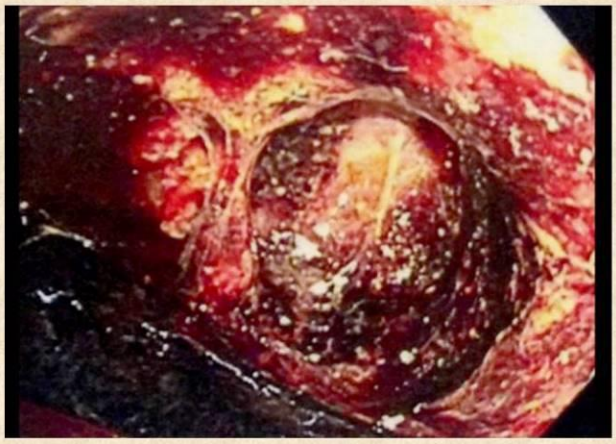
Gupta, N., Haq, K., Mahajan, S., Nagpal, P. & Doshi, B. (2015). Gastrointestinal bleeding secondary to Calciphylaxis. *American Journal of case reports, 16*, 818-822. doi:10.12659/AJCR.895164. (Reprinted with permission, page 820).

CT scan of the abdomen demonstrating severe circumferential calcification of the abdominal aorta, celiac artery, superior and inferior mesenteric arteries and their branches (stars highlight areas of extensive calcification along the visceral organs, arrow heads and arrows indicate extensive calcification of all the arteries within the abdomen).



Gupta, N., Haq, K., Mahajan, S., Nagpal, P. & Doshi, B. (2015). Gastrointestinal bleeding secondary to Calciphylaxis. *American Journal of case reports, 16*, 818-822. doi:10.12659/AJCR.895164. (Reprinted with permission, page 821).

Colonoscopy demonstrating severe rectal ulceration extending up to the muscularis mucosa with rectal necrosis



Treatment

- Blood transfusions as needed.
- Vitamin D supplements and calcium based phosphate binders were discontinued.
- Daily hemodialysis with low calcium bath.
- IV sodium thiosulfate.

Outcome

- Clinical condition deteriorated.
- Patient expired secondary to multiorgan failure.

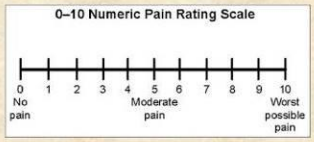
Gupta, N., Haq, K., Mahajan, S., Nagpal, P. & Doshi, B. (2015). Gastrointestinal bleeding secondary to Calciphylaxis. *American Journal of case reports, 16*, 818-822. doi:10.12659/AJCR.895164. (Reprinted with permission, page 821).

Pain

Pain Assessment

An accurate pain assessment is essential

- Pain scales
  - Unidimensional
    - Numerical scales
    - Visual analog scales
    - Wong-Baker FACES pain rating scale



  - Multidimensional
    - McGill pain questionnaire
    - Brief pain inventory (BPI)
    - Graded chronic pain scale
- PEG pain scale
  - Multidimensional
  - Derived from the BPI
  - Validated
  - Easily used in primary care settings
  - **Can be followed over time to assess the patient's response to treatment**

(Boston University, 2016)

PEG Pain Scale

1. What number best describes your pain on average in the past week:

0 1 2 3 4 5 6 7 **8** 9 10

No pain → Pain as bad as you can imagine

2. What number best describes how, during the past week, pain has interfered with your enjoyment of life?

0 1 2 3 4 5 6 7 8 **9** 10

Does not interfere → Completely interferes

3. What number best describes how, during the past week, pain has interfered with your general activity?

0 1 2 3 4 5 6 7 8 **9** 10

Does not interfere → Completely interferes

Krebs, E., Lorenz, K., Bair, M., Damush, T., Wu. J., Sutherland, J.,... Kroenke, K. (2009). Development and initial validation of the PEG, a 3-item scale assessing pain intensity and interference. *Journal of General Internal Medicine, 24*, 733-738. doi:10.1007/s11606-009-0981-1

