CHUNG, SHERNETT M., Ph.D. Establishing the Suitability of an Instrument that Determined Advanced Practice Registered Nurses' Baseline Knowledge of Chronic Kidney Disease Practice Guidelines. (2021)
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**Background:** Chronic kidney disease (CKD) is the eighth leading cause of US deaths, requiring dialysis or kidney transplant at end-stage. Poor knowledge of CKD among physicians and patients contributes to early deaths and avoidable complications, but non-Nephrology adult health Advanced Practice Registered Nurses (APRN) have not been studied similarly, although they are important in addressing the physician shortage. **Objective:** This study examined a 15-item instrument that was designed to assess physicians' knowledge of CKD practice guidelines, for its suitability with non-nephrology APRNs. **Methods:** An online survey of APRNs (n = 254) was administered over a three-week period. Exploratory Factor Analysis (EFA) examined the factor structure and the relatedness of the items to the derived factors and Pearson's Chi-square test of independence examined associations between scores and the APRN descriptors. **Results:** Cronbach's alpha was .71 overall, and below .69 for the subscales. The EFA five-factor solution explained 52% of the variance. There were statistically significant ($p < .05$) associations between the scores (M = 29.44, SD = 6.26) and descriptors. Over 55% of the APRNs worked in specialty areas outside of Internal and Family Medicine, did not practice independently, and relied on team members to handle complex cases like CKD. **Conclusion:** The Physicians' instrument had excellent face validity. It was inadequate for determining baseline knowledge of CKD practice guidelines among APRNs in this study, the majority of whom reported that they did not diagnose or treat CKD cases, hence there was no need for them to have an in-depth knowledge of CKD guidelines. Based on the results, an unvalidated 12-item alternative scale was developed for non-Nephrology APRNs practicing outside of primary care, to demonstrate that knowledge of the

guidelines can be assessed without complex CKD-specific jargon, staging, and laboratory values. The findings can inform Nursing Education curricula and generate nursing research and instrument development that targets APRNs.

*Keywords:* Advanced Practice Registered Nurse, chronic kidney disease, CKD Belt, content analysis, exploratory factor analysis, knowledge of CKD practice guidelines, Knowles' theory of adult learning, parallel analysis

# ESTABLISHING THE SUITABILITY OF AN INSTRUMENT THAT DETERMINED ADVANCED PRACTICE REGISTERED NURSES' BASELINE KNOWLEDGE OF CHRONIC KIDNEY DISEASE PRACTICE GUIDELINES

by

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Approved by

Dr. Eileen Kohlenberg
Committee Chair

# DEDICATION

For my husband whose unconditionally boundless support and understanding, has made it possible for me to complete this work. You have always put me and my needs above yours, and you have tirelessly picked me up too many times to count. I know you can sense my heartfelt gratitude. Thank you, Peter.

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APPROVAL PAGE

This dissertation written by Shernett M. Chung has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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# CHAPTER I: INTRODUCTION

## Background

*Chronic kidney disease* (CKD) is three or more months of physical or functional changes to the kidneys, that can affect one's health (KDIGO, 2013). It is further defined by biomarkers of kidney function or damage, over the same time period (KDIGO, 2013). It is a global burden (GBD, 2020) that exacts physical (Lee & Tsai, 2020; Lin et al., 2017; Lin et al., 2018; Liu et al., 2019; Yang et al., 2018) and psychological suffering (DaVita, 2021a; Huang, 2020; Shirazian et al., 2017; Wang et al., 2019) in individuals and causes personal and financial stresses (Hettiarachchi & Abeysena, 2018; Kim et al., 2017), while negatively affecting quality of life (Legrand et al., 2020; Nguyen et al., 2017; Wang et al., 2019). Individuals can suffer from kidney disease for several years without exhibiting any symptoms (Centers for Disease Control and Prevention [CDC], 2019; NKF, 2019; NKF, 2020), and by the time they become symptomatic, it is often too late to prevent serious complications. Kidney disease is the eighth leading cause of death (CDC, 2020a) with diabetes and hypertension being the primary and secondary causes of CKD, respectively (CDC, 2019; NKF, 2019). Complication and progression of CKD can result in kidney failure: permanent kidney damage that requires renal replacement therapy— kidney transplant, hemodialysis, or peritoneal dialysis—for survival. The term kidney failure is sometimes used interchangeably with end-stage renal disease (ESRD).

### CKD Practice Guidelines

> Clinical practice guidelines are … used in health care to improve patient care and as a potential solution to reduce inappropriate variations in care. Guidelines should be evidence-based as well as based upon explicit

criteria to ensure consensus regarding their internal validity. (United States Department of Veterans Affairs [USDVA], 2015a)

CKD *practice guidelines* or *clinical practice guidelines* in this study are referenced from Kidney Disease Improving Global Outcomes (KDIGO) and National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF KDOQI™), international and national organizations, respectively, that produce evidence-based chronic kidney disease practice guidelines. Their work groups convene (separately) regularly to update sections of their respective guidelines that reflect the changing science; some sections like the definition of CKD have not changed in a long time. The definition of CKD is a very important aspect of the guidelines because its narrow but medically sound meaning helps to prevent misdiagnoses and reduce delays in addressing the disease.

**Health Disparities**

Health disparities should not be overlooked in any discussion on CKD. African Americans, Native Americans, and Hispanics are more prone to developing ESRD than Caucasians (CDC, 2019). In a 19-year initiative (from 2000 to 2019) by the National Institutes of Health (NIH), the National Kidney Disease Education Program (NKDEP) established interventions and provided education to reduce CKD progression within vulnerable racial and ethnic groups (NIDDK, n.d.-a). During that time African Americans, Hispanics, and Native Americans, were 4, 1.3, and 1.2 times respectively, more likely to progress to renal failure (NIDDK, 2021), and they are still the groups most affected by CKD and ESRD (CDC, 2019). During the course of the initiative, African Americans were specifically targeted with educational programs that included *Kidney Sundays*, *Sisters Together*, and *Family Reunion Kidney Health Guide*; Spanish and English versions remain available (NIDDK, n.d.-b).

Adult African Americans represent 35% of the total number of cases of renal failure in the United States (US)—the most for a single group (NKF, 2021)—but only comprise about 13% of the total US population (United States Census Bureau [USCB], 2019). Contributing to this health disparity is the fact that hypertension and diabetes are the main causes of renal failure within the African American community (CDC, 2019). African Americans with diabetes tend to develop hypertension six times more than Caucasians and are about four times more likely to develop kidney failure, than Caucasians (CDC, 2019). In 2018, the 66 and older age group's hospitalization and hospital encounter rates for African Americans with CKD (1,458 per 1,000 person-years) exceeded Caucasians' 1,240 person-years (USRDS, 2020a).

As CKD and its comorbidities like diabetes and cardiovascular disease progress, illness severity results in increased hospitalization, re-hospitalization, and death at higher rates among African Americans than in similar groups within the general population without CKD (USRDS, 2020a). The disease has garnered attention from the federal government and numerous national healthcare bodies in an effort to address the societal and individual burdens. As a result, considerable efforts have been initiated to: (a) defray the cost of care; (b) raise awareness through education; (c) reduce health disparities, incidence, prevalence, morbidity, and mortality; and (d) increase the number of individuals who are aware of their kidney function status. Primary care providers (PCP) are also the focus of attention because they are expected to play an important role in educating patients, being cognizant of quality indicators, providing competent care, and adhering to evidence-based practice guidelines that ultimately address CKD issues. However, there is a scarcity of physicians—the largest group of primary care providers in the US.

Due to the growing physician shortage in the US (Griffith et al., 2021; Zhang, et al., 2020) and the high incidence and prevalence rates of CKD, APRNs could soon be seeing more cases. They compare well to physicians on several documented metrics (Jackson et al., 2018; Kuo et al., 2015; Kurtzman & Barnow, 2017) and their numbers have increased steadily, boasting a 75% increase in the last 20 years (AANP, 2020a). Determining their knowledge of the CKD guidelines would be helpful in addressing the disease, but a literature search of instruments to determine CKD knowledge for APRNs for the last five years yielded no results, although dated physician studies with various instruments were found. Since those instruments were not developed for or previously used in APRN studies, the suitability of the selected one will need to be checked first.

## Purpose

The main purpose for conducting this study was to establish the suitability of the instrument that was used to determine APRNs' baseline knowledge of chronic kidney disease (CKD) practice guidelines, using an instrument that was designed for physicians. Establishing the suitability of the instrument has the potential to generate a wealth of foundational information that can inform future studies.

## The Problem

The problem is that there is no validated instrument to study knowledge of CKD guidelines among non-Nephrology APRNs. They need to be studied similarly to physicians since both groups are sources of primary care who will likely see patients with CKD during a time when the disease is a problem for patients, and because physician studies continue to find that the latter is deficient in knowledge of various aspects of the practice guidelines.

### Current APRN Study

This is the first known study of its kind wherein non-nephrology adult health APRNs' baseline knowledge of CKD practice guideline is determined in an effort to assess the suitability of the instrument used. Also notable is a lack of literature on the subject. For this study, knowing the survey scores are not as critical as evaluating the suitability of the instrument, but based on the evidence that knowledge of CKD is deficient among patients and physicians, an approach that allowed some learning and exposure to aspects of the disease was thought to be beneficial to the APRNs. An *educate and assess* style using Knowles' Adult Learning Theory, where the APRNs were expected to simultaneously use what they learn in this study, along with their professional experiences to make inferences and respond to the survey items, guided this research. Furthermore, they were expected to seek additional information about CKD after the study ended, as a result of their readiness to learn and internal motivation (Knowles', 1984). The study is approached from the perspective that anything learned about CKD will be beneficial and can have far-reaching effects on not just the APRN participants, but everyone who is exposed to this study. As in many chronic illnesses, there are several simple actions that healthcare providers and their patients can take at any stage of the CKD disease process, to delay complications.

## Background and Significance

### Justification for the Study

In light of the CKD problems that disproportionately affect minorities and health care deserts in the US, it is reasonable to expect that non-Nephrology APRNs would contribute to addressing said problems (like their physician counterparts) as a result of their increasing

numbers and documented competence as healthcare providers. However, no studies were found to support that point, although the majority of APRNs are trained in the primary care role.

A literature search of the following yielded no results: non-Nephrology APRNs' baseline knowledge of CKD practice guidelines, and issues surrounding their preparedness to address the growing CKD problem, although those issues are widely studied among physicians—the largest group of primary care providers. None of the selected studies (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Estrella et al., 2012; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013) that examined physicians' knowledge of CKD guidelines was overwhelmingly demonstrative of a firm knowledge of said guidelines, none investigated identical aspects of the guideline, and none of them used similar tools, however, they all relied on the National Kidney Foundation's (NKF) Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines. Physicians were hardly aware of some key aspects of the guidelines, like recognizing risk factors for CKD and when to refer patients for specialist care.

This study is necessary because little is known about APRNs' knowledge of the CKD practice guidelines due to a lack of peer-reviewed studies on the subject. It is important for APRNs' CKD knowledge to be determined since it is highly likely that they will be encountering patients with or at risk for CKD, given that its incidence, prevalence, morbidity, and mortality are problematic for about 37 million Americans, disproportionately affecting minorities and people living in the southeastern part of the US. Although APRNs have a record of health care delivery that is comparable to physicians' it is fair to assume that both groups are similarly deficient in CKD knowledge, especially since physician studies have not determined conclusively, the reason for that knowledge deficit. The literature suggests that overall, physicians lack awareness in certain aspects of CKD (Agaba et al., 2012; Agrawal et al., 2009;

Choukem et al., 2016; Estrella et al., 2012; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013).

**Advanced Practice Registered Nurses**

APRNs provide patient care according to the scope of their licenses, which is regulated by their respective State Boards of Nursing. Of this growing population, Certified Nurse Practitioners (CNPs)—also known as Nurse Practitioners (NPs)—represent the largest of the following four groups: (1) Certified Registered Nurse Anesthetists (CRNA), (2) Certified Nurse Practitioners (CNP), (3) Certified Nurse-Midwives (CNM), and (4) Clinical Nurse Specialists (CNS): a highly skilled and qualified group of health care providers with an annual increase in their numbers. NPs have been instrumental in meeting the health needs of rural North Carolinians, having achieved a 187% increase in employment over a 17-year (2000-2017) timespan (Spero & Galloway, 2019).

In 2019, about 270,000 NPs, most (89%) with a primary care background in Family, Adult and Geriatrics, Women's Health, and Pediatrics worked in the US. That number continued to rise in 2021 to over 325,000 (AANP, 2020a). They have established cost-effective patient care (Perloff et al., 2015; Poghosyan et al., 2019) that is comparable to physicians' (Barnes et al., 2018; Fraze et al., 2020). Support for allowing APRNs complete autonomy and full practice authority maintains that lower consumer cost with high-quality care is beneficial to the health system (Conover & Richards, 2015; Poghosyan et al., 2019). Allowing full practice authority has the potential to increase the number of APRNs in medically underserved communities nationwide, with the possibility of more patients being served.

### *Healthcare Reform and APRNs*

With more states granting full practice authority to APRNs (AANP, 2021) and healthcare reform still unfolding, APRNs are expected to continue to make significant contributions to healthcare, considering their continued surge in number (AANP, 2020a). Most APRNs are trained in the primary care provider role which allows them to work in various specialties (AANP, 2020b). Their importance to healthcare is recognized and emphasized by the Patient Protection and Affordable Care Act (PPACA) (2010), which in part, proposes several benefits to nursing to alleviate the shortage of primary care physicians: student loans and nurse-managed health clinics, to name a few. Ten years after its inception, over 29 million Americans had acquired health insurance under the PPACA (Tolbert et al., 2020), causing more people to access the health system in which physician shortages were already a problem.

APRNs' make high-quality contributions to patient care (Buerhaus et al., 2018; Rantz et al., 2018) with no difference in performance when compared to physicians (Jackson et al., 2018; Kuo et al., 2015; Kurtzman & Barnow, 2017). Examining their baseline knowledge of CKD practice guidelines is important because it provides insight into possible inclusionary topics for instrument development that will target non-nephrology practitioners, while satisfying the Healthy People goals and objectives for CKD. However, such an instrument does not exist because APRNs' baseline knowledge of CKD guidelines was not studied up to the time of this research. A 15-item instrument that was created for physicians was used instead, but since it was not used outside of that study, it was necessary to establish its suitability for use in this study with APRNs.

## Theoretical Framework

Knowles' Adult Learning Theory guided this research which established the suitability of the Physicians' questionnaire that determined APRNs' baseline knowledge of CKD practice guidelines. Based on peer-reviewed medical studies that consistently showed that physicians lack knowledge on the guidelines, reference to online sources concerning said guidelines were provided to the APRNs at the end of the survey, despite their scores on the test (baseline knowledge). The expectation was that they would access the sources to increase their awareness through informal self-directed learning on their own time after the survey. It would have been unethical not to share the information with the nurses since it had the potential to increase their CKD awareness and knowledge, and directly affecting their practice and patients' health outcomes. Due to the evidence that many individuals lack knowledge of CKD, this author attempted to *educate while assessing*, by including CKD information before asking questions. Passive learning can have a longer lasting impact than a task-oriented, active learning session. Because of the learning opportunity that this study presented to the APRNs, an adult learning theory—Knowles' Theory— was appropriate to guide the research.

### Malcolm Knowles' Adult Learning Theory

The theoretical framework guiding this study is based on andragogy—educating adults. Knowles' (1980) adult learning theory recognizes the learners' ability and need to be self-directed while relying on their life experiences and aspirations. Adults can use their various life experiences as frames of reference for how and what they learn. This quality is what creates camaraderie among adult learners and helps to keep them engaged and actively participating in their own learning (Jackson & Caffarella, 1994). Those are the main characteristics that set adult learners apart from non-adult learners. Knowles referred mainly to the classroom setting in his

writings, but for this study, an online environment replaced the classroom, further recognizing the responsible nature of the nurses to take charge of their own learning.

This study was designed on the premise that APRNs are self-directed learners who keep abreast of the latest developments in healthcare, and therefore would take advantage of a self-assessment on CKD practice guidelines. It was also expected that their intellectual curiosity and individual performance on the self-assessment would motivate them to seek further information after the survey ended, by following the provided hyperlinks to two CKD practice guidelines. Attempting to educate the APRNs about CKD while assessing them was an ambitious intent of this study. Andragogy learning theory proposes the following five assumptions that pertain to the learner: (1) self-concept, (2) experience, (3) readiness to learn; (4) "life-centered, task-centered, or problem-centered orientation to learn" Knowles, 1984, pp. 11-12); and (5) motivation (Knowles, 1984). Knowles acknowledged the influence of other scholars' work in the development of his theory and has even admitted that he might not have conceived a theory, but a "system of concepts" (1984, p. 8).

### *Application of Andragogy Constructs*

**Learner's Self-concept.** Adults need to be able to dictate the conditions of their learning experience as reflected in the APRNs' decision to participate in optional activities that could enhance and satisfy their professional practice and curiosity. The nurses were invited to participate in the study to determine their baseline knowledge of CKD practice guidelines and they had the right to leave the study at any time without being penalized. Because the online experience was self-paced, the length of time that each person spent on it varied according to his/her individual needs.

**Learner's Experience.** While participating in the online knowledge assessment of the practice guidelines, the APRNs were able to draw from their professional experiences and prior graduate studies in order to make inferences to select the appropriate responses. They were expected to integrate their experiential sources along with sound inductive and deductive reasoning to respond to the items on the questionnaire.

**Learner's Readiness to Learn.** The APRNs voluntarily chose to participate in the study, that was a potential career enhancer. They were expected to be fully engaged in assessing their own knowledge of CKD practice guidelines. Because of the professional stage of life in which they were, the APRNs already had taken on the role of self-directed learner in this study. Completing the questionnaire then accessing the online practice guidelines provided to them, demonstrated their readiness to learn and kept them further engaged in the process. This was confirmed when they provided feedback about what they learned and how they planned to use that information in their practice. Attempts to access the online sources demonstrated their readiness to learn, keeping the APRNs further engaged in the learning process.

**Life-centered, Task-centered, or Problem-centered Orientation to Learn.** The specific focus for the aim of the study was to establish the suitability of the instrument that determined APRNs' baseline knowledge of CKD practice guidelines. They were provided with questionnaire items that specifically targeted areas of CKD practice guidelines, using relatable scenarios that were based on realistic clinical situations (problem-centered orientation to learn). This is synonymous with Knowles' suggestion that adults learn because they need to apply that specific knowledge to a predetermined condition that directly pertains to their lives (Knowles, 1984). This life-centered assumption was related to positive and negative experiences that were not just limited to their professional work.

**Learners' Internal Motivation.** APRNs have professional pride (internal motivation) and engage in tasks like voluntary participation in a study to assess their knowledge of CKD practice guidelines. Because they are expected to keep abreast of practice updates post-graduation (external motivation), some APRNs might satisfy the requirements, but will not be overly motivated since there is little personal satisfaction in doing that (Knowles, 1980). The APRN's motivation to succeed professionally was expected to drive his/her need to fulfill a knowledge deficit related to the practice guidelines. Knowles (1984) asserts that an adult's internal motivation far outweighs his/her external motivation.

## Specific Aims and Research Questions

### Aim #1

Determine the factor structure of the instrument that determines CKD knowledge.

#### *Research Question 1*

Are the extracted underlying dimensions (factors) distinguishable from each other?

#### *Research Question 2*

The following 10 areas of knowledge of the CKD guidelines were cited in the original study: definition, classification, risk factors, laboratory evaluation, management, indications for referral to nephrologist, complications, management of bone and mineral disorder, management of anemia, and medications used (Agrawal et al., 2009). Are the extracted factors representative of the aforementioned areas?

### Aim #2

Assess the psychometric properties of the questionnaire that determined CKD knowledge.

***Research Question 3***

Which attributes of the instrument contribute to its suitability for assessing APRNs' knowledge of the CKD practice guidelines?

***Research Question 4***

Does the instrument have the ability to discriminate across groups of participants?

**Aim #3**

Modify the instrument to improve its suitability for determining APRNs' baseline knowledge of CKD practice guidelines.

***Research Question 5***

How can the instrument be modified so that it will be more suitable for use with the participants?

**Short-response Survey Questions**

***Short-response #1***

If you are aware of any clinical practice guideline for chronic kidney disease (CKD), please state it/them.

***Short-response #2***

If you are not up to date on CKD clinical practice guidelines, please list the top two barriers that prevent you from keeping up to date.

***Short-response #3***

Now that you have completed the exercise, what are the top three things that you will change and/or incorporate in your practice, as they pertain to chronic kidney disease practice guidelines?