Treatment of Calciphylaxis

Medical/Surgical Care	Pharmacologic

▪ Prevention is the number one treatment
▪ Managing calcium, phosphorus, and PTH
▪ Increased dialysis time or frequency
▪ Parathyroidectomy
▪ Aggressive wound care and antibiotics for infection
▪ Hyperbaric oxygen
▪ Surgical debridement of necrotic tissue
▪ Maggot larval debridement
▪ Revascularization
▪ Pain management
	▪ Non-calcium based phosphate binders
	  ▪ sevelamer
	  ▪ lanthanum
	▪ Sensipar (Cinacalcet)
	▪ Bisphosphonates
	  ▪ Didronel (etidronate)
	  ▪ Aredia (pamidronate)
	  ▪ Boniva (ibandronate)
	▪ Sodium thiosulfate (STS)

Sodium Thiosulfate (STS)

Indications and Mechanisms of Action:

- Mechanism of action unknown
- Antidote for cyanide poisoning, more recently as prophylactic treatment of carboplantin- and cisplatin-induced nephrotoxicity
- Common intervention to treat calciphylaxis (off label use)
- Chelating agent for calcium and iron
- Vascular inhibitory effects, antioxidant, and a vasodilator (Hayashi, 2013; Rudolph & Lerrma, 2012)

Dosage

- Common dose is 25 grams three times week after hemodialysis or during the last 30-60 minutes of dialysis
- Alternatively, in patients <60 kg, reducing the dose to 12.5 gms may reduce the incidence of adverse events (Nigweker et al., 2015)

Side Effects:

- Nausea
- Vomiting
- Abdominal cramps
- Headache
- Anion gap metabolic acidosis
- Hypotension if administered too rapidly (Nigweker, et al., 2016)
- Reduced bone mineral density in humans (Rudolph & Lerma, 2012)
- Prolongation of the Q-T interval, which can lead to sudden cardiac death (Nigweker et al., 2016)

Is STS Therapy Effective?

- Study conducted at Morehouse School of Medicine in Atlanta
- 10 year retrospective review of 45 patients with biopsy confirmed calciphylaxis
- Results presented at American Society of Nephrology Kidney Week 2015

(Charnow, 2015)

	STS Therapy	Non-STS Therapy
N = 45	n = 23 (51%)	n = 22 (49%)
One year mortality rate	22%	50%
Likelihood of needing a major surgery	52%	86%

Is STS Therapy Effective?

- Miceli et al. reported a case that, unfortunately, did not demonstrate a good outcome following treatment with STS.
- 56 yo female: HTN, cardiomyopathy, SVT, & ESRD. Renal transplant failure on hemodialysis.
- Developed biopsy proven calciphylactic lesions with involvement of upper and lower limbs and trunk.
- Patient's general condition: malnourished, dehydrated, fever, tachycardia, and HTN. Pain 10/10.
- Parathyroidectomy without improvement in lesions despite lower serum calcium.

- Increase in disease severity and critical lower limb ischemia. Evidence of SIRS without identification of an infectious source.
- Initiated STS 25 gms QIW post dialysis (about 8 months after diagnosis).
- After 7 days noted improvement in wounds and severity of pain.
- After 16 days further improvement in wounds/pain.
- However, patient condition continued to deteriorate, treatment stopped, patient discharged to home, and expired 2 days later.

CALISTA Study

- A phase 3 clinical trial of Intravenous sodium thiosulfate in acute calciphylaxis patients (CALISTA) (2017).
- Hope Pharmaceuticals.
- Multicenter, randomized, double-blind, and placebo controlled.
- Start date: May 24, 2017.
- Estimated completion date: May 2019.

- Primary endpoint:
  - Number of patients with 30% improvement in pain severity.
- Secondary endpoints:
  - Number of patients with stabilization or improvement in calciphylaxis skin lesions.
  - Occurrence of surgical debridement of skin lesions and/or amputations.
  - Time to achieve ≥ 30% improvement in pain based on pain intensity score.

VitK-CUA

- Evaluation of vitamin K supplementation for calcific uremic arteriolopathy (Nigwekar, S., 2017). ClinicalTrials.gov identifier:NCT02278692
- Massachusetts General Hospital
- Pilot randomized control trial of vitamin K in CUA
- No. of participants = 20
- Start date: March 2015
- Estimated completion date: December 2017
- Primary outcome measure
  - Change from baseline in circulating MPG levels at 12 weeks
- Secondary outcome measures
  - Change from baseline in pain at 12 weeks
  - Change from baseline lesion in size at 12 weeks
- Other outcome measures
  - Adverse events

Calciphylaxis: The Dialysis Medusa

Test your Knowledge

What is the primary cause of death in patients with calciphylaxis?

Calciphylaxis: The Dialysis Medusa

Test your knowledge

What is the hallmark sign of calciphylaxis?

Calciphylaxis: The Dialysis Medusa

Test your Knowledge

Identify the calciphylaxis lesion

Identify the Calciphlactic Lesion

Livedo racemosa–like purpura

Indurated plaque

Hemorrhagic patches

Necrotic ulceration

Primary lesion
Secondary lesion

Weenig, R., Sewell, W., Davis, M., McCarthy, J., & Pittelkow, M. (2009). Calciphylaxis, Natural history, risk factor analysis, and outcome. *Journal of the American Academy of Dermatology, 56*(4), 569-579. doi:10.1016/j.jaad.2006.08.065. Reprinted with permission of Dr. Weenig.

Identify the Calciphlactic Lesion

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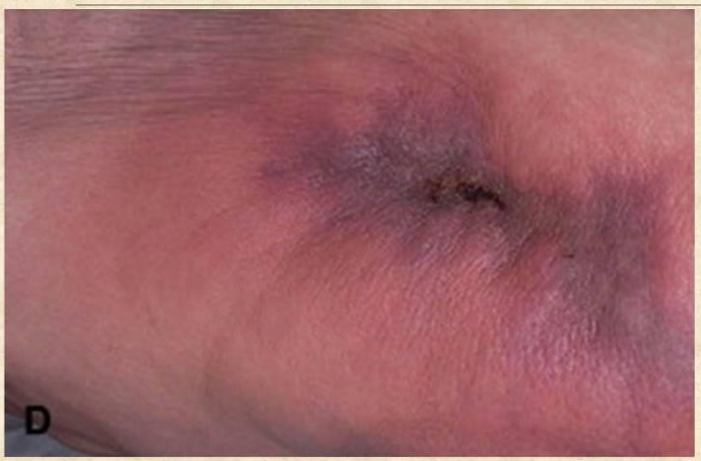
Identify the Calciphlactic Lesion



Livedo racemosa–like purpura

Indurated plaque

Hemorrhagic patches

Necrotic ulceration

Primary lesion
Secondary lesion

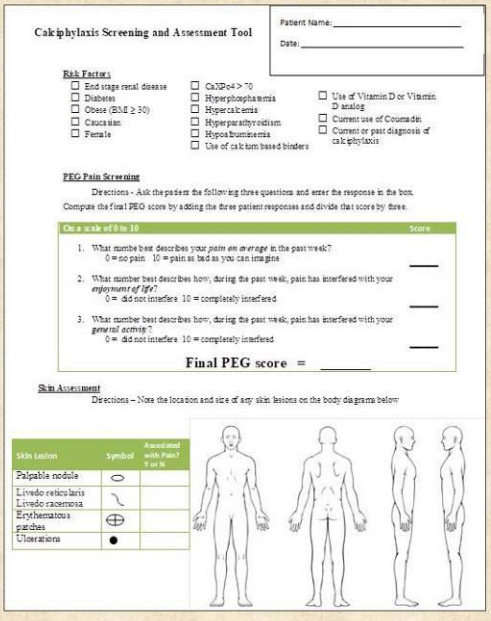
Weenig, R., Sewell, W., Davis, M., McCarthy, J., & Pittelkow, M. (2009). Calciphylaxis, Natural history, risk factor analysis, and outcome. *Journal of the American Academy of Dermatology, 56*(4), 569-579. doi:10.1016/j.jaad.2006.08.065. Reprinted with permission of Dr. Weenig.