## Definitions

1. Adult learner: the Advanced Practice Registered Nurses (APRN) in this study that is guided by Knowles' adult learning theory. In the study, adult learners are selected from two specific categories—Certified Nurse Practitioner (CNP) and Certified Nurse-Midwife (CNM)—from a database provided by the NC Board of Nursing.
2. Advanced Practice Registered Nurse: ". . . registered nurses educated at Masters or post Masters level and in a specific role and patient population. APRNs are prepared by education and certification to assess, diagnose, and manage patient problems, order tests, and prescribe medications" (NCSBN, 2021, para. 1). The APRN participants in this study are CNPs and CNMs.
3. Andragogy: ". . . the art and science of helping adults learn" (Knowles, 1980, p. 43). This study uses Knowles' (1984) five assumptions of adult learners to deliver an informative component to APRNs so that they can become more familiar with CKD practice guidelines.
4. Chronic kidney disease: three or more months of physical or functional impairment that can affect health (KDIGO, 2013).
5. CKD Belt: a term that this study has coined to describe the disease prevalence within the southeastern region of the US.
6. Dialysis: the process that is required to take over the normal waste-filtering function of the kidneys when healthy kidneys fail to function effectively to sustain life. The dialysis data used in this study refers to hemodialysis and peritoneal dialysis.
7. Early referral: (also called *timely referral*), it is referring a patient with CKD to a nephrologist, at least 12 months before a kidney transplant or beginning dialysis. Two goals

of early referral are to delay progression of kidney impairment or to undo the damage that is already done (KDIGO, 2013).

8. End-stage renal disease (ESRD): Also known as kidney failure (NIDDK, 2018), the most common meaning of ESRD is the fifth of five stages of CKD in which dialysis or transplantation is required to prolong life (KDOQI, 2015). A less common meaning of ESRD follows: "*End-stage renal disease* is an administrative term in the United States. It indicates that a patient is treated with dialysis or transplantation, which is the condition for payment for health care by the Medicare ESRD Program" (Levey et al., 2003, para. 1).
9. Estimated glomerular filtration rate (eGFR): an estimate of kidney function based on a mathematical calculation that takes the serum creatinine (SCr) into consideration, to increase the accuracy of prediction based on an individual's characteristics like body surface area (1.73 $m^2$), race (black or white), age, and gender. Two ways of determining the eGFR are the: (1) Modification of Diet in Renal Disease (MDRD) Study equation and (2) Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equations.
10. Glomerular filtration rate: The actual measure of kidney function status, with the following units: ml/min/1.73 $m^2$. The numerical ranges and their descriptions as described by KDIGO (2013) follow: The units are omitted below for ease of reading.
    - $\geq$90: normal or high
    - 60-89: mildly decreased
    - 45-59: mildly to moderately decreased
    - 30-44: moderately to severely decreased
    - 15-29: severely decreased
    - Less than 15: kidney failure

11. Knowledge of CKD guidelines: a demonstration of the APRN's ability to select the appropriate responses on the CKD questionnaire that covers recognition of risk factors, laboratory findings suggestive of CKD, and management and referral to a nephrologist, based on his/her awareness and understanding of the clinical practice guidelines.
12. Practice guideline; clinical practice guideline:

> Clinical practice guidelines are … used in health care to improve patient care and as a potential solution to reduce inappropriate variations in care. Guidelines should be evidence-based as well as based upon explicit criteria to ensure consensus regarding their internal validity. (United States Department of Veterans Affairs [USDVA], 2015a)

Field & Lohr (1990) also offer a definition for practice guidelines:

> Practice guidelines are systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances. … they describe clearly appropriate care, clearly inappropriate care, or care about which the scientific evidence and consensus are equivocal … When the evidence is extremely strong and professional judgment is virtually unanimous, the guideline may be treated as a standard of practice permitting few if any exceptions. When the evidence is equivocal, the guideline may only identify currently acceptable practice options. (pp. 38-39)

The CKD practice guidelines referenced in this study are from Kidney Disease Improving Global Outcomes (KDIGO) and National Kidney Foundation Kidney Disease Outcomes Quality Initiative (KDOQI, 2015).

13. Psychometric property: “An evaluation of the quality of an instrument, in which its measurement properties (i.e., its reliability, validity, and responsiveness) are estimated” (Polit & Beck, 2021, p. 799). In this study, the content and face validity and the internal consistency (reliability of the items) were assessed.
14. Questionnaire: “A written, or electronic instrument used to gather self-report data via self-administration of questions” (Polit & Beck, 2021, p. 800). In this study, the: *General Survey Form for APRNs* (see Appendix A), *Physicians' Questionnaire for Chronic Kidney Disease* by Agrawal et al. (2009) (see Appendix B), and the *Post-survey Form for APRNs* (see Appendix C) were the three questionnaires used. The words questionnaire, tool, instrument, and scale are often used interchangeably.
15. Renal replacement therapy: Kidney transplantation or any method of dialysis that is required to take over some functions of the kidneys to prolong individuals' lives.
16. United States region:
    - Northeast - Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania (USCB, 2016).
    - Midwest - Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota (USCB, 2016).
    - South - Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas (USCB, 2016).
    - West - Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, and Washington (USCB, 2016).

## Assumptions

Of particular importance to this study is the assumption that the participants will provide their own responses to the kidney disease questionnaire, rather than seek the information from existing guidelines and/or sources. It is also assumed that APRNs in this study will perform similarly to physicians in other studies that show poor knowledge of the CKD practice guidelines, although it is possible that their training and residency status in the *CKD Belt* could increase their scores. Similar to the purpose of the original instrument in its application to physicians, it is assumed that employing its use among the APRN group would be an adequate measure of relevant parts of CKD knowledge in the following areas: "definition … classification … risk factors … laboratory evaluation … management and clinical action plan … identification of complications … anemia … bone and mineral disorder … referral to nephrologist … and medication use" (Agrawal et al., 2009, p. 734).

### APRNs and CKD

This study assumed that APRN training programs in the southeastern United States region, commonly referred to as the *Stroke Belt*, have emphasized risk factors for stroke, including, but not limited to CKD and hypertension (also a risk factor for kidney disease). It was assumed that if APRNs in this study were aware of the stroke-hypertension-kidney disease connection, then it would have been likely for them to be knowledgeable of the CKD practice guidelines whether implicitly or explicitly learned.

## Summary

CKD causes personal, social, and financial burdens nationally and internationally, with a younger demographic acquiring the disease in the US, than in many other parts of the world. CKD and its main precursors, diabetes and hypertension, have been problematic to control over

the years, disproportionally affecting African Americans and other minority groups, along with poorer and rural Americans. APRNs' knowledge of the CKD guidelines is absent from the literature and so for this study, an instrument designed for physicians was used. Because APRNs and physicians have fairly indiscernible differences in their care of patients (Jackson et al., 2018; Kuo et al., 2015; Kurtzman & Barnow, 2017) it was surmised that the former could demonstrate poor knowledge of CKD practice guidelines, similar to the physician studies. However, because the study is being conducted in southeastern US, it is possible that the APRNs, especially if they were trained locally, are more aware of the high incidence and prevalence rates of CKD within the region and are better able to demonstrate this on their surveys.

# CHAPTER II: REVIEW OF THE LITERATURE

## Introduction

The main purpose for conducting this study was to establish the suitability of the instrument that was used to determine Advanced Practice Registered Nurses' (APRN) baseline knowledge of chronic kidney disease (CKD) practice guidelines. An instrument designed to determine physicians' knowledge of said guidelines was used because none existed for non-nephrology APRNs at the time that this research was conducted.

Ideally, if the information was available, this chapter would include and discuss non-nephrology APRNs' knowledge of CKD practice guidelines, performance of the instruments that were used in those studies, variables that were included, results of the studies and how those results have effected change in nursing. This chapter demonstrates the extent of the CKD problem that necessitates the study of APRNs' knowledge of the guidelines. Although there is no instrument to study that phenomenon, the focus of the study has to be on establishing the suitability of the instrument first.

### Distribution of CKD

Chronic kidney disease is a national public health problem. Of the roughly 328 million people who live in the US (USCB, 2019), approximately 37 million (11.3%) suffer from CKD, with about 747, 000 suffering from ESRD (NKF, 2020). As a result of the complexities and number of comorbidities associated with CKD, markedly less people have ESRD because individuals with CKD are up to 10 times more likely to die before advancing to ESRD (NKF, 2020; USRDS, 2020a). The 37 million people with CKD can be compared to the two most populous states, California and Texas, with 39.5 and 29 million residents, respectively (USCB, 2019). For such a fairly small segment (11.3%) of the US population (with CKD), a relatively

large percentage (22.3%) of the total Medicare expenditure for Parts A (inpatient), B (outpatient), and D (prescription) services are allocated to them (USRDS, 2020b). Considering though, that CKD is often accompanied by comorbidities (cardiovascular disease being the most common and the most expensive to manage [USRDS, 2020b; USRDS 2020c]) and that the complexity of the sequelae of diseases increase with time, the high cost is expected.

***Medicare Expenditure***

Tracking disbursements in this fee-for-service payment model works because ESRD is not included as it is billed differently than CKD (USRDS, 2020b). Recall that ESRD requires dialysis or kidney transplant for survival. In 2018, of the $363.7 billion Medicare expenditure, $81.8 billion was allocated to patients with a CKD diagnosis (not including ESRD), costing $25,769 and $38,743 per person per year to care for the 66 and older and the under 66-year-old groups, respectively, with Parts A, B, and D coverage (USRDS, 2020b).

Despite their age, individuals with CKD are hospitalized at approximately three times the rate of those without CKD (USRDS, 2020d). While the youngest and oldest persons with CKD tend to incur more charges overall, it is hospitalization across all groups that accounts for $23.3 billion: the majority (33%) of all Medicare spending for those with a CKD diagnosis (USRDS, 2020b). For the 66 and older age-group, however, hospitalization rate increases with an increase in age among Medicare subscribers with CKD. Re-hospitalization in a fee-for-service payment plan can dramatically increase the cost of CKD care, especially since it is common (22.6% in 2018) within the first 30 days of discharge within the CKD population: the frequency of which increases with advanced CKD stages in the presence of diabetes and cardiovascular disease (USRDS, 2020d). Thirty-day rehospitalization rates were higher for ESRD (31.1%) that CKD (23.2%) in 2018 with most of the causes being directly related to dialysis: vascular access

infections, heart failure (fluid overload), and hyperkalemia (USRDS, 2020e). Additional exorbitant costs are avoided because of the *Hospital Readmissions Reduction Program* which encourages a discharging hospital to provide outstanding care to a patient to prevent rehospitalization (to any hospital) within 30 days of a discharge, as the basis for Medicare payment (CMS, 2020a). Payment based on quality of care rather than volume of care has been the focus of Medicare.

Individuals with ESRD often require inpatient care and the cost of each stay usually increases to account for its comorbidities. Total Medicare expenditure for ESRD in 2018 was $507.9 billion (USRDS, 2020e). From a healthcare economics perspective, chronic kidney disease is not just one disease, but two distinguishable *diseases* with different billing structures. From a pathophysiological standpoint, however, end-stage renal disease is simply the final stage of the chronic disease process. Considering those two ideas, it is important to note the significance of Medicare's role in ESRD. Only a few chosen individuals received life-saving dialysis treatment in the 1960s when it was first introduced: its use being limited by its affordability (Ball, 1973). The Social Security Act was modified in 1972 to provide federal health benefits to significantly more people. Public Law 92-603, section 299I (P.L. 92-603, §299I) made it possible for anyone in the general population with ESRD, at any age (not just those aged 65 and older) to receive benefits for kidney transplant or dialysis (Ball, 1973). ESRD, and decades later, amyotrophic lateral sclerosis (Lou Gehrig's disease) are the only two diseases that do not require the usual lengthy (up to 24 months) waiting period prior to receiving benefits (CMS, 2020b).

**Global Impact of CKD**

The burdens caused by CKD are not limited to Americans. Chronic kidney disease is also a global public health problem that poses even greater issues for nations which have more restrictive budgets and fewer resources to spend on terminal illnesses (Agaba et al., 2012; USRDS, 2020f). Voluntarily reported data from about 40 international regions show that the majority of CKD cases are caused by diabetes, with most of the incident counts occurring in the 75 and older age group: It is a natural phenomenon that in the elderly, the glomerular filtration rate (GFR) decreases (reduced kidney function) with increasing age due to aging kidneys, even in the absence of kidney disease (KDIGO, 2013).

Only Japan and one Mexican state, Aguascalientes outpaced the US in the incident cases of ESRD within the 20-44 age group with 653, 388, and 145 per million population, respectively (USRDS, 2020f). Without knowing the underlying factors though, it is still reason for pause that US residents are developing end-stage kidney disease at a much earlier age, than the expected *old age* compared to most of the reporting countries.

For almost all of the reporting regions and the US, in-center hemodialysis was the preferred method of dialysis over peritoneal dialysis, with Hong Kong being the only region in which more than half (69%) received peritoneal dialysis over hemodialysis (USRDS, 2020f). Generally, the rate of kidney transplantation is poor worldwide with two reporting regions performing more than the US per million population and relying more on living than deceased donors: Aguascalientes, Mexico (128) and Kazakhstan (82) to the US's (68) transplants (USRDS, 2020f). CKD is a global problem that negatively impacts international economies in different ways, depending on their resources and how they prioritize their health care expenditures (GBD, 2020).

## Stroke and CKD in the Stroke Belt

Reference to the *Stroke Belt* is necessary because strokes can be associated with hypertension and hypertension can be both a symptom and a cause of CKD. Hypertension and cardiovascular disease are closely associated, as seen in late stages of CKD when a decline in the glomerular filtration rate (GFR)—a measure of kidney function— (GFR <60 ml/min/1.73 $m^2$) is highly correlated with elevated risks for cardiovascular disease events, including stroke and sudden death (KDIGO, 2013). Interrupted blood flow to the brain, caused by a ruptured blood vessel or a blockage from a blood clot, commonly results in a stroke, also known as a brain attack (American Stroke Association [ASA], 2015).

Stroke and CKD are the fifth and eighth (CDC, 2020a) leading causes of death in the nation (not considering the Covid-19 pandemic), respectively. NC is recognized as one of the states in the *Stroke Belt* (CDC, 2017; Howard & Howard, 2020) and one of three in the *Stroke Buckle* (American Heart Association [AHA], 2014; Howard & Howard, 2020). The long-standing relationship between CKD and stroke (CDC, 2019; Vellanki & Bansal, 2015) is compounded by their association within the southeastern region of the US called the Stroke Belt and the same region where CKD prevalence is high—the CKD Belt.

### *Prevalence of Stroke Deaths*

Stroke in the southeastern region of the US is very significant because it has been a problem for decades. The prevalence of stroke deaths have been relatively unchanged from 2000 (see Appendix D) through 2020 (see Appendix E) with slight shifts in prevalence of deaths between neighboring counties and states. Its longstanding prevalence with CKD in the same region—southeastern US—is a potentially deadly combination (see Appendix F). The three maps (see Appendices D, E, and F) are presented to demonstrate that the Stroke Belt has not

changed much over the years, and that CKD, a known comorbidity of stroke is a problem for the region. This study refers to the region as the *CKD Belt* because of the disease prevalence.

This study assumed that health care providers who live and/or practice within the Stroke Belt would be more knowledgeable about the significance of stroke and CKD and be more proactive in their approach to prevention and management, than their counterparts outside of the Stoke Belt. Limiting the study to practitioners within the Stroke Belt could likely demonstrate better knowledge of the practice guidelines than the reported national and international physician studies mentioned in this dissertation.

***The Population Most Affected***

Due to their elevated risk for diabetes, obesity, and hypertension, African Americans are more prone to strokes than Caucasians, although there are numerous other risk factors that include living in the Stroke Belt (ASA, 2018). The Stroke Belt was identified over three decades ago because of the high rates of stroke mortality in the following 11 southeastern states: Alabama (AL), Arkansas (AR), Georgia (GA), Indiana (IN), Kentucky (KY), Louisiana (LA), Mississippi (MS), North Carolina (NC), South Carolina (SC), Tennessee (TN), and Virginia (VA) (ASA, 2018; CDC, 2017) (see Appendix D).

Stroke mortality has improved over the years, causing states to be added to and removed from the list, now leaving only eight (see Appendix E) over a roughly 17-year period when the counties, rather than the individual states were tracked (Howard & Howard, 2020). GA, NC, and SC were commonly referred to as the Stroke Buckle because of their much higher prevalence of stroke (AHA, 2014; Howard & Howard, 2020). Coincidentally, during that time period, states with the highest cases of CKD were directly within the Stroke Belt, in addition to California and its southern border with Mexico, with an even higher prevalence of kidney failure (NKF, 2013)

(see Appendix F). Stroke is a common comorbidity of CKD and the fact that their high prevalence counts have coexisted together in the same geographical region (southeastern US) for decades, is a serious combination for residents.

Further emphasizing the importance of this study is the involvement of various programs, agencies, and grassroots initiatives that share a common goal of raising CKD awareness and implementing measures to reduce the CKD burden. Some of them include: (a) Healthy People 2020 (HP2020), a health promotion and disease prevention program; (b) the Agency for Healthcare Research and Quality (AHRQ), which monitors the standards of preset healthcare measures for CKD, among other things; and (c) *Kidney Sundays* and *Sisters Together*, two national interventions that address CKD health disparities among African Americans.

**Kidney Sundays.** *Kidney Sundays* is a pre-existing faith-based, national intervention that educates African Americans about renal disease. Spearheaded by the National Kidney Disease Education Program (NIDDK, n.d.-b), the goals of *Kidney Sundays* are to raise awareness, motivate individuals to get screened, foster discussions about kidney disease within faith communities and families, and to provide free health screenings. The simple intervention, designed for educating the public, offers flexibility in its execution so that interest in and sustainability of the program can be maintained.

**Sisters Together.** *Sisters Together* is community-based intervention that targets adult African American women. The goal is to achieve and sustain a healthy weight through lifestyle modifications that include a sensible diet and exercise, while relying on each other for support. The premise behind this program is to address obesity which is prevalent among African American women and one of the risk factors for CKD (NIDDK, n.d.-b).

**Healthy People 2020**

HP2020 has dedicated 14 health promotion and disease prevention goals to directly address CKD (HP2020, 2015). The exhaustive list recognizes CKD as a national problem in need of serious attention to address the health disparities that it causes, and as such, also addresses individuals who have never been screened for kidney disease or its risk factors (HP2020, 2015).

In addition to reducing the incidence, prevalence, and mortality related to CKD, improving patient outcomes is equally important. Among other areas, attention is given to: hypertension and diabetes, the two main precursors of CKD; increasing the number of individuals who are aware of their kidney function status; specific treatments and interventions; referral to nephrologists; and preference of arteriovenous fistulas over catheters for hemodialysis (HP2020, 2015). Although not explicitly stated, the burden of improving the 14 CKD objectives appears to rest on primary care providers (including APRNs), which further implies that they must be knowledgeable about CKD practice guidelines for the evaluation and management of the disease so that effective patient care can occur, should they take on the PCP role.

**CKD Quality Indicator**

It is of great importance when nationally recognized healthcare bodies advance the quality of healthcare standards through gathering and promoting evidence-based reports that help to guide the healthcare community's actions in improving targeted initiatives. Agency for Healthcare Research and Quality (AHRQ) does just that through its report, *National Healthcare Quality and Disparities Report* by identifying two (of numerous) health measures that pertain to CKD that are also similar to HP2020 objectives 10 and 12, respectively (HP2020, 2015). The objectives are:

i. End stage renal disease (ESRD) patients age 18 and over who saw a nephrologist at least 12 months prior to initiation of renal replacement therapy. (AHRQ, n.d.; HP2020, 2015)

ii. Dialysis patients under age 70 who were registered on a waiting list for transplantation within a year of initiation. (AHRQ, n.d.; HP2020, 2015)

Of the three categories that describe benchmark status, the aforementioned items (i) and (ii) were designated *close to benchmark* at 35%. That means that they had not achieved the benchmark, but instead, were within 35% of achieving it (AHRQ, n.d.-a). Over five years later, however, both benchmarks were currently different: The former improved to 30.4% and the latter worsened to 43.9%, respectively (AHRQ, n.d.-b). Item (i) describes what is commonly known as early referral (KDIGO, 2013). Early referral to a nephrologist is vital to overall patient outcomes because it can slow or prevent complications (Adejumo, et al., 2016; Fraser & Blakeman, 2016; Okaka, et al., 2020; Patrice et al., 2019; Selim et al., 2015) and help, among other things, to determine the type of hemodialysis access that is necessary (Hamadah & Gharaibeh, 2019). Early referral is also associated with reducing: the exorbitant Medicare costs associated with the progression of CKD to ESRD; incidence; prevalence; morbidity; mortality; and the associated health disparities (NIDDK, n.d.-c).

Kidney transplant is not a popular procedure among patients with CKD, and especially among minorities. In 2018 more Caucasians (28,554) were on the transplant waiting list with a shorter wait time (41.3 months) than African Americans (17,280 and 59.9 months) respectively) (USRDS, 2020g). Due to their age and several comorbidities, 70-year-old patients on dialysis, despite their race or ethnicity, are not good candidates for kidney transplant, the few who receive transplants have very poor survival rates (HP2020, 2015). The focus, therefore, is on the

population under 70 years old, to be placed on the transplant waiting list as soon as renal replacement therapy (dialysis or transplant) is ordered. Preparation for kidney transplantation and dialysis normally begin with early referral to a nephrologist.