Calciphylaxis: The Dialysis Medusa

An Assessment and Screening Tool to Assist in the Identification of Early Calciphylaxis

Assessment & Screening

- Literature supports early diagnosis and treatment.
- There is no evidence, nor are the recommendations, to inform screening.
- Form is developed based on evidence and best practices in skin and wound assessment, screening, surveillance; and expert opinion.
- Purpose of the form is to assist chairside staff and advanced practitioners to:
  - Identify risk factors,
  - Perform a pain assessment,
  - Indentify calciphylactic lesions,
  - Evaluate response to intervention.
- Screening can be incorporated with monthly foot checks and pain assessments.



Calciphylaxis Screening and Assessment Tool

Patient Name: _____

Date: _____

Risk Factors

- ☐ End stage renal disease
- ☐ Diabetes
- ☐ Obese (BMI ≥ 30)
- ☐ Caucasian
- ☐ Female
- ☐ CaXPo4 > 70
- ☐ Hyperphosphatemia
- ☐ Hypercalcemia
- ☐ Hyperparathyroidism
- ☐ Hypoalbuminemia
- ☐ Use of calcium based binders
- ☐ Use of Vitamin D or Vitamin D analog
- ☐ Current use of Coumadin
- ☐ Current or past diagnosis of calciphylaxis

PEG Pain Screening

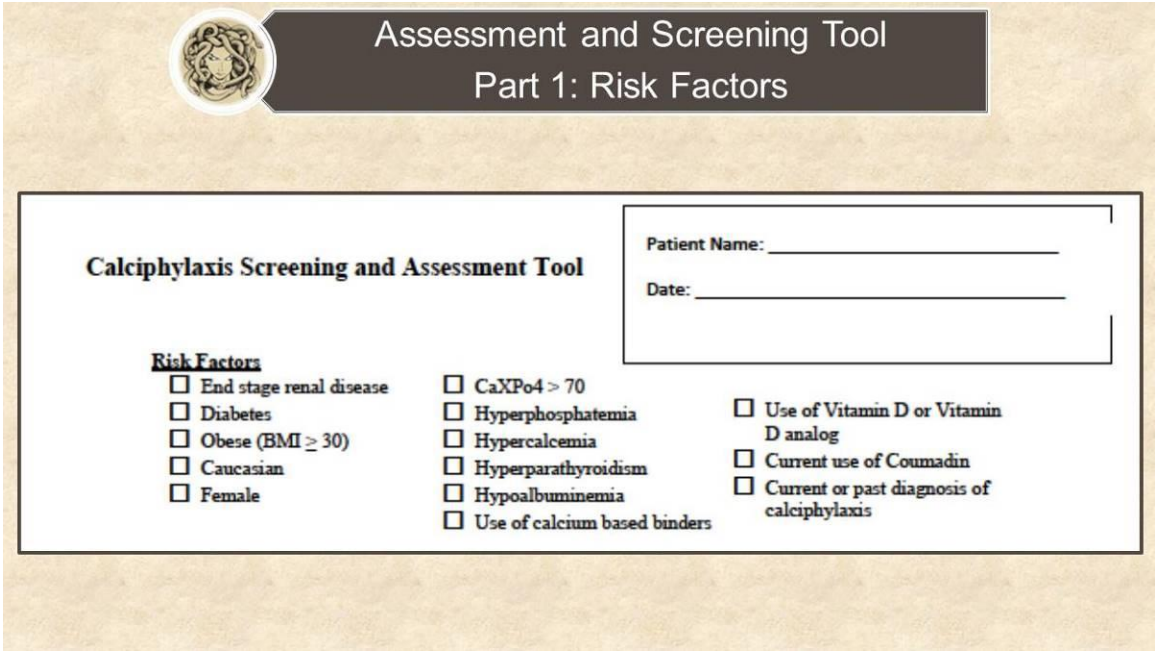
Directions - Ask the patient the following three questions and enter the response in the box. Compute the final PEG score by adding the three patient responses and divide that score by three.

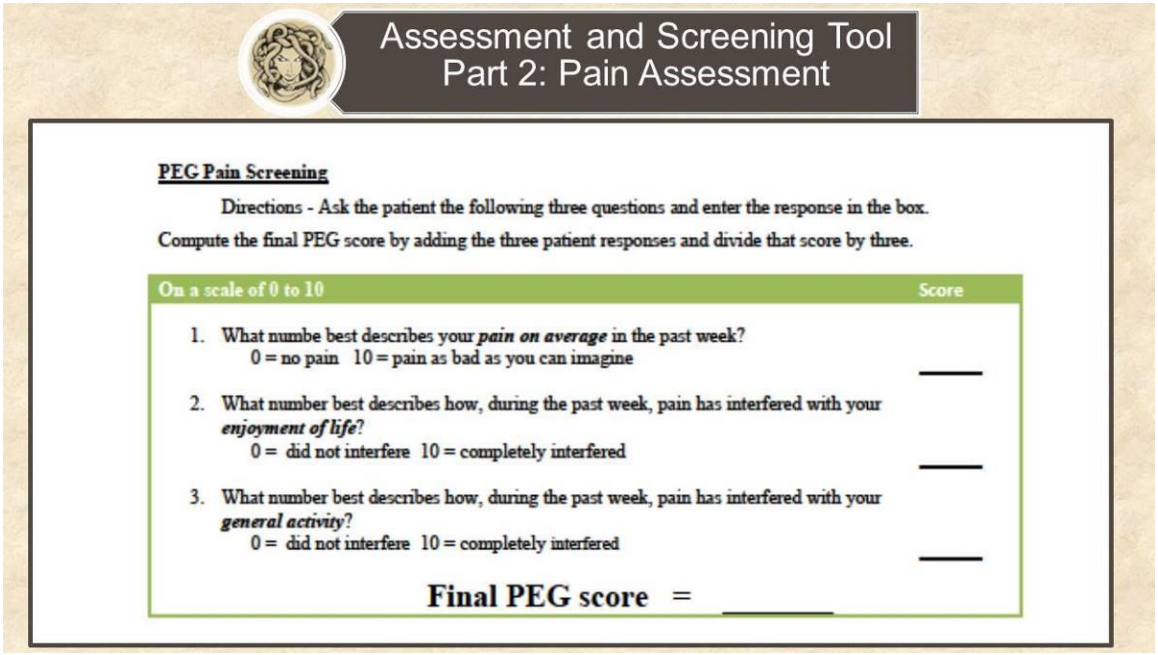
On a scale of 0 to 10	Score
1. What number best describes your *pain on average* in the past week? 0 = no pain 10 = pain as bad as you can imagine	____
2. What number best describes how, during the past week, pain has interfered with your *enjoyment of life*? 0 = did not interfere 10 = completely interfered	____
3. What number best describes how, during the past week, pain has interfered with your *general activity*? 0 = did not interfere 10 = completely interfered	____
Final PEG score =	____

Skin Assessment

Directions – Note the location and size of any skin lesions on the body diagrams below

Skin Lesion	Symbol	Associated with Pain? Y or N
Palpable nodule	⬭	
Livedo reticularis Livedo racemosa	∿	
Erythematous patches	⊕	
Ulcerations	●	


Assessment and Screening Tool
Part 1: Risk Factors
Calciphylaxis Screening and Assessment Tool
Patient Name: _____
Date: _____
Risk Factors
End stage renal disease
Diabetes
Obese (BMI ≥ 30)
Caucasian
Female
CaXPo4 > 70
Hyperphosphatemia
Hypercalcemia
Hyperparathyroidism
Hypoalbuminemia
Use of calcium based binders
Use of Vitamin D or Vitamin D analog
Current use of Coumadin
Current or past diagnosis of calciphylaxis