*Pre-emptive transplant waitlist* is the status of a patient who is new to dialysis who was placed on the kidney transplant list before his/her CKD worsened to ESRD where dialysis or transplantation are options to prolong life. Early referral to a nephrologist is consistent with being placed on a kidney transplant list and a delayed need for dialysis and kidney transplant. Asian Americans (8.3%) are more likely to be pre-emptively waitlisted than Caucasians (5%) or African Americans (3.9%) (USRDS, 2020g).

From a cost-comparison aspect, kidney transplant is a good option over dialysis since it is a one-time procedure that costs less than three-day/week dialysis sessions for the rest of an individual's life (USRDS, 2020e). Regarding the CKD quality measures, part (ii) relies on part (i) for positive patient outcomes and decreased costs. Clearly, when the benchmark for part (ii) changed from 35% to 43.9%, only minimal progress was made in achieving the goal of getting more adults on a waiting list for kidney transplantation within a year of starting dialysis. The evidence shows that kidney transplant surgeries remain low for that age-group (USRDS, 2020g).

**Impact of CKD on Individuals**

The kidneys do much more than filter waste from the body and regulate fluid and electrolyte balance—they also produce hormones and enzymes. Therefore, people with failing kidneys will eventually experience problems such as: (a) anemia and osteoporosis from decreased production of the hormones erythropoietin and calcitriol, respectively; (b) unstable blood pressure from reduced secretion of the enzyme renin and impaired atrial natriuretic peptide (ANP) receptor sites in the kidneys; (c) chronic itching due to accumulation of toxic wastes

caused by impaired filtering mechanism; and (d) edema and decreased urine production as a result of impaired ANP receptor sites and filtration mechanisms within the kidneys. Other comorbidities that are frequently associated with CKD include congestive heart failure, cardiovascular disease, lung disease, peripheral vascular disease, neurological problems, malnutrition, mineral and bone disorder, elevated potassium and phosphorus, pain, restless leg syndrome, sleeplessness, and metabolic acidosis (CDC, 2019, DaVita, 2021b; NIDDK, 2018). Psychiatric comorbidities in the patient with CKD are also concerning.

***Depression***

Individuals with chronic illnesses, including CKD, experience depression as a comorbidity: Depression within the CKD community is well-documented (CDC, 2019; Haverkamp, et al., 2019; Nguyen, et al., 2017; NIDDK, 2019; Shirazian, et al., 2017; USRDS, 2020; Wang et al., 2019). Depressive symptoms, if left untreated could progress into a firm diagnosis of major depression or major depressive disorder—both commonly referred to as depression—a mood disorder. Depression and ESRD are equal opportunity mental and medical illnesses respectively, whose complexities increase when they coexist. Adding to the complexity is the fact that symptoms of depression and ESRD can be very similar and can mask the presence of each other. A lack of energy, lethargy, and/or sleepiness, for example, can be explained as symptoms of depression or uremic syndrome that is caused by ESRD. Somatic illnesses, lack of appetite and sexual desire, anhedonia, and the presence of other mental illnesses can also mimic depressive and ESRD symptoms.

***Comorbidities***

Since numerous comorbidities exist with ESRD and/or depression it is important to be cognizant of evidence that they are associated with decreased quality of life (Legrand et al.,

2020; Nguyen et al., 2017; Wang et al., 2019), smoldering immune responses (Akchurin & Kaskel, 2015; Ishigami et al., 2019; Santos et al., 2017; Shrestha et al., 2019), exacerbated medical conditions (CDC, 2019), increased hospitalizations (USRDS, 2020e), increased morbidity and mortality (USRDS, 2020d), and suffering for those with ESRD. Not all conditions that ensue from a diagnosis of ESRD can be controlled by the patients. The immune response to foreign matter is one such example.

### *Inflammation*

Immunology plays a significant role in the health of patients undergoing renal replacement therapy, with the inflammatory response being one of several reactions to stimulating the immune system. Exposure to materials like dialysis catheters for hemodialysis and even the concentrated glucose solution in the dialysate for peritoneal dialysis can initiate the inflammatory response (Christo et al., 2015; Kokubo et al., 2015; Poppelaars et al., 2018). The combination of declining kidney function with routine exposure to hemodialysis materials has been posited to increase the level of inflammation, causing an increased inflammatory response which in turn induces more inflammatory biomarkers, making the cyclical process difficult, if not impossible to break. Haverkamp et al. (2019) speculate that depression stimulates inflammation and that proinflammatory mediators–produced as a result of inflammation–can in turn cause depressive symptoms. Like the link between exposure to dialysis materials and inflammation, depression and proinflammatory markers have a cyclical connection, another process that poses some difficulty to resolve. Adding more complexity to providing care to a patient with CKD is the number and classes of medications that are required and an awareness that renal clearance of many medications will be compromised. Clearly, individualized and specialized care of the patient with CKD are indicated for disease management.

**Specialist Care**

Nephrologists dedicate their expertise to caring for patients with CKD, are well-versed on the intricacies of disease management, and are knowledgeable on the types and timing of kidney transplant and the surgical placement of apparatus required for renal replacement therapy. Because of their specialist training in kidney disease, they are expected to be current on the practice guidelines within their field. As a result, co-management of patients with non-nephrology physicians, whether they are primary care or specialists, is an ideal mode of disease management.

Patient co-management between nephrologists and non-nephrology physicians is not always practical, and it is also impractical for any health care provider to be well-versed on a single disease especially if he/she practices general medicine. While physicians are competent healthcare providers, there have been challenges to their identification and management of CKD (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Estrella et al., 2012; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013), and that has a high likelihood of patients being referred too late to specialist care. Early referral has the potential to educate patients on the disease process and expected lifestyle adjustments, initiate the necessary steps for kidney transplant, prevent rapid disease progression and the long-term use of temporary dialysis catheters, and lower the risk of complications that can lead to death (KDOQI, 2015). Despite Healthy People 2020 (HP2020) goals and objectives, nationally recognized quality indicators, and practice guidelines regarding kidney disease, it is not always feasible for patients with CKD to be seen by a nephrologist, despite the evidence that early referral is best for patient outcomes (HP2020, 2015; KDOQI, 2015).

## Access to Care

### *Rural Healthcare*

Patients' access to healthcare usually determines if appropriate, timely, or quality care is received or even delivered by the most qualified provider. Access also includes barriers, for example: ability to pay, make health-related decisions and communicate effectively with caregivers; being health literate; availability of health care providers; distance and public transportation; and time (Cyr et al., 2019; Douthit et al., 2015; Salim et al., 2018; Scholes-Robertson et al., 2020). In fact, rural areas are less densely populated and not as financially attractive to health care professionals whose incomes and opportunities to network are exponentially better in urban areas. Health care professionals like physicians are scarce in rural areas (Cyr et al., 2019; Douthit et al., 2015) including regions in North Carolina (NC) (Yorkery, 2018). This also translates to specialists who are even more scarce, forcing generalists to assume those roles (Cyr et al., 2019).

Cyr et al. (2019) describe rural residents as generally older and less educated and since CKD is more prevalent in the older population, dialysis can be more challenging. For patients receiving hemodialysis three times per week for the rest of their lives, travel times and the physical burden of the commute, disease state, and post-dialysis treatment can become overwhelming (Scholes-Robertson et al., 2020). There are fewer dialysis centers in rural than urban areas, and fewer centers can increase the travel distance and time for already sick individuals.

**Home Hemodialysis.** Home hemodialysis is an excellent alternative to avoid traveling to a center and Scholes-Robertson et al. (2020) assert that inadequate or unavailable home hemodialysis training is a contributing factor to low numbers of rural individuals participating in

that program. However, Salim et al. (2019) found that despite benefits that include increased longevity, a host of improved physical and mental health, and better Medicare benefits, it was used by less than 2% of the population studied. The reasons were attributed to patients' lack of support and confidence in inserting their own dialysis cannula, in addition to physicians' lack of awareness about home hemodialysis and its potential benefits to patients.

LaVeist and Isaac (2013) concur that physical access to healthcare is a challenge to low-income and rural communities and that a combination of distance and affordability prevents some people from seeking routine care. They found that low-income individuals spend more time waiting for public transportation and traveling, than actually being productive, and that primary care establishments are scarce in those communities, limiting their choice in providers (LaVeist & Isaac, 2013).

Because access to care can present such a limitation for patients, primary care providers might be the only option for managing CKD. This does not necessarily mean that those patients will receive subpar care. After all, primary care providers' knowledge and expertise in medicine and patient care are essentially in their own control. They are responsible for keeping abreast of practice guidelines, evidence-based practices, collaborating with and/or seeking other professional opinions, and expanding their knowledge base, despite their demanding careers. The shortage of primary care providers in rural areas (Griffith et al., 2021) created a demand for non-physician providers like Physician Assistants (PA) and Advanced Practice Registered Nurses (APRN) to fill the need (Iglehart, 2018; Barnes et al., 2018). APRNs, the focus of this study, have additional employment opportunities in rural areas despite the fact that only some states grant full practice authority which allows them to practice independently without physician

supervision (AANP, 2021). In NC, however, supervising physicians can be in different geographic locations than the APRNs they supervise (Spero & Galloway, 2019).

**Knowledge of Chronic Kidney Disease**

With the attention given to CKD, in terms of national interventions and quality measures, that aim to understand and address the prevalence of CKD, the next logical step was to ascertain what the stakeholders in CKD really understood. Those stakeholders are the individuals with CKD and primary care providers (PCP). The Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PubMed databases of the last five years, beginning with the search terms: *knowledge of chronic kidney disease*, *non-Nephrology Advanced Practice Registered Nurse knowledge of chronic kidney disease*, and *instruments to determine knowledge of chronic kidney disease* were searched. A combination of sources from the reference lists of a few of the original articles plus refinement of the search term yielded other pertinent articles, albeit some were outside of the five-year range but were considered because they were either primary sources or had timeless information. When the searches yielded inadequate or no results, the time range was disregarded, hence the inclusion of articles outside of the five-year maximum limit.

There were various areas of CKD knowledge and awareness that were lacking in all three groups (stakeholders), and the instruments that were used to determine physicians' knowledge were not always identified in the literature, making it impossible to make fair comparisons. Adding to that, the areas of the practice guidelines that were used for knowledge assessment were not all the same, and for those with similarities, the wording of the questions and the context in which they were asked were also not always comparable. The meanings of the terms *knowledge of CKD* and *awareness of CKD* were not clearly defined and were indistinguishable

as used in the respective studies. The terms *knowledge* and *awareness of the guidelines* are used interchangeably in this manuscript.

***Choice of CKD Studies***

**Operational Definition.** None of the studies that were selected for further examination were alike. In their overall assessment, the operational definitions for any type of knowledge deficit including *lack of*, *low,* and *poor knowledge* are not stated, but instead are reported as numbers in descriptive statistics. For the scores, stating cut-off points and the basis for those values as they relate to the results of knowledge assessment—for example, *low*, *high*, *poor*, *good*, *knowledgeable*, and/or *deficient*—would have been useful. In the following studies, the definition of *adequate knowledge* was operationalized as percent correct answers: 70% (Agaba et al., 2012); ≥ 88.8% (Israni et al., 2009); and ≥ 70% (Wolide et al., 2020). As the remaining identified articles were studies to determine knowledge, the term *knowledge of CKD* is really left to the imagination—a non-scientific approach that leaves one without a firm understanding of the specific intent of how that variable was used, and of the results that were derived. Among other things, definitions, measurements, and methods are crucial to sound scientific research so that reasonable comparisons, contrasts, and conclusions can be drawn.

**Clarification of Terms.** Another term that needed clarification was diabetes because the types were not distinguished. Although diabetes is a risk factor for CKD, it is Type 2 diabetes mellitus that can be controlled with lifestyle modifications. The distinction between the two types is also important because the recommendation (practice guideline) for the first CKD screening is different for both. Individuals with diabetes should be advised of measures that can be taken to reduce their chances of developing diabetic kidney disease, especially if they can

make personal adjustments to their lives. Diabetic kidney disease is kidney disease that is caused by diabetes.

**Nursing Studies and Theoretical Framework.** Also, noticeably missing from the studies that determined primary care provider (PCP) knowledge of CKD guidelines was the absence of nurse-led studies, and in particular, ones whose participants were non-nephrology, adult health, primary care nurse providers—all of them were instead, medical studies that did not even include a theoretical framework. The inclusion of a theoretical framework would provide: a basis for understanding the logical flow of the study; parameters specific to the study; definitions of study-specific terms, concepts, and constructs; and allow for replication of said studies. Inclusion of a framework demonstrates a thorough, scientific approach and adds an element of professional nursing that guides the study, uses a set of assumptions, and presents a clear progression of the study.

**Physician Studies.** In the studies regarding PCP knowledge, the psychometric properties of the instruments that were used were reported in only a few studies: validity and reliability (Agrawal et al., 2009; Israni et al., 2009) and reliability (Tahir et al., 2014; Wolide et al., 2020). Also, the instruments themselves were not always named or available, making those studies unsuitable for replication, and leaving questionable thoughts about their robustness. For two of the tools, although validity was determined, no statistical measures of reliability were reported (Estrella et al., 2012; Yaqub et al., 2013). Without the reliability further comparisons and inquiry into the effectiveness of the tools or replication of the studies would be meaningless. Estrella et al. (2012) analyzed the scores from an established online training module that was reportedly used by over a hundred internal medicine programs annually to measure progress in CKD knowledge among internal medicine residents. Nevertheless, the studies all focused on

different areas of CKD knowledge and in the absence of established tools, some were designed (but not validated) for use in their respective one-time only research. None of the studies (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Estrella et al., 2012; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013) used the same survey instrument. While validity is important, it is subjective and requires reliability measures (an objective, scientific approach) to bear stronger relevance (Vogt & Johnson, 2016). So, the studies that only reported validity and no reliability are not statistically sound, from that perspective.

**Instrument to Determine CKD Clinical Practice Guidelines.** From the selection, the instrument by Agrawal et al. (2009) was only one which had several attributes that closely matched what would be helpful to study APRNs' baseline knowledge of CKD practice guidelines. The study by Agrawal et al. (2009): determined physicians' knowledge of CKD guidelines only, as opposed to focusing on a combination of constructs; used a national sample and shared information about the pilot study; reported item discrimination, measures of central tendency, Cronbach's alpha; and included the questionnaire with the published study. The questionnaire by Agrawal et al., (2009) was used in this study because it appeared to be the most generalizable one which presented clear and pertinent statistical methods, and it had excellent face validity.

**Physicians' Knowledge**

The selected articles reviewed in this section, were chosen because of their contributions to the decision in selecting a questionnaire for this study. While other more current ones were rejected, these were retained for their content rather than their age because they were found to have pertinent information that remains current and useful. Although most of them are dated, they still bear importance to the overall information in this study.

Because the patients with CKD continue to demonstrate poor knowledge of CKD, it is then up to PCPs to close the knowledge gap. The high CKD incidence and prevalence combined with the low number of nephrologists (in comparison to PCPs) make it necessary for PCPs to manage those patients, but the literature shows that CKD knowledge among non-nephrology physicians, nationally and internationally is moderate at best, with some areas of focus being poor (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013). Primary care providers have a responsibility to be aware of the CKD practice guidelines, but they also have to be aware of the guidelines for several other disease conditions, so it should be expected that there might be a few areas of knowledge deficit to account for that. This deficit could be attributed to lack of short, easily referenced materials. Physicians reported that the KDOQI practice guidelines were too detailed and lengthy (Estrella et al., 2013; Yaqub et al., 2013), presenting challenges to their use, but alternatives could include pocket cards (Agrawal et al., 2009; United States Department of Veterans Affairs [USDVA], 2015b), one-page summary (Yaqub et al., 2013), or clinical decision support systems (Estrella et al., 2013) in which real-time help in making clinical decisions is supported by health information technology.

***Disease Management***

Across studies to determine physicians' CKD knowledge, surprisingly large numbers of them were unaware of various areas of disease management, but there is no indication of a pattern for this knowledge deficit, except that: internists scored better than other specialists on CKD knowledge questionnaires (Agaba et al., 2012; Israni et al., 2009); CKD knowledge increased with an increase in post-graduate years (PGY) (Agrawal et al., 2009; Estrella et al., 2012); and that better scores were strongly associated with a younger age (Israni et al., 2009).

Since all of the studies used different measurement tools and the areas of focus differed, it was difficult to make sweeping comparisons, but nonetheless, knowledge deficits were present, with CKD recognition and management being consistently poor.

***Cardiovascular Disease***

The prevalence of cardiovascular disease among individuals with CKD might come as a surprise to clinicians who are unaware of the association. Further inquiry into patients' and providers' poor knowledge in other areas could well reveal a cause for the high prevalence of certain conditions other than CKD. The incident and prevalent cases of cardiovascular disease conditions, including stroke, within the Stroke Belt of the US where most incident and prevalent cases of CKD also exist might not be an aberration after all, it could be the norm, considering the cardiovascular disease-CKD knowledge deficit among providers and patients. This argument strongly suggests that if threats to patient outcomes must be curtailed, then there should be many more physicians who were able to identify the risk of developing cardiovascular disease in the presence of CKD, for example, 75% of non-nephrology physicians (N = 470) in one study is insufficient (Israni et al., 2009).

***Diabetes and Hypertension***

It is not enough that almost all of the physicians were aware of diabetes and hypertension as risk factors for CKD (Agaba et al., 2009; Agrawal et al., 2009) or that overall, they demonstrated good knowledge of blood pressure goals and were aware of the necessity of angiotensin-converting enzyme (ACE) inhibitor and angiotensin II receptor blocker (ARB) to control hypertension (Agaba et al., 2009; Agrawal et al., 2009; Israni et al., 2009). More awareness and knowledge of CKD are indicated because it is such a multifaceted disease that it requires equal attention to all areas of recognition and maintenance to prevent or slow disease

progression—areas that were lacking among physicians (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013). CKD recognition and maintenance are at the heart of patient care because they include knowledge of risk factors, signs and symptoms, clinical markers and their parameters that indicate signs of disease progression, staging of the disease, indications for referral to nephrologist, knowledge of medication management, appropriate testing, and the sequelae of conditions caused by CKD (KDIGO, 2013)—all interrelated aspects that require PCPs to be well-versed on the disease process.

***Referral to Nephrologist***

Guidelines and recommendations are not meant to replace good clinical judgment. PCPs will have to consider several clinical markers to determine the best time to refer patients for nephrology care, bearing in mind that patients will need to be seen by the specialist long before initiation of renal replacement therapy (kidney transplant or dialysis) to avoid poor health outcomes. Some indicators for nephrology referral include: GFR less than 30 ml/min/1.73 $m^2$ (KDOQI, 2015; KDIGO, 2013), sudden decline in GFR, worsening CKD, CKD and hypertension that do not respond to at least four antihypertensive medications, acute kidney injury, and regular problems with albuminuria, kidney stones and serum potassium (KDIGO, 2013).

Non-nephrology physicians generally had poor knowledge of indications for referring patients to nephrologists (Agaba et al., 2009; Agrawal et al., 2009; Tahir et al., 2014; Yaqub et al., 2013) (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013). The attention to patient referral by HP2020 infers that those findings are not isolated, but a reflection of a much bigger problem.

HP2020 CKD objective-10 proposes that patients be referred to a nephrologist at least 12 months before renal replacement therapy (HP2020, 2015). Clearly, the referring physician must be competent at recognition and maintenance of CKD for that objective to be achieved. Similarly, meeting each of the other HP2020 CKD objectives should not be considered in isolation because they are all interrelated, suggesting that PCPs' knowledge of CKD practice guidelines (if they are strictly followed), could have the overarching effect of improving other HP2020 objectives.

### *Kidney Disease Education and Physicians*

The addition of kidney disease education to the Medicare Improvements for Patients and Providers Act (MIPPA) of 2008 §152(b) took effect in 2010 (CMS, n.d.-b). MIPPA was designed to improve patient outcomes, but it can, in fact benefit non-nephrology physicians if they choose to co-manage their patients with nephrologists.

**Patient Co-management.** For stable or slowly progressing CKD, co-management has the benefit of sharing patient care with an expert who is knowledgeable on the clinical practice guidelines and can also advise on best practices in that particular field, while the non-nephrology physician can manage aspects within his/her scope or comfort level of practice (KDOQI, 2015; KDIGO, 2013; Samal, et al., 2015). Nephrologists also benefit because they will not be inundated with referrals of patients who can be primarily managed by a non-nephrology physician. Co-management has had positive results wherein there was an increase in the likelihood for patients to: be prescribed ACE and ARB medications, have better blood pressure control, and be monitored for CKD progression (Samal et al., 2015), all of which contribute to areas of identification and management of CKD, which have been shown to decrease complications, slow disease progression, and decrease mortality rate—components of good patient management.

Since non-nephrology physicians have overall poor CKD knowledge, and some of those areas of management are improved when patients are co-managed with nephrologists, then it is highly likely that the nephrologist will know the finer details of management, monitor for disease progression, among other things, and be able to determine even more accurately, the optimum time to prepare the patient for renal replacement therapy. Kidney disease education affords the patient in CKD stage-four a longer delayed time period before renal replacement therapy is initiated, giving him/her sufficient time to learn about common comorbid conditions of CKD stage-five, make lifestyle adjustments, and prepare for renal replacement therapy—their options for type of dialysis and kidney transplant. Kidney disease education at stage-four also implies that a significant number of patients will need careful, accurate, monitoring, and management skills to control pre-existing conditions.

**HP2020 and Improved Providers' Knowledge**

Possible outcomes from improved CKD knowledge among non-nephrology physicians have the potential to directly impact patients' lives and address several of the HP2020 objectives. As CKD can go unnoticed for several years before symptoms are noticeable, screening tests for individuals who are at risk for CKD will increase the number of patients who are aware of their status. This explains CKD objective one (CKD-1) (HP2020, 2015), and provides evidence that education is beneficial for this patient population. Patients who received CKD education experience a slower disease progression than those who did not receive education (Enworom & Tabi, 2015; Sofue et al., 2019). For diabetics with CKD, screening/evaluative tests that include serum creatinine (SCr), lipids, microalbuminuria, glycosylated hemoglobin (HbA1c), eye examinations, and treatment as indicated with ACE inhibitors or ARBs (CKD-4, CKD-5, CKD-6) (HP2020, 2015) are considered management of CKD and its complications (KDIGO, 2013).

Management has the potential to reduce: mortality (CKD-7) (HP2020, 2015), incidence of ESRD (CKD-8) (HP2020, 2015), and ESRD caused by diabetes (CKD-9) (HP2020, 2015), and to improve cardiovascular disease status (CKD-6) (HP2020, 2015). Knowledge of those management areas has been poor among PCPs.

***Early Referral to Specialist Care***

If more patients receive early nephrology referrals (CKD-10) (HP2020, 2015), then arteriovenous fistulas and/or peritoneal access for hemodialysis and peritoneal dialysis respectively, will result in less use of venous catheters (CKD-11) (HP2020, 2015). Venous catheter use for dialysis access is associated with an increased risk of central venous disease (CVD) in patients receiving hemodialysis (Park et al., 2019). CVD is a condition in which the veins that are essential for hemodialysis begin to narrow to the point where it becomes unsafe for patients to continue treatment because, in many cases, that disease is untreatable. A common reason for accessing the veins for dialysis is because patients do not have an arteriovenous fistula, the preferred dialysis modality choice (KDIGO, 2013), which takes about three months to mature after it is surgically created. Since most individuals do not get diagnosed or referred to a nephrologist as soon as it is indicated, they end up needing emergency dialysis, hence the veins must be accessed. Early referral ensures that the fistula is created and healed months before the patient will ever need it.

Although late referral to a nephrologist is the main cause of catheter use for dialysis, sometimes other physiological options have been exhausted and a suitable hemodialysis access site is not possible. However, with venous catheters being used in more than 50% of initial hemodialysis cases, and the fact that non-nephrology physicians have poor CKD knowledge, it is highly likely that they were unaware of indications for patient referral to nephrology care, greatly

reducing the time for initiating patient education and timely surgical placement of arteriovenous fistulas.

**Patient Education.** Kidney disease education classes, if they are indicated, have the potential to increase the number of patients who opt for kidney transplant (CKD-13) (HP2020, 2015) and those being waitlisted for a kidney (CKD-12) (HP2020, 2015) mainly because awareness of renal replacement therapy options is a teaching point that is required by the MIPPA (CMS, n.d.-b). Patients who learn and understand about kidney transplant are likely to act on the new knowledge. Ideally, if all of the aforementioned measures are taken into consideration and acted upon, they could have the cumulative effect of reducing mortality within the ESRD population (CKD-14) (HP2020, 2015).

More African Americans could benefit from kidney disease education classes because they are the group most likely to be affected by diabetes, hypertension, CKD, go undiagnosed until shortly before they need dialysis, less likely to receive a kidney transplant, and have worse CKD outcomes. King et al. (2020) found that African Americans, even when they stated that they were aware of living kidney donation transplant, were still unlikely to receive a transplant. Their lack of knowledge was not just limited to CKD, but to the treatment options for late stage CKD.

**Patients' CKD Knowledge**

Consistently low awareness of CKD symptoms and risk factors is common among patients and is not limited to a particular part of the world, for example, in Indonesia (Agustiyowati, 2020), Saudi Arabia (Almutary, 2021), US (Betz, et al., 2021), Australia (Gheewala, et al., 2018), Ethiopia (Goro, et al., 2019), Bangladesh (Iqbal et al., 2018), US (King, et al., 2020), Rwanda (Ngendahayo, 2018), South Africa (Spies et al., 2021), US (Welch, et al.,

2016), and major knowledge deficits in basic relationships concerning hypertension, diabetes, and CKD also exist. In fact, numerous patients with CKD were unaware of the asymptomatic nature of the disease (Almutary, 2021; Molnar et al., 2020). This is a common problem that can be avoided by general CKD education, especially if individuals are at risk for CKD. Since the practice guideline recommend screening for at risk individuals with hypertension and diabetes, it suggests that if they were being followed by a health care provider, there might have been a communication breakdown or the possibility that the provider was unaware of the practice guidelines. Healthy People recognizes that problem in its CKD Objective two (CKD-2) which states, "Increase the proportion of persons with chronic kidney disease (CKD) who know they have impaired renal function", and Objective four (CKD-4) states, "Increase the proportion of persons with diabetes and chronic kidney disease who receive recommended medical evaluation" (HP2020, 2021). The two objectives show that that knowledge deficit is a recognized problem that needs to be addressed.

***Factors Associated with CKD Knowledge***

A lack of or decreased CKD knowledge varies widely, but some findings are similar. While older age was associated with lower CKD knowledge in patients with CKD (Molnar et al., 2020), Ngendahayo (2018) found that among patients with diabetes and hypertension, low knowledge of CKD risk factors and low level of CKD preventive behaviors coexisted. Learning about the risk factors for CKD after living with the disease, and the two main causes of said disease is not helpful at that point, but if an educational intervention is implemented while individuals are young, it could have the potential to influence how they live their lives. Lack of CKD knowledge has been reported so many times in the literature, that it is evident that large-

scale education of the public is warranted. Novel ways of educating them about CKD and its risk factors could be highly beneficial.

### *Educate and Assess Study Participants*

Studies consistently refer to a CKD knowledge deficit among patients with CKD. To address that problem, this study suggests that for every study that examines CKD knowledge deficits within any population, it should be assumed that there will be some deficit and those researchers should be tasked with educating their participants, at least, about the risk factors for CKD. Rather than, or in addition to incentivizing participants with the usual tokens, researchers should provide them with information that has the potential to last them a lifetime: education. Planning and executing research, including acquiring the potential participants, require careful planning and can be time-consuming. Coordinating with individuals to teach them something that they might not be aware of and/or have no interest in, is a daunting task. Assembling and incentivizing them in order to gather information could be easier, so it makes sense to use that opportunity to provide education to them.

## The Effect of CKD Education on People with CKD

Education has been a successful solution for limited CKD knowledge, and it effects positive changes in patients' disease progression and behaviors (Alikari et al., 2019; Betz et al., 2021; Enworom et al., 2015; & Sofue et al., 2019). There is no standard set of CKD areas that are taught to patients, and it has not been demonstrated that a thorough needs assessment is usually done before it is decided that patients will be taught. That method is guaranteed to overlook the needs and styles of learning for individual patients. Consider that with the fact that racial/ethnic minorities, rural, poor, and less educated individuals are more prone to develop CKD with more difficult to manage comorbidities, it is no wonder that some individuals appear

to be helpless. Individualizing CKD education to meet the needs of any marginalized group would take more than normal effort by most staff, considering that reimbursement might not be very high. Many poor people do not have health insurance and Medicare only covers the full cost of CKD when the patient has gotten so sick that they are classified as end-stage. Barriers still exist even though help is available.

Enworom et al. (2015) showed that patients at stage four CKD who received CKD education, did not deteriorate as fast as others who did not receive that education. While it is remarkable that they were taught, it could be argued that education could have been more beneficial had they been in at least stage two when the downward trends were being noticed in their kidney function. Patient education that begins at stage two has the potential to effect lifestyle changes and slow their disease progression. After all, stage four is the stage right before they will need to get a transplant or start dialysis to extend their lives. Unfortunately, patient education is reimbursable, just not when they are at their healthiest.

Slowing the decline in their kidney function was also a benefit for individuals with stage three CKD (there are five stages and stage five is the last) between age 40 and 70 who participated in a group education program for one year (Sofue et al. 2019). Lifestyle changes, not medications, were credited with their success, although their medications were not adjusted. A true measure of the success would be if all of their medications were discontinued during that year. The authors did not consider an adjuvant effect of the current medications with the lifestyle changes, before claiming research success. Patients at CKD stage three would already be taking medications to prevent kidney function decline (and or to address other comorbidities) the very thing that was being measured—glomerular filtration rate.

### *Poor CKD Knowledge After Education*

The assertion that meaningful patient-provider conversations do not always occur due to patients not being able to fully understand the magnitude of their health is a reasonable explanation, but after a year of care, patients in an outpatient nephrology clinic also failed to understand their CKD diagnosis (Gray et al., 2015). Those patients were lacking in CKD knowledge pertaining to: etiology, reason for their referral, treatment, and the meaning of CKD. The patients were exposed to expert care and had other resources at their disposal, not to mention multidisciplinary team involvement that provided education. There was slight improvement over the course of a year, so it is a perplexing situation that limited knowledge still existed among them like Enworom and Tabi found (2015). It is fair to assume that factors other than lack of provider knowledge were at play in those situations—possibly inattention to patients' acceptance and coping skills, language and cultural barriers to learning, failure to provide individualized care to the patients, or even low health literacy. These are rational assumptions to make, because one would expect that patients receiving expert care in a specialized clinic, where patient education was emphasized, would demonstrate and retain a high level of knowledge about their disease.

## CKD in African Americans

Hypertension, diabetes, and a family history of CKD are strong risk factors for CKD, and while those two diseases can be asymptomatic for a while before symptoms are experienced, this puts African Americans at a greater risk for advanced stages of CKD, especially if they already have hypertension and/or diabetes (DaVita, 2020c; (NKF, 2021). There is no indication that because African Americans with diabetes and hypertension develop kidney failure at about four times the rate of Caucasians (CDC, 2015a), or that they represent 32% of the cases of renal

failure, they have a different level of knowledge about CKD than the general population. In fact, African Americans are not unique when it comes to CKD knowledge deficits, including low knowledge of hemodialysis (King et al., 2019). Similar to gender, race has not been associated with CKD knowledge deficit. The social determinants of health, however, are more frequently stated, with respect to the higher incidence and prevalence, but as for their CKD knowledge being assessed, it is highly possible that they face the same deficits as everyone else—various areas of poor and fair knowledge among different sub-groups.

***Predisposition to CKD***

While there are measures that African Americans can take to reduce the incidence and prevalence of CKD, genetic factors can predispose them to the disease. For example, the gene—*APOL1*—is highly associated with an elevated risk of ESRD in individuals of African descent, and can appear in African Americans (Freedman et al., 2018; Nestor & Mohan, 2019; Yusuf et al., 2021). The etiology of the kidney disease has no relationship to diabetes. As a matter of fact, the gene was naturally selected for as an immuno-protectant in *African Sleeping Sickness*, but a mutation somehow elicited this new negative property of initiating kidney failure. The mutated gene and/or its kidney disease-initiating property have/has not been detected in Caucasians, therefore creating an added health risk for kidney disease within the African American population. Since it is not possible to predict the expression of the gene in any African American, and because that population bears so many risk factors for kidney disease, CKD education and awareness should become a priority, to give individuals the opportunity to address the lifestyle factors that they can control. The *APOL1* gene is not the only biomarker that has the potential to widen the health disparity gap for African Americans.

**Stress.** Inflammatory biomarkers have been known to fluctuate when individuals experience stressful situations, but it has been found that African Americans appear to be under permanent stress, even during sleep, based on negligible fluctuations in their cortisol levels (LaVeist & Isaac, 2013, p. 154). While it is known that stress exacerbates other illnesses and make them more difficult to control, inflammatory biomarkers (Baker et al., 2018; & Puthumana, et al., 2020) are also known to retard healing and exacerbate CKD symptoms, causing patients to remain in a "sick" state. The more unwell they are, the more stressed they become, and the more inflammatory markers are produced in response. That cycle is very difficult to break. The *John Henryism Hypothesis* (JHH) helps to explain the presence of the continuously high stress hormone levels in AAs especially if they are from a low socioeconomic status (SES). It is believed that African Americans face a lifetime of stress, initiated by the fact that they have a darker skin color, and that leads to subtle and overt racism; oppression is at the heart of their stress (LaVeist & Isaac, 2013). A combined inflammatory risk from dialysis materials (Kokubo et al., 2015; Poppelaars et al., 2018), stress, and their propensity for inflammation (Shrestha et al., 2019), increases African Americans' susceptibility to kidney disease, another compelling reason why CKD education is important in this group.

**Factors Associated with Better Knowledge of CKD**

Education is key to patient self-care—it is unreasonable to expect lifestyle changes, good decision-making, and adherence to any health program if patients are not being informed. Nurses are holistic caregivers in comparison to the symptom- or disease-specific approach of physicians. Due to the nature of their practice, APRNs would be more likely to identify denial, maladaptive behaviors, or poor coping strategies that their patients exhibit, and would be more

likely to consider alternatives in care delivery that could ultimately *increase* patients' knowledge of their CKD status.

With similar results from national and international studies, it can be concluded that lack of knowledge about CKD is a problem that needs to be addressed with patients. Tailored, innovative, educational interventions that target patients' needs should continue to be implemented, and CKD conversations must be a consistent part of treatment regimens. Equally important in conducting studies on patients' knowledge or awareness of chronic illnesses, is determining the way they cope. Qualitative studies that evaluate CKD knowledge would be appropriate for assessing the reasons for patients' maladaptive behaviors and failure to adhere to diet, fluid restrictions, and medication orders. Having respondents give short responses that supplement the information gathered by scales can produce a wealth of information

The following connections with CKD education were obtained from studies. Associated with better CKD knowledge were: higher educational level (Betz et al., 2021; Gheewala et al., 2018; Iqbal et al., 2018), higher economic status (Betz et al, 2021; Hussain, et al., 2019; Iqbal et al., 2018), and urban residence (Iqbal et al., 2018). Among the medical conditions that were associated with better CKD knowledge were: personal or family history of diabetes or CKD, (Gheewala et al., 2018; Hussain et al., 2019), and CKD stage and length of time with CKD (Almutary, 2021). Greater CKD knowledge was associated with a higher quality of life, better compliance with dietary and fluid intake habits (Alikari et al., 2019) and having lived in a relationship (Gheewala et al., 2018). Patients who are aware of their status are more likely to be proactive in managing their CKD. That is likely the thought behind CMS's urge to implement education as a part of CKD management.

### *CMS and Kidney Disease Education*

Nurse Practitioners (NPs)—also known as Certified Nurse Practitioners (CNPs)—and Clinical Nurse Specialists (CNSs) have been named (among others) by Centers for Medicare and Medicaid Services (CMS) as qualified providers of kidney disease education as part of the amended Medicare Improvements for Patients and Providers Act (MIPPA). This patient-centered amendment which aims to provide individual and group education to patients in stage-4 CKD intends to slow the disease progression, hence the imminent need for renal replacement therapy. Because CKD education has been considered a fee-for-service since 2010, health care providers have an incentive to provide the service. An added benefit to them is that taking the time to provide high quality education does not go uncompensated, in an age when time is such a precious commodity and patients often get abbreviated treatment times at each visit.

There would definitely be an added benefit for patients who get kidney disease education under similar guidelines before they advance to stage-4, but such a law has not yet been enacted. Health literacy assessment for patients diagnosed with stage-1 CKD could be one of the first things done, followed by a consistent trend toward helping them to hone those skills. Based on the MIPPA (CMS, n.d.-b), patients must be taught about their treatment options, food choices, self-management of comorbid conditions, and about their medications as a result of their poor demonstration of knowledge in those areas.

## APRNs and Education

To date, there has been no study to determine non-nephrology APRNs' baseline knowledge of CKD practice guidelines, and this remains an area for further inquiry because, for the most part, they are an underutilized group in terms of meeting the demands of a growing and diverse healthcare industry. Being the largest segment of the APRN group with a proven record

of providing care, NPs are skilled to work in the primary care setting, offering care similar to physicians (Jackson et al., 2018; Kuo et al., 2015; Kurtzman & Barnow, 2017), while being able to rely on skillsets from the nursing discipline. Teaching has always been an integral part of nursing, so advanced degrees in nursing should allow an even higher caliber of teaching, and CMS has recognized this. In their effort to address CKD knowledge deficit and reduce morbidity and mortality among patients with CKD, CMS makes it possible for the NP and the CNS to deliver the content to patients (CMS, n.d.-b). The learning materials are not available from CMS however, so they have been designed by the respective providers who submit proof of the patients' achievement to CMS—a manageable feat for an advanced practice nurse.

Up to the time that this study was done, a CMS mandate did not address finer details like compensation for those APRNs who might participate in kidney disease education for patients with CKD. Whereas CMS is a recognized federal institution, the scope of practice for APRNs is determined by each state's board of nursing and in some states those nurses cannot practice as primary care providers, although they can still provide education under the MIPPA. Billing for services as a PCP or receiving payment while being supervised by a physician limits the ways in which an APRN might seek employment or decide to work and as a result there will be differences from state to state, in how the latter delivers the kidney disease education content as they continue to demonstrate their role in education and research.

**Patients' Kidney Disease Education Achievement**

Not only are APRNs capable of designing the curricula and providing CKD education to patients, but they can evaluate the outcomes of the educational intervention too—a necessary part of the MIPPA's kidney disease education program. Enworom and Tabi (2015) evaluated stage-4 patients' CKD knowledge by studying their GFR and found that their kidney function did

not decline as fast as that of non-participants in a kidney disease education program. This is in stark contrast to the previous findings that showed progressive kidney function decline and poor CKD knowledge among patients with CKD (followed by the usual suggestion of education to slow the process). If kidney disease education providers share their outcomes assessment, then eventually, a validated amalgam could become the standard method of assessing kidney disease education outcomes. Additional nursing studies to evaluate the learning outcomes are needed. A similar nursing intervention for patients in stages one through three would also help to delay disease progression and add to the growing body of knowledge. Stage one CKD is considered normal kidney function. The point in proposing that education begins there is to get as many people as possible to become aware of CKD; knowing the risk factors is a good start.

## Gaps in the Literature

The most noticeable gap in the literature was lack of studies pertaining to non-nephrology APRNs' knowledge of CKD practice guidelines. They have gained popularity in their ability to meet the needs of medically underserved populations in areas where physician shortages are common. It is important to know that they can effectively demonstrate knowledge and good practice of the CKD guidelines, especially in the Stroke Belt and the CKD Belt of the US, and how they, as a group contribute to achieving the Healthy People CKD objectives. APRNs have the foundational training that allows them to change their focus of practice mid-career, so studies that demonstrate their readiness to undertake the CKD problem, a public health concern, would be valuable. Also, studies that determine their knowledge and awareness of CKD practice guidelines are needed, but until then, a validated APRN-specific instrument with good internal consistency needs to be designed.

Definition of terms like *knowledge of the guidelines*, *good* and *poor knowledge,* and how they can be measured so that equal comparisons across groups and studies can be made, are absent from the literature. Standardized instruments to measure various constructs of knowledge of the guidelines, that also contain subscales that show the most common areas where knowledge is lacking, are unavailable, and would also be helpful.

## Summary

The literature, unlike physician studies, is void of studies on non-nephrology APRNs' knowledge of CKD practice guidelines and of an instrument to study that phenomenon. CKD knowledge deficits are common among patients with CKD and primary care providers, nationally and internationally. In addition to kidney disease education, a thorough patient assessment to include health literacy and numeracy skills, coping ability, return demonstration, and cultural and linguistic barriers could help to determine how best to teach patients about their risk factors and kidney disease. Physician studies have yet to demonstrate the best ways to effectively educate healthcare providers on the CKD guidelines after they have entered the workforce. Efforts to improve the psychometric properties and widespread use of pre-existing tools that determine healthcare providers' CKD knowledge should be made, and studies that include APRNs should be undertaken as steps to improve CKD awareness and knowledge. Desired outcomes of improving CKD knowledge across all groups—general population, patients, and providers— include a decrease in the cost, incidence, prevalence, mortality, and morbidity of the disease. An increased use of clinical decision support systems and patient co-management between PCPs and nephrologists has the potential to lessen the knowledge burden on providers who must manage health conditions other than CKD. Researchers are in a unique position to access individuals that might go unnoticed by CKD public health initiatives and task forces.