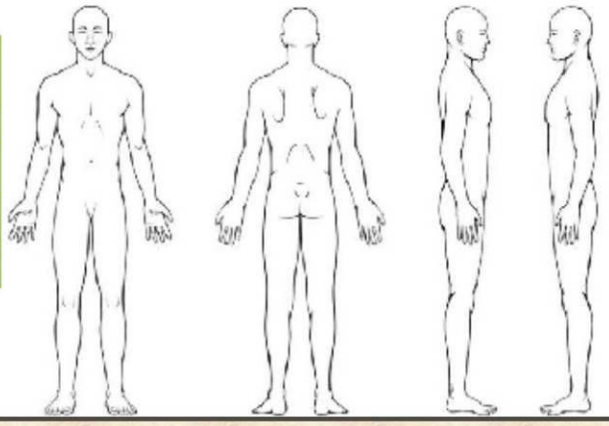

Assessment and Screening Tool
Part 2: Pain Assessment
PEG Pain Screening
Directions - Ask the patient the following three questions and enter the response in the box.
Compute the final PEG score by adding the three patient responses and divide that score by three.
On a scale of 0 to 10
Score
1. What numbe best describes your pain on average in the past week?
0 = no pain 10 = pain as bad as you can imagine
2. What number best describes how, during the past week, pain has interfered with your enjoyment of life?
0 = did not interfere 10 = completely interfered
3. What number best describes how, during the past week, pain has interfered with your general activity?
0 = did not interfere 10 = completely interfered
Final PEG score =

Assessment and Screening Tool Part 3: Skin Assessment

Skin Assessment

Directions – Note the location and size of any skin lesions on the body diagrams below

Skin Lesion	Symbol	Associated with Pain? Y or N
Palpable nodule		
Livedo reticularis Livedo racemosa		
Erythematous patches		
Ulcerations		



Clinical Pearls

- Calciphylaxis is a diagnosis with a dismal prognosis
- Calciphylaxis is a rapidly progressive disease process
- Early recognition is important to direct treatment and improve outcomes
- There should be a high index of clinical suspicion for early and accurate diagnosis of calciphylaxis
- Severe pain is an important clinical symptom
- Mortality rate of 80% is associated with ulcerative lesions
- Sepsis most common cause of death
- Disturbances of calcium and phosphorus metabolism found to be risk factors
- Skin biopsy can worsen the lesion and should not be performed routinely

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Appendix D: ANNA Abstract Form

AMERICAN NEPHROLOGY NURSES ASSOCIATION
ABSTRACT FORM

Instructions

1. Organize the body of the abstract as follows: Briefly state the topic or problem to be described; describe the topic or the approach to the problem; present the information about the topic or the solutions and/or conclusions; and state the implications/relevance of the topic or solutions to the nephrology patient and/or nurse. Please see the scoring criteria used for research and non-research abstracts at the bottom of this form.
   - The use of standard abbreviations is desirable. Use kg, ml, %, etc. Place unusual abbreviations in parentheses after the full word the first time it appears. Use numerals to indicate numbers, except to begin a sentence. For therapeutic options/drugs, use only generic names.
   - Do not identify locations, authors, companies and/or products in the body or title of the abstract.
   - Each author's full name, credentials, employer, and home city/state must be listed in the abstract box. List the presenter's name and information first. Allow one (1) line after the body of the abstract before listing this information.
2. You must create both a blinded and unblinded version of this form for submission. The unblinded version contains ALL requested information. The blinded version omits all identifying information (names, locations, etc). To blind this form for review, delete the information on the bottom of this page and delete all author names and identifying information in the abstract box. Then, save the document as a new file.

This abstract is a		The preferred format for my abstract presentation is		
Research Project	☐ Yes ☒ No	☐ Verbal	☒ Poster	☐ No preference
CQI Project	☐ Yes ☒ No	**Upon completion of this presentation, the participant will be able to: (List one measurable objective)**		
Clinical Paper	☐ Yes ☒ No	Utilize the calciphylaxis risk assessment and screening tool in clinical practice.		
Other	DNP Project			
An award is given to the top-rated RESEARCH abstract.				