They should assume the responsibility of sharing basic CKD knowledge with the populations that they study, since the literature has an abundance of examples of CKD knowledge deficit among marginalized and other groups. It is a choice to share the information, but also an ethical act. The same argument is true for health care providers. If they are unaware of the CKD guidelines or other aspects of CKD, the information and how to access that information should be shared with them by researchers, like this study has done.

# CHAPTER III: METHODOLOGY

## Introduction

The main purpose for conducting this study was to establish the suitability of the instrument that was used to determine Advanced Practice Registered Nurses' (APRN) baseline knowledge of chronic kidney disease (CKD) practice guidelines. An instrument designed to determine physicians' knowledge of said guidelines was used because none existed for non-nephrology APRNs at the time that this research was conducted.

In conducting this study, it was necessary to: (1) assess the psychometric properties and factor structure of the instrument that was used to determine CKD knowledge, (2) calculate the item difficulty of the 15 items, (3) perform Pearson's Chi-square test of independence to get a cursory view into possible relationships between the demographics and the scores, and (4) analyze the APRNs' responses to the opinion-based and open-ended questions, which provided an exploratory outcome that enhanced the quantitative results.

## Design

The non-experimental, quantitative study used a cross-sectional, correlational design with survey methods and a convenience sample of 254 participants. A cross-sectional design describes one in which the data that are collected at a single point in time can be used to describe occurrences or their associations (Polit & Beck, 2021). As this was a non-experimental study, a correlational design was most appropriate because there was no need to manipulate independent variables; associations were made instead (Polit & Beck, 2021; Vogt & Johnson, 2016).

## Framework

The measurement framework guiding this study was exploratory factor analysis. Knowles' theory of adult learning was the theoretical framework that guided the participants'

progress through the Physicians' 15-item CKD questionnaire on chronic kidney disease (CKD) practice guidelines.

## Sampling Method and Subjects

The convenience sample of APRNs was derived from the entire database of APRN's in the North Carolina Board of Nursing's (NCBON) registry, selecting only Certified Nurse Practitioners (CNP) and Certified Nurse-Midwives (CNM) for the study. Recruitment and data collection were via email, using Qualtrics. Prior to analysis, sample size determination was conducted to ensure that the requirement for exploratory factor analysis was met.

### Sample Size

A sample size of at least 150 participants was required for the study since a requirement for using exploratory factor analysis is that the *n*-to-variables ratio should be at a minimum, 10:1 (Huck, 2012). In this case, the number of variables refers to the number of items (questions) on the questionnaire (15) by Agrawal, et al., (2009). For this study, the actual sample size was 254.

### Inclusion Criteria

Participants for this study were Advanced Practice Registered Nurses who cared for adult patients. The APRNs read and wrote English proficiently and held current, unrestricted licenses in North Carolina. Their baseline CKD knowledge was sought in this study. APRNs practicing nephrology were ineligible to participate because this study assumed that they were more versed on CKD practice guidelines than the majority of non-nephrology APRNs who would be serving the general population, as opposed to only patients with CKD concerns. Practitioners who cared for the pediatric population were excluded from the study since differences exist between the two groups in management and clinical parameters (KDIGO, 2013) and because the instrument to determine physician knowledge of CKD practice guidelines did not include pediatrics. CNP and

CNM were favored for inclusion over Certified Registered Nurse Anesthetists (CRNA) and Clinical Nurse Specialists (CNS) because the former two were more likely to provide primary and routine care on a continuum and refer patients for nephrology consultation as needed. CRNAs and CNSs were excluded from this study. The population size from which the convenience sample was derived was 7,424 CNPs and CNMs (not considering duplicate or inaccurate contact information).

## Data Collection

Data collection over three weeks, was in the form of an online knowledge assessment that used the online data collection software, Qualtrics. Learning was expected to occur through conceptual thinking—analysis of the CKD questions with nursing education and experiences serving as the foundation. Participants received an email that introduced and explained the study, and then they were given the opportunity to continue or decline participation. Demographic information, a Physicians' questionnaire to determine CKD knowledge, and a post-survey questionnaire collected information from the participants. Included in the demographic and post-survey data collection were three short-response items which were also analyzed. A reminder email was sent after two weeks.

## Human Subjects Protection

Prior to conducting the study, the Principal Investigator (PI) sought permission from The University of North Carolina at Greensboro's (UNCG) Institutional Review Board (IRB), and then immediately before each participant attempted to complete the survey. The informed consent statement advised each participant that proceeding with the survey implied that consent was given and that leaving the study at any time without being penalized was allowed. The anonymous survey did not collect personal identifiers from the participants because none were

required. The contact list was stored on an encrypted data storage device in a locked home-office file cabinet, separate from the collected research data. Risks to the participants were foreseen to be minimal from test anxiety and slight fatigue from computer use. Measures to minimize those possible risks were not applied because no harm was anticipated, and the participants were at liberty to discontinue their participation as they saw fit. The IRB application was exempt from full board review because the study was not sensitive, and it posed less than minimal risk to the participants.

## Instruments

The three instruments that were used to collect information from the participants were: (1) *General Survey Form for APRN*, that was designed by the PI (see Appendix A), (2) *Physicians' Questionnaire for Chronic Kidney Disease* (see Appendix B) that was designed to assess physicians' knowledge of the CKD practice guidelines (Agrawal et al., 2009), and (3) *Post-survey Form for APRN*, designed by the PI (see Appendix C). All of the information was collected electronically.

### General Survey and Post-survey Forms for APRN

These forms collected sociodemographic data which were transformed to categorical variables and used in analyses. There was no compelling suggestion in the literature that healthcare providers' race/ethnicity, income, and/or gender (common demographic identifiers) play a role in their understanding of the CKD practice guidelines, therefore those measures were not used in analyses in this study. Race/ethnicity, gender, and age were collected to account for representation by different groups.

Additionally, the data of interest were: (1) United States (US) region where APRN was trained, (2) postgraduate length of time in practice, (3) type of APRN—Certified Nurse

Practitioner (CNP) or Certified Nurse Midwife (CNM), (4) specialty or main area of practice, (5) awareness of any CKD clinical practice guidelines, (6) confidence in referring patients to nephrologist, (7) expected practice change related to nephrology, (8) perspective on stroke, (9) perspective on CKD, and (10) barriers to staying abreast of CKD practice guidelines. Some of those areas were satisfied with open-ended questions and their short-responses.

***Assumptions of the Categorical Variables***

Since information is lacking about APRNs' knowledge of CKD practice guidelines, this study used evidence from the literature on physician studies, along with assumptions, to formulate the independent variables that could influence their knowledge of the guideline and scores (dependent variable). The following are the categorical variables and the rationales for choosing them.

It was assumed that:

(a) being trained in the south where CKD is more problematic than the other three regions, the APRNs would have an extra awareness of the disease, and that it would also be a part of their graduate studies; the variable name was *Region*.

(b) the length of time in practice could influence knowledge of the CKD guidelines as they changed over time. Scores on CKD knowledge surveys were higher for physicians who were in their residency programs for a longer time (Agrawal et al., 2009) and for practicing physicians (Estrella et al., 2012). The variable name was *Practice time.*

(c) the participants worked in primary care. If they did not work in Internal or Family Medicine, they were classified as *Other* and asked to state their specialty area of practice; the variable name was *Specialty.*

(d) if an APRN was aware of the guidelines, it might influence his/her scores; the variable name was *Awareness.*

(e) if an APRN was keen on the importance of early referral to a nephrologist (a key aspect of the guideline), he/she would be more confident in timely patient referral as soon as it was indicated. The variable name was *Confidence.*

(f) because the participants lived and worked in the Stroke Belt, they were more likely to be aware of CKD being a risk factor for stroke and it would inform their professional practice and influence their survey scores; the variable name was *Stroke Belief.*

(g) as healthcare providers, the APRNs believed that the higher incidence and prevalence of CKD in the southeastern region where they practiced should make them more aware of CKD management; the variable name was *HCPBelief*.

**Physicians' Questionnaire to determine CKD knowledge**

The National Kidney Foundation Kidney Disease Outcomes Quality Initiative (KDOQI) was the frame of reference for the 15-item questionnaire by Agrawal et al. (2009). The questions were derived from evidence-based studies that encompass 10 clinical practice areas which emphasize knowledge of the guidelines. The areas, all pertaining to CKD, are: (1) definition, (2) classification, (3) risk factors, (4) laboratory evaluation, (5) management, (6) indications for referral to nephrologist, (7) complications, (8) management of bone and mineral disorder, (9) management of anemia, and (10) medication use (Agrawal et al., 2009).

***Scoring***

In the original study for the 15-item questionnaire, 49 was the maximum possible total score because the question as a whole is not deemed correct or incorrect based on the selected response(s). In fact, correct responses of a multiple response item (question) were counted

individually (partial credit). Any "*I do not know"* responses were deemed incorrect (Agrawal et al., 2009). This study scored the questionnaire similarly. The number of response choices for each item differed throughout the questionnaire, ranging from four to 10, and the number of possible correct responses per item ranged from one to eight.

***Psychometric Properties***

Subsequent to conducting a pilot study (n = 43) using their instrument, Agrawal et al. (2009) reported item discrimination (D), also known as discrimination index (≥ 0.3), and internal consistency (0.69) in a convenience sample of internal medicine physicians (n = 479) ranging from postgraduate years (PGY) one through three. Item discrimination is a numerical indicator of the quality of the test item when the scores of the high-scoring versus the low-scoring individuals are compared (Oermann & Gaberson, 2019). A discrimination index ≥ 0.2 on a range of -1.00 to +1.00 is good, and the closer that number (D) is to +1.00, the better it is at identifying a good quality test item (Oermann & Gaberson, 2019). It means that more high-scoring than low-scoring individuals answered that particular item correctly. For the instrument to measure physicians' knowledge of CKD guidelines, Agrawal et al. (2009) determined that the item discrimination was acceptable at ≥ 0.3.

Cronbach's alpha (coefficient alpha or alpha coefficient) ranges from zero to 1.0 and is calculated to estimate the internal consistency (reliability) of the items on an instrument (Vogt & Johnson, 2016). The internal consistency demonstrates the consistency in the results that are derived from testing the instrument and indicates that the items are measuring what they intended to measure. DeVellis (2016) proposed that an alpha value from 0.65 to 0.7 is minimally acceptable, 0.7 to 0.8 is respectable, and 0.8 to 0.9 is good. The internal consistency of the

instrument to measure physicians' knowledge of CKD guidelines was 0.69 (Agrawal et al., 2009), minimally acceptable by DeVellis' (2016) standard.

## Data Analysis

### Quantitative Analysis

Analyses were completed using Statistical Package for the Social Sciences (SPSS) software program version 26 (SPSS Inc., Chicago, IL, USA) after data cleaning and coding were done. Missing data were coded 99, and dummy coding was used for some dichotomous categorical variables to indicate the absence of the characteristic of interest. Frequencies and percentages were calculated for all of the variables (see Table 1). No preparatory material was provided to the non-nephrology APRNs and there was no pre-test/post-test, so the scores were expected to be lower than nephrology APRNs and physicians in post-graduate years one through four (the participants in the study by Agrawal et al., 2009). Recall that the baseline CKD knowledge of non-nephrology participants who could potentially assume primary care provider roles in underserved and other areas is also of interest in this study.

#### *Research Question 1*

*Are the extracted underlying dimensions (factors) distinguishable from each other?*

(Aim #1: Determine the factor structure of the instrument that determines CKD knowledge.)

If the extracted factors are distinguishable from each other, the eigenvalues will appear on the scree plot with values ≥ 1.0 and a single factor will be ≥ 5% of the total eigenvalue variance after factor analysis (Huck, 2012; Polit & Beck, 2021). The factors should also demonstrate relatedness to the items.

Exploratory factor analysis, using the extraction method, principal components analysis was employed to learn more about the dimensions of the construct, *knowledge of CKD practice* guidelines. Several methods were used to extract and determine the number and nature of the factors. The Kaiser-Guttman rule requires inclusion of all eigenvalues that are at least one (eigenvalues explained the amount of variance of specific factors), scree plot (a plot of eigenvalues) provided an estimate of the number of factors, and parallel analysis (used with scree plot [Vogt & Johnson, 2016]) also determined the number of factors retained. Parallel analysis also determined the number of components to retain. It was referred to as the gold standard (Braeken & van Assen, 2017) and was deemed a highly underused technique due to its complexity, although it was found to be a very accurate method that performed superiorly to the Kaiser-Guttman rule and scree test (Hayton et al., 2004).

**Exploratory Factor Analysis.** Since findings of the psychometric properties for the questionnaire to determine CKD knowledge are limited to the study by Agrawal et al. (2009) and the underlying dimensions (factors) and relationships (correlations) among factors and variables were unknown, exploratory factor analysis (EFA) was most appropriate to offer more information about it. The following assessments of factorability (Polit & Beck, 2021) for the 15 items were checked prior to running EFA: (a) sample size, (b) reliable correlations and adequacy, and (c) multicollinearity/singularity. Next, a 2-step process for EFA was done, factor extraction and factor rotation.

**Reliable Correlations and Adequacy.** The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were assessed (see Table2). The KMO test assesses the strength of relationships among variables and should fall between zero and one, inclusive. Stronger relationships have a value closer to one. Bartlett's test of sphericity, if significance ($p < 0.001$)

exists, indicates that the correlations among all the variables in the matrix are zero (Polit & Beck, 2021).

**Multicollinearity/Singularity.** Multicollinearity (determinant < 0) and singularity (determinant = 0) are undesirable characteristics in a correlation matrix. The former exists when two or more variables are highly correlated with each other instead of the desired state between a dependent variable and one or more independent variables. The latter is undesirable when variables are exactly correlated, resulting in a correlation coefficient of either -1 or +1 (Field, 2009). Multicollinearity/singularity was determined from the correlation matrix.

**Factor Extraction and Rotation.** Principal components analysis (PCA) extraction method was used to reduce the 15-item correlation matrix to fewer components (see Table 3) that showed the possible dimensions, under which those 15 items naturally organized due to their relationship with each other. Using the Kaiser-Guttman rule, only the factors with eigenvalues greater than one were retained (Huck, 2012). A scree plot (see Figure 1) was also used to determine the number of extracted factors. Factors greater than one were retained (Huck, 2012). Orthogonal (varimax) rotation (see Table 4) provided an uncorrelated matrix that differentiated the high and low loadings for each factor, such that higher loadings were more distinguishable as belonging to that component under which it loaded. A simple matrix in which only one item loads under each component is the desired outcome. Orthogonal (varimax) rotation ensured that the factors were uncorrelated.

Finally, to provide a basis for comparison with the previous method, parallel analysis (see Tables 5 and 6), with the use of an online calculator (https://oconnor-psych.ok.ubc.ca/nfactors/parallel.sps) and a syntax developed by O'Connor (2000), was another method that determined how many components to retain, due to its accuracy.

***Research Question 2***

*The following 10 areas of knowledge of the CKD guidelines were cited in the original study: definition, classification, risk factors, laboratory evaluation, management, indications for referral to nephrologist, complications, management of bone and mineral disorder, management of anemia, and medications used (Agrawal et al., 2009). Are the extracted factors representative of the aforementioned areas?*

(Aim #1: Determine the factor structure of the instrument that determines CKD knowledge.)

The aim of factor analysis is to reduce a large dataset to a smaller, more condensed form so that the items on the questionnaire group together with a common theme and align beneath the factor (a table heading) that describes them within the factor matrix (body of the table). In practice, each item on the questionnaire should be measuring only one construct (like one of the 10 aforementioned areas). Each item on the questionnaire should be related to a factor loading that denotes an association of the observed variable and its corresponding factor.

In this study, all factor loadings that were greater than .4 were replaced with the constructs (represented by capital letters) that each questionnaire item measured (see Table 4). From the Rotated Component Matrix (see Table 4), factor loadings of at least the absolute value of 4 ($\geq |.4|$) (Polit & Beck, 2021) were retained for interpretation, with .7 being considered excellent (Tabachnick & Fidell, 2013). If more than one loading corresponded to an item (cross loading), all values were retained for scrutiny (neither would be removed) as this exercise was exploratory and not for tool development. (A reference list [see Table 7] was created for easier verification). To determine if the extracted factors were representative of their respective

loadings, each group of constructs that aligned under a particular factor was scrutinized for a common theme which would become the new name of the factor (see Table 8).

Since one construct is usually measured per item on a matrix, only one capital letter was expected to replace each (numerical) factor loading in this study. Huck (2012) suggested that others uninvolved with the study complete the naming and matching of the loadings, but it was overlooked for this research since tool development was not the goal and it was not anticipated that researcher bias would contribute significantly since this was a straightforward task.

***Research Question 3***

*Which attributes of the instrument contribute to its suitability for assessing APRNs' knowledge of the CKD practice guidelines?*

(Aim #2: Assess the psychometric properties of the questionnaire that determined CKD knowledge.)

The following properties were determined from the SPSS output for interpretation and comparison: Cronbach's alpha, mean, standard deviation, variance, difficulty index, and content validity (see Table 9). Reliability statistics were run on each of the five components of the Rotated Component Matrix (see Table 10) to further ensure that the respective items were measuring the same thing. A Cronbach's alpha greater than .7 was the minimum cutoff (Vogt & Johnson, 2016). Any suggestion to remove an item to increase the Cronbach's alpha was disregarded because item development was not the goal in this study. (Mean score ± SD) was converted to percentage for comparison to the reported values from the original study by Agrawal et al. (2009).

Item discrimination was not assessed because it is not necessary to know how well an individual performed on the questionnaire or on individual items in this study. Aggregate scores

are more meaningful in determining the suitability of the instrument for a group. Difficulty index (see Table 11) was assessed after calculation. The two main indicators that had the potential to influence the item difficulty, based solely on looking at the instrument were: (a) the highly technical content like specific laboratory parameters and complications of CKD, with treatment decisions, and (b) and its structure (visual appeal). A low difficulty index is indicative of a "hard test". Oermann and Gaberson (2019) suggest that indices less than or equal to .2 are difficult, and easy if they are greater than or equal to .8. They further assert that those measures alone should not be the deciding factors, but also assessing if the subject matter was taught well is equally important. The latter point was not considered as this research was not a teacher-student relationship. Assessing the item difficulty index alone was sufficient for this study, since other analyses contributed to the final decision. Face and content validity (see Table 8) were assessed.

***Research Question 4***

*Does the instrument have the ability to discriminate across groups of participants?*

(Aim #2: Assess the psychometric properties of the questionnaire that determined CKD knowledge.)

Associations between the scores and the sociodemographic descriptors can indicate the instrument's suitability for assessing CKD knowledge among the APRNs. Pearson's Chi-square test of independence examined associations between independent variables that described different aspects (subgroups) of the APRNs (see Table 1), and the scores (dependent variable) generated by the instrument. The scores used were categorized as *Correct* and *Incorrect*. The response choices varied from four to 10 per item, and the number of correct responses ranged from one to eight per item (see Table 12).

***Research Question 5***

*How can the instrument be modified so that it will be more suitable for use with the participants?*

(Aim #3: Modify the instrument to improve its suitability for determining APRNs' baseline knowledge of CKD practice guidelines.)

Since the Physicians' questionnaire was not designed for APRNs, there was an expectation that modifications would be required to make it more suitable for the latter. The modifications would only be possible after scrutinizing the questionnaire, analyzing the data, and answering the preceding research questions. Based on the results from Research Questions one through five and first person statements from the participants, an unvalidated 12-item survey was created (see Figure 3) to demonstrate what a blueprint (including content) of an improved survey for APRNs would look like. Also, an example of the accompanying Component Matrix (see Table 13) that would have resulted from Principal Components Analysis extraction method (had it been done), was constructed. Examples of some of the first person statements from the participants (see Tables 14, 15, and 16) are included.

**Qualitative Analysis**

***Short-response Survey Questions***

The short-response section was intended to give an indication of what the participants passively learned and/or recognized as a knowledge deficit, factors that might explain their scores, awareness and use of the CKD practice guidelines, and how participating in the study might influence their professional practice, with respect to nephrology. Qualitative content analysis was used to analyze three short-response questions by finding common themes within the first-person statements.

**Qualitative Content Analysis.** Initially, statements containing common words or phrases were grouped together by those common words or phrases. Each remaining statement was read for a common meaning and placed in the preexisting groups, if they were similar. If they had nothing in common, then a new group was started. The uncategorized pool of statements was gradually reduced with each round of analyzing their meanings. This was repeated until all of the statements were categorized. Each group was named, based on its common theme. Finally, the contents of each named group were individually read and compared to the question to further interpret the response. A few representative example quotes were tabulated (see Tables 14, 15, and 16) then expressed in narrative form (see Chapter 5). The following are the three questions that were selected for further evaluation with content analysis.