Please provide a few keywords that will identify the focus of your abstract. calciphylaxsis, calciphylaxis screening, calciphylaxis risk, calcific uremic arteriolopathy (CUA)

Abstract Box (The abstract title, abstract, and all author information must be typed in this box. The length cannot exceed a total of 2,300 characters, including spaces.)

Development of a Calciphylaxis Risk Assessment and Screening Tool to Assist in the Identification of Primary and Secondary Calciphylasix Lesions

The Problem: Calciphylaxis, primarily seen in the end stage renal disease (ESRD) population, is a systemic disease process that carries a high mortality rate. In its late stages, the symptom burden can negatively impact the patient's health related quality of life. There are very few random controlled trials to inform treatment.

Approach to the Problem: Despite this lack of evidence, the literature clearly supports the need for routine screening, early diagnosis, and prompt treatment to improve outcomes on an individual and population level. The literature, however, does not provide any evidence or clinical screening tools to inform practice.

Purpose of Presentation: The focus of this DNP project was to address this practice gap by developing a calciphylaxis risk assessment and screening tool (the tool). Designed to be an extension of the monthly foot inspection and pain assessment, the tool can easily be integrated into the dialysis routine with minimal disruptions in workflow .

Implications for Practice: The tool can be used as an interdisciplinary approach to achieve early intervention by empowering nephrology nurses to assume a proactive leadership role in calciphylaxis disease management. The nurse leader, collaborating with the ESRD patient and interdisciplinary team can develop a patient centered plan of care aimed at reducing disease burden, enhancing quality of life, and ultimately improving population health.

Dissemination: The tool was presented to a group of nephrology staff as part of the DNP project. Feedback has been positive. As the incidence of calciphylaxis increases, the need for routine screening is evident. The tool is now being offered to the nephrology community to be further developed, validated, and implemented into practice.

The title and author names will appear in the National Symposium program book exactly as they appear above.

Scoring the Non-Research Abstract	Scoring the Research Abstract
A blind review of the abstracts will be rated using the following criteria:	A blind review of the abstracts will be rated using the following criteria:
1. Is the topic important to nephrology nursing?	1. Is the problem/purpose clearly and concisely described?
2. Is the topic clearly described?	2. Is the sample characteristic adequate?
3. Is the topic of informative value?	3. Is the design/method/technique appropriate?
4. Is the purpose and/or outcome readily evident?	4. Are the results described accurately from the data?

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	5. Are implications/relevance clearly stated or realistic?
	6. Is there consistency between findings and conclusions?
	7. Overall appearance.

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Appendix E: ANNA Abstract Acceptance Letter

2/4/2018 2018 ANNA National Symposium Abstract Submission Results

From: LouAnn Leary [redacted]
To: [redacted]
Subject: 2018 ANNA National Symposium Abstract Submission Results
Date: Fri, Dec 15, 2017 2:45 pm
Attachments: Pennington Confirmation Letter.docx (672K), 03 Poster Abstract Guidelines.docx (119K), 02 Speaker Disclosure Form.docx (122K)

Hello Janice ~ Congratulations! The 2018 National Program Committee is pleased to announce that your abstract has been accepted for a poster presentation at ANNA's 49th National Symposium, to be held April 15-18, 2018 in Las Vegas, NV. Attached are the following documents with details regarding your poster presentation.

1. Confirmation Letter
2. Speaker Disclosure Form ~ return to Lou Ann Leary, louann.leary@annanurse.org, by **February 16, 2018**
3. Poster Abstract Guidelines

Please confirm receipt of this email and also let me know if you have any questions. Thank you and again, congratulations! We look forward to seeing you in Las Vegas!

Lou Ann Leary
Director of Membership Services
American Nephrology Nurses Association
856-256-2336, 888-600-2662 x22

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