***Short-response #1.*** If you are aware of any clinical practice guideline for chronic kidney disease (CKD), please state it/them.

***Short-response #2.*** If you are not up to date on CKD clinical practice guidelines, please list the top two barriers that prevent you from keeping up to date.

***Short-response #3.*** Now that you have completed the exercise, what are the top three things that you will change and/or incorporate in your practice, as they pertain to chronic kidney disease practice guidelines?

## Summary

This non-experimental, quantitative research was designed to establish the suitability of a 15-item Physicians' questionnaire that was used to determined APRNs' baseline knowledge of CKD practice guidelines. That instrument was created for physicians but was used in this study for APRNs because none existed for them. Email recruitment from the NCBON's database was followed by a three-week data collection period using Qualtrics and data analysis with SPSS.

Knowles' Adult Learning Theory guided this research. To assess the suitability of the instrument, the relationship of the extracted factors and the items was studied, using Exploratory Factor Analysis, parallel analysis, item difficulty, measures of central tendency, and Pearson's Chi-square test of independence. Three questions elicited short-response data from the 254 APRN participants, which were then analyzed using content analysis. Two exemplars, an unvalidated 12-item scale and its accompanying Component Matrix, were created for the APRNs in this study, as a result of the collective analyses from the quantitative and short-response questions.

# CHAPTER IV: RESULTS

## Introduction

The main purpose for conducting this study was to establish the suitability of the instrument that was used to determine Advanced Practice Registered Nurses' (APRN) baseline knowledge of chronic kidney disease (CKD) practice guidelines. An instrument designed to determine physicians' knowledge of said guidelines was used because none existed for non-nephrology APRNs at the time that this research was conducted.

The 4.8% response rate could not account for email addresses that were unmonitored or no longer used. Of the 7,199 surveys sent, 349 were acknowledged, and 254 were retained for the study after excluding incomplete surveys and those with conflicting self-reported data that did not meet the inclusion criteria. Prior to the 349 surveys being acknowledged, Qualtrics automatically excluded duplicate email addresses and those that bounced (undeliverable). The data were then cleaned and coded in preparation for analysis.

The sociodemographic data (see Table 1) revealed that more females (90.9%) than males (9.1%) participated in the study and more Certified Nurse Practitioners (CNP) (96.9%) than Certified Nurse-Midwives (CNM) (3.1%); not surprising since the nursing profession is a female dominated one that is predicted to remain that way for at least another decade (Angeles, 2018) and CNPs represent the largest group of APRNs. Like gender, information on race/ethnicity was sought to account for inclusive sampling, although the literature does not support their influence on knowledge in a professional learning environment. Those variables were therefore not included in analyses. Native Hawaiians and/or Pacific Islanders were not represented in this study.

The self-reported characteristic listed as *Other* under *Specialty* (n = 140) (see Table 1) is an extensive list that includes areas like Occupational Health, Gerontology, Hospitalist, Psychiatry, Endocrinology, Pulmonary Medicine, Obesity Medicine, Wound Care, Neurology, Emergency Medicine, Urgent Care, and Anticoagulation. The respondents had the option of writing in their main area of practice or selecting Internal Medicine or Family Medicine.

**Table 1. Sociodemographic (categorical) Data of Participants (N = 254)**

| Characteristic | n | Percentage (%) |
|---|---|---|
| Type of APRN | | |
| CNP | 246 | 96.9 |
| CNM | 8 | 3.1 |
| Specialty | | |
| Internal & Family Medicine | 114 | 44.9 |
| Other | 140 | 55.1 |
| Time in Practice (years) | | |
| 5 or less | 101 | 39.8 |
| 6 or more | 133 | 52.3 |
| Declined to respond | 20 | 7.9 |
| Region [a] | | |
| South | 220 | 86.6 |
| Other | 34 | 13.4 |
| Gender [b] | | |
| Female | 231 | 90.9 |
| Male | 23 | 9.1 |
| Age range (years) | | |
| 25 - 39 | 87 | 34.3 |
| 40 - 54 | 92 | 36.2 |
| 55 and older | 75 | 29.5 |
| Race/ethnicity [c] | | |
| AI or AN | 3 | 1.2 |
| Asian | 2 | 0.8 |
| Black/African American | 18 | 7.1 |
| Hispanic/Latino | 2 | 0.8 |
| NH or PI | 0 | 0 |
| White/Caucasian | 223 | 87.8 |
| Other | 6 | 2.4 |

*Note.* AI = American Indian; AN = Alaskan Native; NH = Native Hawaiian; PI = Pacific Islander; CNP = Certified Nurse Practitioner; CNM = Certified Nurse-Midwife.

[a] Region, as defined by the U. S. Census Bureau is Northeast, Northwest, South, and West. Region where each participant was trained is the variable of interest.

[b] Gender and [c] race/ethnicity are reported to account for inclusive sampling. The literature does not support their influence on knowledge in a professional learning environment.

**Research Question 1**

*Are the extracted underlying dimensions (factors) distinguishable from each other?*

(Aim #1: Determine the factor structure of the instrument that determines CKD knowledge.)

***Assessments of Factorability***

The results of the tests of factorability (sample size, reliable correlations and adequacy, and multicollinearity/singularity) (see Table 2) were obtained prior to EFA. The 254 participants (cases) who used the 15-item (variable) questionnaire exceeded the 10 cases to one (10:1) variable ratio suggestion, making it an adequate (16.9:1) variable ratio with 254 total cases (sample size). From the correlation matrix the determinant was greater than zero at .152, indicating that multicollinearity did not exist. Factor extraction (see Table 3) and factor rotation (see Table 4) were then completed using Principal Components Analysis.

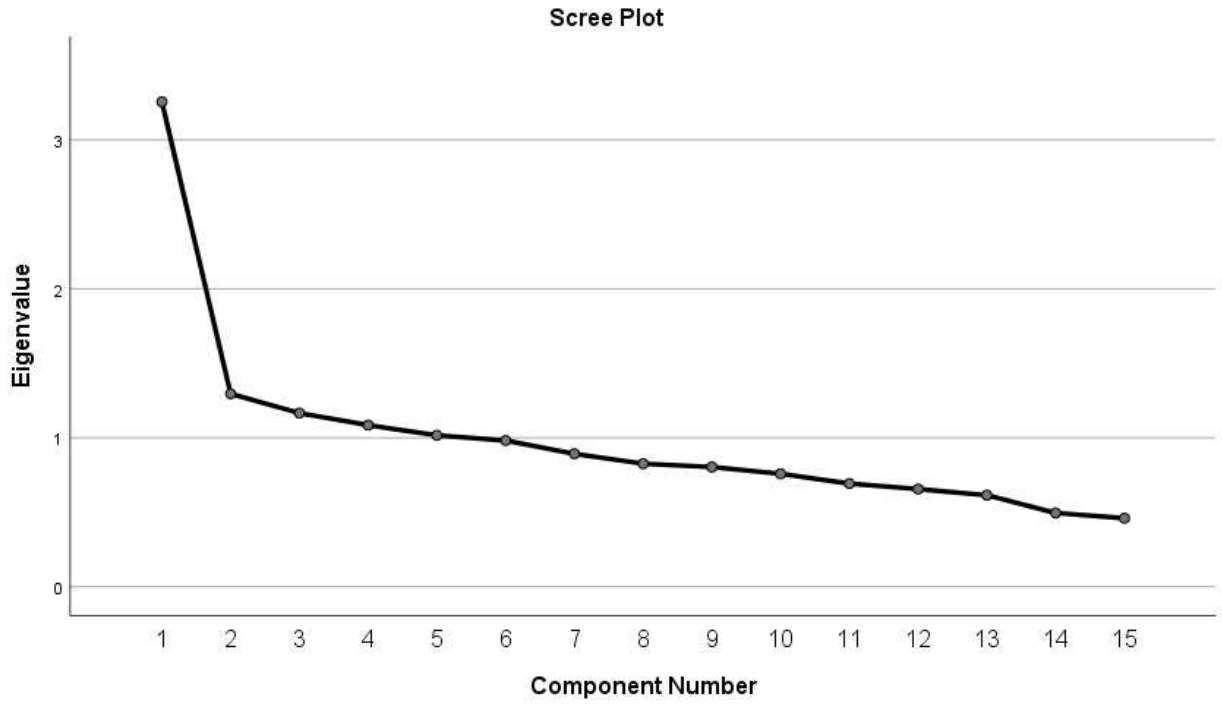
**Table 2. Reliable correlations and adequacy**

| Test | Value |
|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) | .776 |
| Bartlett's Test of Sphericity | |
| Approximate Chi-Square | 465.100 |
| Degrees of Freedom (df) | 105 |
| Significance (Sig.) | <.000 |

*Note.* Both tests have met the requirement for proceeding to conducting Principal Components Analysis, the extraction method used in EFA. This is valid because the KMO (.776) is greater than .7, a minimum for continuing (Vogt & Johnson, 2016) also because Bartlett's Test of Sphericity is significant at $p<0.001$.

The scree plot is (see Figure 1) a method of factor extraction that was used in this study. The Kaiser-Guttman rule requires that all eigenvalues greater than one be retained, so based on the plot, five were retained. They correspond to Component Numbers one through five, also known as the factors.

**Figure 1. Scree Plot for the Instrument to Determine Knowledge of CKD Guidelines**




*Note.* Five factors appear above eigenvalue 1, indicating they should be retained.

Factor extraction, using the Principal Components Analysis extraction method also confirmed a five-factor solution (see Table 3). Five factors with eigenvalues greater than one explain 52% of the variance. Item #1 contributes more than twice as much as the other four items.

**Table 3. Principal Components Analysis: Total Variance Explained**

| Item /Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings [a] |
|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total |
| 1) Definition of CKD | 3.256 | 21.704 | 21.704 | 3.256 | 21.704 | 21.704 | 2.715 |
| 2) eGFR in patient at stage III | 1.295 | 8.636 | 30.341 | 1.295 | 8.636 | 30.341 | 1.870 |
| 3) Risk factors for CKD | 1.166 | 7.772 | 38.113 | 1.166 | 7.772 | 38.113 | 1.344 |
| 4) Tests to assess kidney damage | 1.085 | 7.233 | 45.346 | 1.085 | 7.233 | 45.346 | 1.203 |
| 5) blood pressure with diabetes | 1.017 | 6.778 | 52.124 | 1.017 | 6.778 | 52.124 | 1.654 |
| 6) CKD management with diabetes | .982 | 6.544 | 58.668 | | | | |
| 7) CKD management plan for diabetic | .893 | 5.952 | 64.620 | | | | |
| 8) Medications for proteinuria | .826 | 5.508 | 70.128 | | | | |
| 9) eGFR <60 mL min-1 1.73 m-2 complications | .804 | 5.360 | 75.488 | | | | |
| 10) Preparing for dialysis and vascular access | .758 | 5.055 | 80.543 | | | | |
| 11) Actions relates to nephrology consult | .693 | 4.617 | 85.161 | | | | |
| 12) Mineral disorder management | .656 | 4.373 | 89.533 | | | | |
| 13) Goal hemoglobin with anemia and CKD | .615 | 4.098 | 93.631 | | | | |
| 14) Medications for anemia | .495 | 3.302 | 96.934 | | | | |
| 15) Lab values after ACE inhibitor | .460 | 3.066 | 100.000 | | | | |

*Note.* Extraction method: Principal Components Analysis. Five extractions were made.
[a] When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Orthogonal (varimax) rotation (see Table 4) transformed the factors into a simpler structure so that they were easier to interpret. Rotation increased the size of the larger values and decreased the size of the smaller ones. The minimum eigenvalue was set at .4 so that values below it would not be included in the matrix. Greater loadings indicate that the variable is a pure measure of the factor loading; values ≥ .71 are excellent (Tabachnick & Fidell, 2013).

**Table 4. Orthogonally (Varimax) Rotated Component Matrix [a]**

| Item | Components | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1) Definition of CKD | | .631 | | | |
| 2) eGFR in patient at stage III | | .577 | | | |
| 3) Risk factors for CKD | | .584 | | | |
| 4) Tests to assess kidney damage | | .429 [b] | .539 | | |
| 5) blood pressure with diabetes | | | | | -.755 |
| 6) CKD management with diabetes | | | | .641 | |
| 7) CKD management plan for diabetic | .451 [b] | | .493 | | |
| 8) Medications for proteinuria | | | | | .601 |
| 9) eGFR <60 mL min-1 1.73 m-2 complications | .522 | | | | |
| 10) Preparing for dialysis and vascular access | | | | .785 | |
| 11) Actions relates to nephrology consult | .743 | | | | |
| 12) Mineral disorder management | .708 | | | | |
| 13) Goal hemoglobin with anemia and CKD | | | .750 | | |
| 14) Medications for anemia | .670 | | | | |
| 15) Lab values after ACE inhibitor | .474 | | | | |

*Note*. Extraction Method: Principal Component Analysis. Rotation Method: Orthogonal (Varimax) with Kaiser Normalization. Five factors were retained. Minimum eigenvalue was set at .4. Cross-loadings for items Q4 and Q7 are retained for comparison throughout these analyses.

[a] Rotation converged in 7 iterations.

[b] The cross-loadings were retained for scrutiny.

Parallel analysis (see Table 5) was the final extraction method used in this study. It was used to confirm the number of factors since a weak five-factor model was previously obtained. It was chosen for this analysis because it was found to be very accurate compared to the Kaiser-Guttman (Braeken & van Assen, 2017; Hayton et al., 2004). To conduct parallel analysis, the SPSS syntax by O'Connor (2000) was run through an online calculator.

**Table 5. Parallel Analysis for 15 Items**

| Item | Mean Eigenvalue | Percentile Eigenvalue |
|---|---|---|
| 1) Definition of CKD | 1.443235 | 1.539181 |
| 2) eGFR in patient at stage III | 1.339293 | 1.417400 |
| 3) Risk factors for CKD | 1.260878 | 1.312956 |
| 4) Tests to assess kidney damage | 1.191499 | 1.246257 |
| 5) blood pressure with diabetes | 1.135786 | 1.173590 |
| 6) CKD management with diabetes | 1.076230 | 1.107339 |
| 7) CKD management plan for diabetic | 1.032537 | 1.065611 |
| 8) Medications for proteinuria | 0.983819 | 1.025074 |
| 9) eGFR <60 mL min-1 1.73 m-2 complications | 0.935948 | 0.969664 |
| 10) Preparing for dialysis and vascular access | 0.889716 | 0.925841 |
| 11) Actions relates to nephrology consult | 0.843836 | 0.884716 |
| 12) Mineral disorder management | 0.796631 | 0.834108 |
| 13) Goal hemoglobin with anemia and CKD | 0.748227 | 0.788784 |
| 14) Medications for anemia | 0.696294 | 0.746672 |
| 15) Lab values after ACE inhibitor | 0.626071 | 0.685622 |

*Note*. Eigenvalue Monte Carlo Simulation and Random Data Generation using n = 254, number of variables (number of items on the questionnaire) = 15, data sets = 100, and 95$^{th}$ percentile (O'Connor, 2000).

A one-factor solution was confirmed after using Parallel analysis extraction method (see Table 6). To arrive at the final solution, the total initial eigenvalue (actual data from Table 3) must be greater than the corresponding mean eigenvalue (randomly generated data from SPSS from Table 5) for that factor (component) to be retained (O'Connor, 2000). Only the first factor (component) met that requirement. If that factor were to be named, it would be *CKD Practice Guidelines* because it is a broad enough term that would include all of the items and the constructs that they measured.

**Table 6. Comparison of Total Initial and Mean Eigenvalues**

| Factor (Component) | Total Initial Eigenvalue [a] | Mean Eigenvalue [b] |
|---|---|---|
| **1** [c] | **3.256** | **1.443235** |
| 2 | 1.295 | 1.339293 |
| 3 | 1.166 | 1.260878 |
| 4 | 1.085 | 1.191499 |
| 5 | 1.017 | 1.135786 |
| 6 | .982 | 1.076230 |
| 7 | .893 | 1.032537 |
| 8 | .826 | 0.983819 |
| 9 | .804 | 0.935948 |
| 10 | .758 | 0.889716 |
| 11 | .693 | 0.843836 |
| 12 | .656 | 0.796631 |
| 13 | .615 | 0.748227 |
| 14 | .495 | 0.696294 |
| 15 | .460 | 0.626071 |

*Note.* This table is comprised of data from Table 3 and Table 5 for comparison of values.

[a] Actual data from this study (see Table 3) "Total initial eigenvalues".

[b] Results of parallel analysis from randomly generated data, using SPSS syntax (see Table 5).

[c] One factor was retained in this solution.

**Research Question 2**

*The following 10 areas of knowledge of the CKD guidelines were cited in the original study: definition, classification, risk factors, laboratory evaluation, management, indications for referral to nephrologist, complications, management of bone and mineral disorder, management of anemia, and medications used (Agrawal et al., 2009). Are the extracted factors representative of the aforementioned areas?*

(Aim #1: Determine the factor structure of the instrument that determines CKD knowledge.)

Before the question was answered, each item (Q1 through Q15) was inspected to identify the constructs being measured then the latter were documented (see Table 7). The table describes the 15 items in terms of the constructs that are being measured. Ideally, each item should measure only one construct, but only items 2, 3, and 4 did. The constructs are the 10 areas of knowledge of the guidelines. For a less cluttered table, abbreviated items are not listed, but are instead, represented by Q1 through Q15. Adding the question and the response choices would have been more meaningful in understanding how the constructs were ascertained but would have complicated the table. The 10 constructs are identified by capital letters so that the number and name of the constructs are clearly visualized.

**Table 7. Constructs Being Measured by Each Item**

| Item | Construct Assessed | Letter-coded Construct |
|---|---|---|
| Q1 | definition | A |
| | laboratory evaluation | D |
| Q2 | classification | C |
| Q3 | risk factors | B |
| Q4 | laboratory evaluation | D |
| Q5 | laboratory evaluation | D |
| | complications | G |
| Q6 | management | E |
| | medications used | J |
| Q7 | laboratory evaluation | D |
| | management | E |
| | complications | G |
| Q8 | management | E |
| | complications | G |
| | medications used | J |
| Q9 | classification | C |
| | complications | G |
| Q10 | classification | C |
| | management | E |
| | indications for referral | F |
| Q11 | laboratory evaluation | D |
| | management | E |
| | indications for referral | F |
| | complications | G |
| | medications used | J |
| Q12 | laboratory evaluation | D |
| | management | E |
| | complications | G |
| | bone and mineral disorder | H |

**Table 7. Constructs Being Measured by Each Item**

| Item | Construct Assessed | Letter-coded Construct |
|---|---|---|
| Q13 | management of anemia | I |
| | laboratory evaluation | D |
| Q14 | laboratory evaluation | D |
| | management | E |
| | management of anemia | I |
| | medications used | J |
| Q15 | laboratory evaluation | D |
| | management | E |
| | medications used | J |

*Note.* Multiple constructs are being measured by all but items 2, 3, and 4.

After the constructs were letter-coded, they replaced the numerical loadings on the Rotated component Matrix (see Table 8) to demonstrate how many constructs were being measured by each item. Each construct that aligned under a factor was checked for similarities so that the factor could be named, but there were too many and no similarities—the factors could not be named. Normally, the first construct that aligns under a factor is used as the name for the factor even if there were loose or no similarities within the group, but because there were many groups (instead of single constructs) per item, naming the factors could not be accurately done. The extracted factors, therefore, were not representative of the 10 selected areas of the guidelines.

**Table 8. Rotated Component Matrix of Un-named [a] Factors and their Constructs**

| Item | Factor [a] | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Q1 | | A, D | | | |
| Q2 | | C | | | |
| Q3 | | B | | | |
| Q4 | | D | D | | |
| Q5 | | | | | D, G |
| Q6 | | | | E, **J** | |
| Q7 | D, E, F, H, I | | D, E, **G** | | |
| Q8 | | | | | E, **G**, J |
| Q9 | C, **G** | | | | |
| Q10 | | | | C, E, F | |
| Q11 | D, F, **G**, J | | | | |
| Q12 | D, E, **G**, H | | | | |
| Q13 | | | D, I | | |
| Q14 | D, E, I, J | | | | |
| Q15 | D, E, J | | | | |

*Note.* A = definition, B = risk factors, C = classification, D = laboratory evaluation, E = CKD management, F = indications for referral to nephrologist, G = complications, H = management of bone and mineral disorder, I = management of anemia of CKD, and J = medications used in CKD. Each factor loading is denoted by clusters of or a single capital letter that represents the 10 areas of the guidelines (constructs).

[a] The factors are not named because no common theme exists among its corresponding loadings.

**Research Question 3**

*Which attributes of the instrument contribute to its suitability for assessing APRNs' knowledge of the CKD practice guidelines?*

(Aim #2: Assess the psychometric properties of the questionnaire that determined CKD knowledge.)

Assessing the psychometric properties (see Table 9) showed that the scores were more spread out rather than being concentrated around the mean. The instrument lacked content validity because the relatedness of the items to the derived factor could not be determined, and the items were moderately difficult. Cronbach's alpha (.71) was the only assessed psychometric property in Table 9 that supported the suitability of the questionnaire to determine CKD knowledge.

**Table 9. Psychometric Properties of the Original and Current Studies**

| Measurement | Study by Agrawal et al., (2009) n = 479 | Current Study n =254 |
|---|---|---|
| Cronbach's alpha | .69 | .71 |
| Mean score ± SD (%) | 61.9 ± 12.8 | 60.08 ± 21.26 |
| Variance | Not reported | 39.19 |
| Item Discrimination | ≥ 0.3 | Not assessed |
| Difficulty index | Not reported | 0 - .5 |
| Face validity | ✓ | ✓ |
| Content validity | Not reported | ✓ |

*Note*. The minimum cutoff for Cronbach's alpha was .7 for 15 items. Assessments that were not done in this study were not considered necessary to determining the suitability of the instrument for the population being studied.

Cronbach's alpha for the five subscales (factors) of the Physicians' questionnaire (see Table 10) were assessed to assist in determining its suitability for the APRNs. The first subscale had a marginal internal reliability and the remaining four unreliable. The subscales only had 6, 4, 3, 2, and 2 items respectively. More items in a scale or subscale can increase the reliability.

**Table 10. Reliability of Five Extracted Factors**

| Factor | Number of Items [a] | Cronbach's alpha |
|---|---|---|
| 1 | 6 | .686 |
| 2 | 4 | .416 |
| 3 | 3 | .339 |
| 4 | 2 | .234 |
| 5 | 2 | -.157 |

*Note*. Deleting the smaller of two cross-loadings on items 4 and 7did not improve the internal consistency. If Cronbach's alpha for factor 1 is rounded to two decimal places, it would be the only factor that demonstrates internal consistency.

[a] The total number of items on this table is more than 15 because the two pairs of cross-loadings are considered for items 4 and 7 (see Tables 4 and 8). The lower value in each pair was not removed, as is customary, because instrument development was not the goal herein.

The item difficulty index (see Table 11) ranged from 0 - .5 (moderately difficult) and was not convincingly supportive of the instrument's suitability for the APRNs in this study. The items did not appear to be easy.

**Table 11. Item Difficulty Index (n = 254)**

| Item | Correct Response per Item | | |
|---|---|---|---|
| | Count [a] | Number of Choices [b] | *P*-value [c] |
| Q1 | 81 | 1 | .32 |
| Q2 | 122 | 1 | .48 |
| Q3 | 109 | 8 | .43 |
| Q4 | 22 | 4 | .09 |
| Q5 | 114 | 1 | .45 |
| Q6 | 78 | 6 | .31 |
| Q7 | 42 | 3 | .17 |
| Q8 | 2 | 3 | .01 |
| Q9 | 43 | 7 | .17 |
| Q10 | 101 | 1 | .40 |
| Q11 | 128 | 3 | .50 [d] |
| Q12 | 54 | 3 | .21 |
| Q13 | 59 | 1 | .23 |
| Q14 | 53 | 3 | .21 |
| Q15 | 1 | 4 | .00 [e] |

*Note*. Items with *P*-value ≤ .20 are difficult and P-value ≥ .80 are easy (Oermann & Gaberson, 2019). Partial credit is not recognized. All correct choices must be selected for the item to be considered correct.

[a] Number of people who responded correctly to each item.

[b] Maximum number of correct choices per item.

[c] Difficulty index (*P*-value) is calculated by dividing the number of participants who got the item correct by the total number of participants (n = 254).

[d] This was the least difficult item.

[e] zero is a calculated *P*-value that was too small to be quantified to two decimal places. Only one participant received credit for that item. This was the most difficult item.

The number of response choices and correct responses per item (see Table 12) varied widely within the Physicians' questionnaire. That type of structuring can introduce test fatigue, cuing errors, and bias, especially if the questionnaire is already difficult (Oermann & Gaberson, 2019). The item structure does not support the suitability of the instrument for APRNs.

**Table 12. Number of Response Choices per Item on the 15-item Physicians' Survey**

| Item | Number of Options per Item | |
|---|---|---|
| | Total | Maximum Correct |
| 1) Definition of CKD | 4 | 1 |
| 2) eGFR in patient at stage III | 5 | 1 |
| 3) Risk factors for CKD | 10 | 8 |
| 4) Tests to assess kidney damage | 8 | 4 |
| 5) blood pressure with diabetes | 5 | 1 |
| 6) CKD management with diabetes | 7 | 6 |
| 7) CKD management plan for diabetic | 5 | 3 |
| 8) Medications for proteinuria | 5 | 3 |
| 9) eGFR <60 mL min-1 1.73 m-2 complications | 8 | 7 |
| 10) Preparing for dialysis and vascular access | 5 | 1 |
| 11) Actions relates to nephrology consult | 4 | 3 |
| 12) Mineral disorder management | 4 | 3 |
| 13) Goal hemoglobin with anemia and CKD | 5 | 1 |
| 14) Medications for anemia | 5 | 3 |
| 15) Lab values after ACE inhibitor | 8 | 4 |

*Note.* Lack of consistency in number of responses and the maximum number of correct choices per item (see Appendix B) can introduce test fatigue and confusion.
Some, but not all of the items contained options of various lengths (see Appendix B). That could have caused a cuing error, prompting the APRN to make selections based on the length, especially if the survey was difficult.

**Research Question 4**

*Does the instrument have the ability to discriminate across groups of participants?*

(Aim #2: Assess the psychometric properties of the questionnaire that determined CKD knowledge.)

Pearson's Chi-square Test of Independence was used to establish significant ($p \leq .05$) associations between the dependent variable, score, and the independent variables, confidence, awareness, stroke belief, region, length of time in practice, and healthcare provider belief, and age—all descriptors for the APRNs. The results from a two-way contingency table showed a significant association between the APRN score and his/her: (a) confidence in referring patients to nephrologist $\square^2$ (1) = 6.568, $p < .05$, and (b) awareness of the CKD guidelines $\square^2$ (1) = 5.459, $p < .05$. The significant associations between the dependent and independent variables demonstrated the ability of the Physicians' questionnaire to determine CKD knowledge among the APRNs and supports its suitability in this study.

**Research Question 5**

How can the instrument be modified so that it will be more suitable for use with the participants?

(Aim #3: Modify the instrument to improve its suitability for determining APRNs' baseline knowledge of CKD practice guidelines.)

Modification of the Physicians' instrument to determine CKD practice guidelines involved careful scrutiny of all of the results obtained within the study, including those from three short-response questions. The following results were favorable to keeping the instrument as is, with no changes: its factorability (five factors extracted), acceptable Cronbach's alpha (.71), excellent face validity (the survey was an exceptional representation of the aspects of the

CKD practice guideline), and Pearson's Chi-square test of independence which demonstrated significant ($p \leq .05$) associations between scores and confidence in referring patients to a nephrologist as soon as it is indicated, and scores and awareness of the CKD guidelines.

***Creation of a New Survey***

Some of the results did not allow the instrument to be easily modified. Fundamental problems with the factor structure and a lack of relatedness of the items to the derived factors are usually resolved during instrument development, therefore, instead of modifying the instrument for use with APRNs, a new unvalidated instrument to measure knowledge of CKD practice guidelines in non-Nephrology APRNs was created (see Figure 2). The APRN survey has five factors, is free of nephrology-specific jargon that involves CKD staging, detailed knowledge of laboratory parameters, medications used in CKD, disease complications, and management. The APRN survey did not restate the questions from the Physicians' questionnaire, instead, the new questions avoided the aforementioned complications while maintaining fairly even lengths for each item's four response choices. The construct being measured is underlined at the top of the item (see Figure 2).

**Figure 2. Instrument to Measure Knowledge of CKD Practice Guidelines in Non-nephrology APRNs**

**Direction.** Select one correct response for each question.

**Definition**

1) The CKD guidelines from the Kidney Disease Outcomes Quality Initiative (KDOQI) were derived from a systematic review of the literature. The definition of CKD is a minimum of three months of structural or functional kidney damage that affects a person's health, based on glomerular filtration rate (GFR) <60 ml/min/1.73 $m^2$ or a positive test for urine albumin, for at least three months.

   A 52-year-old female patient with a history of Type 2 diabetes complains of bilateral flank pain, chest pain, difficulty breathing, orange urine, difficulty sleeping, and headache. Her current workup includes BP 150/90 mm Hg, HR 115 bpm, GFR 29 ml/min/1.73 $m^2$, elevated serum potassium, blood urea nitrogen (BUN), and creatinine; decrease in serum albumin; dependent edema; and bilateral lung crackles at the bases. She denies illicit drug and alcohol use but admits to regularly skipping her diabetes medications. Using her phone, she accessed her MyChart account from another institution and shared the information with the staff. Most notably, she had been visiting her clinic for flu-like symptoms, nausea, and back pain for the past nine months in which she has had multiple elevated urine albumin, creatinine, and BUN results. Each visit note documented progressively significant weight gain and a negative human chorionic gonadotropin hormone (hCG).

   Which of the following statements is true? She has CKD because she has

   a) GFR 45 ml/min/1.73 $m^2$ and albuminuria repeated over three months.
   b) GFR 45 ml/min/1.73 $m^2$ and hyperalbuminemia for over three months.
   c) GFR less than 60 ml/min/1.73 $m^2$ with hypertension and is pregnant.
   d) GFR less than 60 ml/min/1.73 $m^2$ and hypertension for three months.

**Referral**

2) For the patient in the preceding question, after she is correctly diagnosed and stabilized, what is the most important action?

   a) Start discharge planning per institution policy.
   b) Explain the importance of diabetes medications.
   c) Refer the patient for nephrology consultation.
   d) Make sure that her pain remains well-controlled.

**Risk factors**

3) Families usually have similar lifestyles and habits. For the patient in the preceding question, when she tells her family about what she was taught in the hospital about CKD, what one thing should she ***not*** say?

    a) Diabetes and hypertension are the main causes of CKD.
    b) A diet of natural foods and herbal teas can cure CKD.
    c) CKD can exist for years before symptoms are obvious.
    d) Smoking, and heart disease are risk factors for CKD.

**Risk factors**

4) According to the CDC and the NKF, people are more likely to develop chronic kidney disease if these conditions exist: diabetes, hypertension, obesity, older age, family member with kidney disease, take certain medications like NSAID on a regular basis, belong to a lower socioeconomic group, and being African American, Native American, Hispanic, or Asian. Who is not at risk for CKD?

    a) A boy receiving Tylenol® and Motrin® for two weeks for fever of unknown origin.
    b) A teenager with a heart murmur, who was adopted by an African American couple.
    c) A fitness instructor who has been taking ibuprofen daily for five years for arthritis.
    d) A freshman college student who was just diagnosed with Type 2 diabetes mellitus.

**Laboratory evaluation**

5) For an individual with CKD, protein can leak into the urine because of structural damage to the kidney's filtration system. The Centers for Disease Control and Prevention (CDC) and the National Kidney Foundation (NKF) agree on two simple screening tests for CKD: urine test to detect protein and blood test for glomerular filtration rate (GFR) that indicates the kidney's filtering capability. Which statement is correct?

    a) A blood test can be substituted for a urine test in screening for CKD.
    b) A blood test and a urine test together are best in screening for CKD.
    c) Protein in the urine is constantly normal in people who feel healthy.
    d) Protein in the urine is often abnormal in people who feel healthy.

**Early referral**

6) Early referral is referring a patient with CKD to a nephrologist at least 12 months before a kidney transplant or beginning dialysis. Studies shows that most patients are not being referred early and Healthy People 2020 has made it a priority objective to increase the number of early referrals. If the 12-month period is an advantage to patients with CKD, which statement is false?

    a) A new vascular access will have time to mature before it is needed.
    b) There are opportunities for pre-dialysis education and preparation.
    c) CKD is cured faster than in individuals who are not referred early.
    d) Early referral helps to delay disease progression and complications.

**Early referral**

7) Based on the definition of early referral, a patient should be referred to a nephrologist as soon as

    a) there is a diagnosis of diabetes or hypertension.
    b) 12 months before deciding to donate a kidney.
    c) one year before dialysis or transplant is needed.
    d) he/she starts to experience symptoms of CKD.

**Epidemiology**

8) The Centers for Disease Control and Prevention (CDC) publishes facts concerning CKD. Which statement about CKD is not a fact?

    a) Hemodialysis cures CKD in 53% of Americans annually.
    b) CKD is the eighth-leading cause of death in Americans.
    c) One in every seven American adults suffers from CKD.
    d) About 90% of those with CKD do not know they have it.

**Epidemiology**

9) The United States Renal Data System (USRDS) tracks and reports data that it analyzes about CKD. Select the statement that is not true.

    a) Racial and ethnic minorities are more likely to have CKD than Caucasians.
    b) More people with CKD live in Southeastern US than the other three regions.

c) Incidence and prevalence of CKD are directly proportional to income level.
d) In recent years, CKD accounted for about 22.3% of Medicare's total budget.

**Kidney transplant**

10) Some people with CKD choose kidney transplantation or dialysis to prolong their lives. Which statement about kidney transplantation and dialysis is correct?

a) Dialysis is more expensive to sustain than a kidney transplant.
b) More Americans get kidney transplants than dialysis every year.
c) Two kidneys must be transplanted at the same time for survival.
d) A person cannot live with only one functioning donated kidney.

**Classification of CKD stages**

**11)** A 48-year old African American woman was recently diagnosed with stage 2 CKD. Her GFR is 89 ml/min/1.73 m2. She is compliant with her medication regimen and lifestyle changes, but she is terrified of going on dialysis and wants more information about the five stages of CKD. Which statement about the CKD stages is not correct?

a) At stage 1, patients must be immediately seen by a nephrologist.
b) At stage 4, a venous access is placed in preparation for dialysis.
c) CKD stage 5 is also known as end-stage renal disease (ESRD).
d) Kidney transplant or dialysis are the treatments for CKD stage 5.

**Complications**

12) In addition to filtering waste, some of the other functions of the kidneys include producing hormones, maintaining fluid and electrolyte balance, regulating osmolarity, and maintaining blood pressure. Which process is not complicated by CKD?

a) Parathyroid glands release the hormone thyroxine.
b) Blood volume is maintained at the proper levels.
c) Bone marrow stimulates red blood cell production.
d) Phosphate and calcium are absorbed from the gut.

Since a new unvalidated survey for non-Nephrology APRNs was created in lieu of modifying the Physicians' questionnaire, an example of its accompanying rotated Component Matrix (see Table 13) was also created. The APRNs' survey contains the named factors and their constructs, showing only one construct being measured by each item, and no cross-loadings. It is important to note that the APRN survey is unvalidated and is presented only to demonstrate that knowledge of the CKD guidelines can be assessed without an in-depth command of said guidelines and in the format of a simply laid out structure. Each subscale would have many more items which would be able to stand alone and have a good internal consistency, if the survey was developed for practical use.

**Table 13. Example of Component Matrix of non-Nephrology APRN survey**

| Item | Factor | | | | |
|---|---|---|---|---|---|
| | Complication | Early Referral | Epidemiology | Risk Factor | Lab. Evaluation |
| 1) Definition of CKD | X | | | | |
| 2) Refer for nephrology consultation | | X | | | |
| 3) Families and risk factors for CKD | | | | X | |
| 4) Individuals at risk for CKD | | | | X | |
| 5) Screening tests for CKD | | | | | X |
| 6) Early nephrology referral | | X | | | |
| 7) Timing of CKD referral | | X | | | |
| 8) CKD facts | | | X | | |
| 9) Epidemiology of CKD | | | X | | |
| 10) Kidney Transplant and dialysis | X | | | | |
| 11) CKD stages | X | | | | |
| 12) Not a complication of CKD | X | | | | |

*Note.* Only one construct is being measured per item. Loadings ≥ .4 would be retained in this example. There are clear associations of the constructs and the named factors. The factors can be easily identified with the corresponding items on the suggested survey (see Figure 3).

## Short-response Questions

### *Short-response #1*

If you are aware of any clinical practice guideline for chronic kidney disease (CKD), please state it/them.

There were 122 responses (see Table 14). While most (50%) respondents did not name a guideline, they stated interventions that they have undertaken to care for patients with CKD, including calculating the glomerular filtration rate to determine kidney function. Others (22.13%) demonstrated that not knowing the names of any guideline was not a deterrent to accessing the information that they needed. A small number (15.57%) stated NKF as a CKD guideline, and although it is not a guideline, it (National Kidney Foundation) is responsible for the KDOQI (Kidney Disease Outcome Quality Initiative) guideline. The first-person responses demonstrated that the APRNs were aware of aspects of the CKD guideline.

**Table 14. Awareness of Clinical Practice Guidelines (n = 122)**

| Response [a] | Example quote | Frequency (%) |
|---|---|---|
| KDOQI and KDIGO | "KDIGO Guidelines for CKD"<br>"K/DOQI" | 15 (12.30) |
| NKF | "National Kidney Foundation guidelines" | 19 (15.57) |
| Intervention | "Assess kidney funcation on a yearly basis unless other issues arise. Use the crockcauft-gault equation to help determine kidney function or dysfunction (rated in stages based on this number). If kidney function is decreased, remove drugs that may further damage kidneys and refer to nephrologist" | 61 (50.00) |
| | "I do check labs, and assess physical symptoms of patients who come into my office for psychiatric care. If something is terribly problematic I send to ER or to see primary care nurse. I am aware of basic nursing practices r/t kidney disease and am able to assess symptoms but do not know the specific guidelines" | |
| Other | "While I do not use them everyday, I will look up information primarily the kidney foundation" | 27 (22.13) |
| | "I know they are out there. I would rely on uptodate to find the latest" | |

*Note.* KDOQI = Kidney Disease Outcomes Quality Initiative; KDIGO = Kidney Disease: Improving Global Outcome; NKF = National Kidney Foundation. Only some of the participants responded to the question in the *General Survey Form for APRN* (see Appendix D). They were allowed to give multiple responses.

[a] Responses were assessed for common themes and grouped accordingly. *Interventions* accounted for most of the responses. Respondents who did not name major guidelines, stated actions that were consistent with the guidelines. They demonstrated that although they could not name them, they were competent enough to carry out their jobs and find appropriate sources.

***Short-response #2***

If you are not up to date on CKD clinical practice guidelines, please list the top two barriers that prevent you from keeping up to date.

There were 457 responses and after applying content analytic procedures, 13 themes were isolated. Some of the responses contained more than one barrier to being current on CKD practice guideline so they were separated and categorized with the appropriate theme.

**Table 15. Barriers to Being Current on CKD Practice Guidelines (n = 457)**

| Barrier | Example quote |
|---|---|
| Unaware | "I haven't seen any guidelines" |
| | "Being a new provider. Lack of knowledge base" |
| | "I didn't know they exist" |
| | "Have never seen practice GUIDELINES for CKD" |
| None | "I have ready access to specialists for my patients" |
| | "I don't perceive any barrier to prevent me from being up to date. I have access to Up To Date, and go to an internal medicine review each year, and my Back up physician is very knowledgeable" |
| | "Have a strong working knowledge" |
| Time | "Time to read guidelines outside of cardiology. So many just with the ACC/AHA/HRS" |
| | "busy workload" |
| | "Currently in DNP school. Challenging to find time to re-educate myself on topics from my masters program when there is so much to do in my DNP program" |
| Not applicable to practice | "my specialty does not involve any screening measures for CKD" |
| | "Specialize in heme" |
| | "Retail clinics do not treat CKD" |
| Lengthy/complex documents | "Guidelines need to be concise" |
| | "They are not easily formatted to be able to read and refer to quickly" |
| | "Complex recommendations" |
| | "The information is hard to understand for non-nephrologist" |

| Barrier | Example quote [a] |
|---|---|
| Access to guidelines | "Rural area, lack of resources to refer to" |
| | "Money. I must prioritize which subjects to spend money on for continuing education since I pay out of pocket" |
| | "If the guidelines are not included in the updates I receive from AANP or not offered in CME, I would not know about them" |
| | "Not taught in" |
| | "Not taught in NP school" |
| Someone else's responsibility | "If the patient has an established PCP I feel it's their responsibility" |
| | "General knowledge but count on others to manage but always be mindful of nephrotoxic effects" |
| | "often already seen by nephrology - I expect them to manage this condition for my patient" |
| | "I work in a walk-in clinic, so I don't typically have to worry about management of chronic illness" |
| | "Nephrologist who don't like to teach" |
| | "I am a specialist in behavioral health and will rely on the Patient's pcp to care for their general health and also refer them if needed to a specialist" |
| Awareness by others/society | "I feel CKD does not receive as much attention by general practitioners as other chronic diseases (such as heart disease, diabetes, etc.) and therefore is overlooked by providers and health care organizations, etc." |
| | "Lack of consistency in recommendations between providers, usually Internal medicine doctors" |
| | "Not discussed much outside of nephrology practices" |
| | "I cannot practice outside of my supervising physician's scope of practice and he doesn't treat CKD. Recognizing that the meds I use may need to be adjusted because the patient has CKD is of more value to me" |

| Barrier | Example quote |
|---|---|
| Refer cases | "Frequently refer out to nephrology" |
| | "I refer to nephrology as soon as indicated, and they are often willing to simply review a case to give advice on refer or not to refer" |
| | "My practice setting is retail health; I don't manage CKD patients or make referrals to specialists. (Patients are referred to their PCP for above)" |
| Personal effort | "have not made the necessary effort to acquire the knowledge" |
| | "laziness" |
| | "New np still trying to navigate practice in general" |
| | "Lack of interest" |
| | "I have never looked" |
| | "Not being intentional about reviewing guidelines" |
| | "I do not take enough initiative in seeking out the guidelines" |
| | "Own lack of taking the initiative" |
| New APRN | "Newer practitioner" |
| | "I'm brand new and only have been working as an np for 3 weeks" |
| | "Few opportunities so far to care for patients with CKD (recent grad)" |
| Patient's fault | "Working with medicaid patients primarily, the access to nephrologists and medication is very limited" |
| | "I am not always able to refer patients to a nephrologist per the guidelines as many are uninsured" |
| Few/ no CKD cases | "Typically do not see pts with ckd" |
| | "Not many young women with CKD" |
| | "Decreased number of chronic kidney disease patients at current practice site" |
| | "Haven't encountered it much" |

"I do not have many patients with this issue"

"Just never encountered them"

"No CKD pts "

"I don't actively manage ckd as much as htn and dm and strokes"

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*Note.* Only some of the participants responded to the question. They were allowed to give multiple responses to the question that asked, "If you are not up to date on CKD clinical practice guidelines, please list the top two barriers that prevent you from keeping up to date." Thirteen themes described their responses.

***Short-response #3***

Now that you have completed the exercise, what are the top three things that you will change and/or incorporate in your practice, as they pertain to chronic kidney disease practice guidelines?

Although some respondents did not answer this question, there were 518 responses with seven distinct themes (see Table 16). As a result of participating in this study, six of the changes (themes) that the APRNs expected to make to their practice were identical to some of the areas of the CKD practice guideline—laboratory evaluation, disease management, referral to nephrologist, medication use, management of bone and mineral disorder, and management of anemia of CKD. The last theme, self-improvement, also included sharing the information learned in this study with their colleagues.

**Table 16. Expected Professional Changes After Involvement in this Study (n = 518)**

| Perceived Change | Example quote |
|---|---|
| Laboratory Evaluation | "More frequent monitoring of Cr/GFR" |
| | "Management of proteinuria as progression of kidney damage" |
| | "Check more urines more often" |
| Disease Management | "monitor progress more closely" |
| | "increased follow up" |
| | "Management of proteinuria as progression of kidney damage" |
| Referral to nephrologist | |
| | "Know when to refer" |
| | "Refer to internal med/nephrology" |
| | "Continue to refer to Nephrology at Stg 3 for education and consideration of dialysis options/access" |
| Medication use | "look at additional risk factors when putting someone on lithium " |
| | "Remember to restrict NSAIDs in pts w/ CKD Stage III or higher" |
| | "Make sure diabetics are on Ace/ arb" |
| | "helping patients avoid nephrotoxic medications especially OTCs" |
| Management of bone and mineral disorder | "Watch for bone mineral density changes" |
| | "Aware I need to check phosphorus" |
| | "screen for bone disease" |
| Management of anemia of CKD | "Connect anemia to Ckd" |
| | "Monitoring of anemia" |
| | "Treatment of anemia of ckd" |

| Perceived Change | Example quote |
|---|---|
| Self-improvement [a] | "BP management not as tight (I was using 135/85 in Diabetics) OLD GUIDELINE- USE JNC8 NOW AWARENESS GOOD" |
| | "need to keep better track of my patients" |
| | "Pass this knowledge to my colleagues" |
| | "Become more familiar with screening tests" |
| | "Look up practice guidelines for CKD for adequate patient screening" |
| | "Look up anemia of CKD management" |
| | "Learn more about when to start/stop ACE/ARB to minimize proteinuria" |
| | "Learn the signs and symptoms of CRD and be more aware of pt's risk" |
| | "be more aware of GFR" |
| | "Make time to read them" |
| | "Know where to access CKD practice guidelines" |

*Note.* Responses were given to the question that asked, "Now that you have completed the exercise, what are the top three things that you will change and/or incorporate in your practice, as they pertain to chronic kidney disease practice guidelines?" The seven identified themes all reflect content from CKD clinical practice guidelines, with the first six being directly related to the Physicians' CKD questionnaire by Agrawal et al. (2009) used in this study.

[a] The *self-improvement* theme is evidence that learning occurred and that the participants recognized deficiencies in their knowledge of the guidelines. Several examples are included to account for the uniqueness and variety of intended personal changes.

## Summary

The scree plot and Kaiser-Guttman criterion clearly distinguished a five-factor solution that explained 52% of the variance. However, the relatedness of the items to the derived factors were not clearly distinguishable because although they were all based on CKD, no distinct differences were found among the items. Furthermore, 12 of the 15 items measured multiple constructs at the same time and the factors failed to represent each group of unrelated items, causing the factors to remain nameless. A second analytical method, parallel analysis, produced a one-factor solution, contradicting the five-factor solution. Other qualities of the instrument were assessed in order to determine its overall suitability. Short-response questions explained the reasons for the mediocre scores on the Physicians' questionnaire and helped to determine that it was unsuitable for the APRNs. The overall results suggested that the instrument was moderately difficult and inadequate for determining baseline knowledge of the CKD practice guidelines. As a result, an APRN survey and an accompanying component matrix were created as exemplars to show what suitable ones could look like. The APRN survey avoided highly technical terms, measurements, and concepts out of consideration for the participants who worked in a variety of non-nephrology and non-primary care fields.

# CHAPTER V: DISCUSSION

## Introduction

The main purpose for conducting this study was to establish the suitability of the instrument that was used to determine Advanced Practice Registered Nurses' (APRN) baseline knowledge of chronic kidney disease (CKD) practice guidelines. An instrument designed to determine physicians' knowledge of said guidelines was used because none existed for non-nephrology APRNs at the time that this research was conducted.

The 15-item Physicians' questionnaire was developed to determine physicians' knowledge of the CKD guidelines due to the growing problem with that disease. Several international physician studies (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Estrella et al., 2012; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013) have been done on the subject and while all have used their own questionnaires, none of them were reused in similar physician studies. Also, the studies all investigated different aspects of the guidelines. That is an indication that a standardized survey is needed. For the Physicians' questionnaire by Agrawal et al. (2009), their study did not detail its development, give any information on its structure, or indicate its generalizability. Although its reported Cronbach's alpha (.69) was barely acceptable, it was the best choice for this study.

### The Categorical Variables

The 15-item Physicians'' scale was based on the CKD practice guidelines, focusing on 10 main areas: definition, classification, risk factors, laboratory evaluation, management, indications for referral to nephrologist, complications, management of bone and mineral disorder, management of anemia, and medications used to treat the disease (Agrawal et al., 2009). As this was the first study of its kind with non-nephrology APRNs, two additional surveys were

administered to gather information about them, that were helpful in understanding how they performed on the survey and if the scores and demographic data were somehow associated with each other. The responses from those two additional surveys were the categorical variables used in this study.

The categorical variables (subgroups of participants) described the participants in slightly non-traditional ways (see Table 1). Common ways to categorize groups are by their gender and age. For this study the participants worked in a traditionally female-dominated profession and since it has not been documented that race/ethnicity affects APRNs' knowledge, those two descriptors were not used. Also, there are no previous studies on non-nephrology APRNs' baseline knowledge of the CKD guidelines which could guide this study. Other variables which were more pertinent were used. Some of those variables were inspired by physician studies on knowledge of CKD guidelines and others were based on the APRNs' responses to short questions that were administered before and after the main survey. Associations of those categorical variables (APRN descriptors, also known as subgroups) and scores (converted to a categorical variable) that were obtained on the main survey were investigated by using Pearson's Chi-square test of independence to determine if the survey was able to discriminate between the subgroups.

***Rationale for Choosing the Categorical Variables***

Survey questions that influenced the choice of APRN descriptors (subgroups, categorical variables) and the reasons for choosing them are stated.

***From which region in the United States did you graduate with an Advanced Practice Nursing degree?***

It was assumed that being trained in the south where CKD is more problematic than the other three regions, the APRNs would have an extra awareness of the disease, and that it would also be a part of their graduate education. It was further assumed that attending a post-graduate program in the south where CKD is common and problematic, would reflect more knowledge of the disease and be reflected as a *very high* mean score (at or above 90 %; not based on the literature) and difficulty index at or above .8 (Oermann & Gaberson, 2019). The APRNs' mean score (M = 60.08, SD = 21.26) was deemed mediocre by this study. The findings herein showed no real advantage to being trained in the south. Some participants stated that prior to this study, they were unaware of CKD guidelines. Others stated that they were unaware of the guidelines because it was not taught in their graduate program. Like this study, Estrella et al. (2012) did not find an association between CKD knowledge scores and post-graduate physicians' training in an area with a high rate of CKD. The literature has not supported an association of high prevalence of CKD with increased scores, and with worldwide incidence and prevalence of CKD rising, it is possible that the key to less CKD cases is education of the providers and patients.

A much higher score than the 60.8% mean for the APRNs in this study was expected, considering that 86.6% of them reported receiving their graduate training in the CKD Belt. Being trained in an area with high incidence and prevalence of CKD does not increase one's knowledge of the disease, as evidenced by the APRNs' stated barriers to being current on the CKD guidelines. Knowledge of CKD and of the guidelines must be formally taught. Some APRNs rely on conferences and continuing medical education (CME) hours to stay abreast of current healthcare issues, and they stated that a lack of nephrology CME offers, and the cost of conferences contributed to their lack of knowledge. Since APRNs have difficulty accessing CKD training information after they graduate from their respective program, then maybe a way

to offset that problem is to include the information in their curricula. Until more healthcare providers are able to prove competence on CKD knowledge assessments, a possible solution is co-management of CKD cases with a nephrologist (KDOQI, 2015; KDIGO, 2013; Samal, et al., 2015).

***Since graduating, how long have you been in practice as an Advanced Practice Registered Nurse?***

Physician studies found that the length of time in practice after graduation was associated with improved performance on the CKD knowledge survey (Agrawal et al., 2009; Estrella et al., 2012). In this study, some APRNs reported that they had been practicing as APRNs for less than a year, citing their length of time in practice as a barrier to being knowledgeable about the guidelines. Those who had been in practice for several years and also did not score well stated that they did not work with patients with CKD, had no time, were unaware that CKD guidelines existed, and relied on others to care for those patients.

Agrawal et al. (2009) and Estrella et al. (2012) both sampled physicians in post-graduate years one through three, with the exception that the latter conducted a pre-test and post-test. As expected, the second exposure to the test material increased the scores. Comparing the scores are meaningless when Agrawal et al. (2009) measured CKD knowledge based on 10 areas of the guidelines, using a different scale form Estrella et al. (2014) who conducted a retrospective study of online training modules, the contents of which are unknown. The annual competency modules provided the physicians with an ongoing exposure to CKD guideline, so their scores should be consistently high after the baseline assessment was done, but that information was not shared in their study. This highlights the problem of a lack of a standard instrument when comparing studies—the main similarity among the selected physician studies is that they all used

the National Kidney Foundation's KDOQI guidelines, a vast compilation of very informative material.

The APRN study did not show an association of length of time in practice with scores. Their explanation of working in non-Nephrology subspecialties is most reasonable because they would need to focus on the practice guidelines for those areas more so than on CKD. Their length of time in practice ranged from three weeks to 42 years, but if they do not work with CKD cases then it is unlikely that they would have high scores on a practice guideline assessment.

***If you are aware of any clinical practice guideline for chronic kidney disease (CKD), please state it/them*** (Short-response #1) (see Table 14).

This study assumed that if an APRN was aware of the guidelines, it might influence his/her scores. As a barrier that prevented them from being current, some participants in this study stated that they had never heard of CKD guidelines (see Table 15), while others were aware, but could not name any of them (see Table 14). The majority of the participants who could not name any CKD guideline gave detailed examples of specific nursing interventions that they have engaged in, and/or stated them to demonstrate their awareness and working knowledge of its contents. Some went further to say that they did not know the names of any of the guidelines but knew of their existence and explained how they accessed them as needed.

For the APRNs, the scores on the Physicians' questionnaire could not have explained why their mediocre performance. However, they demonstrated that they knew enough to get their jobs done if they happened to encounter a patient with CKD concerns, they relied on their team members and supervising physicians. Selecting short-response question for further exploration showed that APRNs need more exposure to the subject of CKD.

***How confident are you in referring patients to a nephrologist as soon as it is indicated?***

Referral to a nephrologist, as stated in the CKD guidelines, requires thoughtful timing and it is based on the stage of the disease, described as the glomerular filtration rate (GFR). More precisely, it is known as early referral (KDIGO, 2013)—at least 12 months before the initiation of renal replacement therapy. This study assumed that if an APRN was keen on that aspect of the guideline, he/she would be more confident in patient referral as soon as it was indicated. Although 87% of them reported having confidence in referring patients, some written statements did not reflect that they knew the meaning of *referral to nephrologist*, in terms of the guideline. Several first-person APRN statements clearly indicated that the participants referred patients, but not because of the guidelines. The following are two examples: "I refer to nephrology as soon as indicated, and they are often willing to simply review a case to give advice on refer or not to refer" and, "Not my usual area of practice; usually immediately refer". This question should be revised for clarity in the use of the word referral if it is reused in future studies.

With regard to their instrument to measure confidence and knowledge in managing CKD, Tahir et al. (2014) stated, "If we accept the link between confidence and knowledge this might enable a measure of confidence as a proxy for improving knowledge." Their study influenced the use of the variable, *confidence*, in this study, however, the 87% of confident participants in this study did not reflect a related percentage score (M = 60.08, SD = 21.26) of knowledge on the Physician's survey. Using the variable was important in learning that *referral to nephrologist* was misunderstood by many participants in this study.

***Chronic kidney disease (CKD) increases the risk of stroke. Do you believe that healthcare practitioners who work in the Stroke Belt of the United States should be more***

***knowledgeable of the risk factors for a stroke, including, but not limited to CKD?*** The variable name was *Stroke Belief*. This next question shares a similar rationale.

***The southeastern states have more incidence and prevalence of CKD. Do you believe that healthcare practitioners in the southeastern United States should be more aware of CKD management in their patients?***

The question was posed in this study to educate and assess the participants' attitude toward their responsibility on the issue of risk factors and the region in which they worked, a southeastern state within the Stroke Belt. Pathophysiology explains why CKD increases the risk of stroke, and unless it is taught, one might not realize the connection in terms of risk factor. Since the literature showed that many individuals with CKD were unaware of CKD risk factors (Agustiyowati, 2020; Almutary, 2021; Betz, et al., 2021; Gheewala, et al., 2018; Goro, et al., 2019; Iqbal et al., 2018; King, et al., 2020; Ngendahayo, 2018; Spies et al., 2021; Welch, et al., 2016), it is possible that their providers also were unaware.

This study assumed that because the participants lived and worked in the Stroke Belt, they might be aware of CKD being a risk factor for stroke and that would influence their professional practice and survey score. Findings showed no advantage on the knowledge survey for the participants who lived and worked in a southeastern state within the Stroke Belt. State health agencies should bear the responsibility of ensuring that an emphasis on stroke as a risk factor for CKD is shared with healthcare practitioners who work in the Stroke Belt. It should also ensure that its residents are well-informed. By the same reasoning, schools of nursing, medicine, and allied health should bear a similar responsibility.

***If you are not up to date on CKD clinical practice guidelines, please list the top two barriers that prevent you from keeping up to date*** (Short-response #2) (see Table 15).

Up to the time that this study was conducted, there were no first-person accounts from study participants that provided insight into the reasons for their performance on surveys of knowledge of the CKD practice guidelines. Thirteen themes were identified, and the most telling one was that they practiced in specialized areas that did not involve many renal cases. This item was intended to understand their performance on the survey and allude to the bigger question about why so many physician studies showed mediocre scores, but it showed more complex issues that APRNs experienced, like a lack of physical and financial access to CKD resources, referring patients rather than handling those cases, and lacking the motivation to learn more on their own. Some also expressed who they believe should take care of patients with CKD: "*If the patient has an established PCP, I feel it's their responsibility*". The responses from the participants clearly demonstrate that simply quantifying results in some studies (like this one), can be more meaningful if those results are considered with feedback from the participants. Findings from physician studies that showed mediocre knowledge of the CKD guidelines should be reconsidered on the basis of possible barriers to those participants being current on the guidelines.

***Specialty*** refers to *Internal & Family Medicine* (n = 114) and *Othe*r (n = 140). It was asked of the APRN participants, to account for the various areas in which they worked. Self-reported data accounted for more than half (55.1%) of the group identifying as *Othe*r, working in a very wide variety of specialized areas that were not easily grouped. Grouping was difficult because they were first-person accounts with slight variations among them and should not be altered to fit into a pre-judged category. Since none of the statements, stated primary care, it can be assumed that that 55.1% of the participants did not need to be well-acquainted with the CKD practice guidelines, especially because nephrology specialists were excluded from this study. It

is unclear if this finding is representative of physicians who participated in CKD knowledge surveys too; their titles might indicate that they are primary care providers, but if their institution already has other physicians to handle nephrology-related cases, then they would not need to demonstrate in-depth knowledge of the guidelines.

## Discussion of Findings

### Research Questions 1-5

***Research Question 1.*** *Are the extracted underlying dimensions (factors) distinguishable from each other?*

(Aim #1: Determine the factor structure of the instrument that determines CKD knowledge.)

All of the assessments of factorability clearly indicated that the data met the conditions for factor analysis—reduction to a smaller, more manageable dataset that can reveal latent factors—the goal of factor analysis. Exploratory Factor Analysis (EFA) using Principal Components Analysis (PCA) extraction method with orthogonal (varimax rotation) further confirmed that the instrument was performing well. Five factors were retained using more than one method, also alluding to clearly distinguishable from each other especially considering a minimum eigenvalue cutoff of .4. There were two pairs of eigenvalues that loaded on two items, but that was not a problem for this study because the literature suggests that an easy fix was to remove the smaller of any pair. That was not done in this study, however, because an instrument was not being developed; this was an exploratory study, and they were kept in the model to further understanding its structure. The research aim and question were answered at this point; the extracted factors were clearly distinguishable from each other; however, a follow-up was done to compare the findings.

Parallel analysis, referred to as a more accurate extraction method (Braeken & van Assen, 2017) (although it has a reputation of under-factoring data), was employed to compare the previous findings. It revealed a one-factor structure, contradicting the previous five-factor solution. It was at this point that the 15-item scale appeared to be questionable. It was a weak scale to begin with, since only 52% of the variance explained the five-factor solution. The conclusion was that since the data appeared to have clearly distinguishable factors and met the requirements for EFA, there might be some value in the acquired solution. Since PCA and Parallel extraction methods have been known to over- and under-factor data, respectively the true solution might be somewhere in between one and five factors.

***Research Question 2.*** *The following 10 areas of knowledge of the CKD guidelines were cited in the original study: definition, classification, risk factors, laboratory evaluation, management, indications for referral to nephrologist, complications, management of bone and mineral disorder, management of anemia, and medications used (Agrawal et al., 2009). Are the extracted factors representative of the aforementioned areas?*

(Aim #1: Determine the factor structure of the instrument that determines CKD knowledge.)

Each of the 10 areas of knowledge were being measured by the 15 items on the questionnaire. It was expected that a matrix would show one item corresponding with one factor as is typical when one construct is shown to be measuring what it is designed to measure. If there were 10 constructs and 10 items, it would be expected that one value (factor loading) per item would correspond to one factor in the matrix; a simple solution. Since there were 10 constructs to measure and 15 items, a one to one matching was not possible. It was expected that

one construct would be measured in more than one item to account for that, however, more than one was measured in all but three of the items (see Table 8), indicating a potential problem.

A simple solution is the goal of factor analysis (Vogt & Johnson, 2016), but multiple constructs per item was a problem in this study. Multiple concepts being measured at the same time cannot truly show how much influence each has on the scale or the findings or, in the results obtained from using that scale. This is indicative of a poorly designed scale and to improve it, an item would need to be rewritten so that too many "ideas" are not introduced at once. In other words, if the item should be measuring CKD management, it should not be worded so that laboratory values, indications for referral, management of bone and mineral disorder of CKD, and management of anemia of CKD are assessed simultaneously as in item #7 (see Table8) (Agrawal et al. (2009). Although some of the other areas mentioned are in the list of possible responses and not the question per se, the person being assessed would need to be knowledgeable about all of those areas of the guidelines in order to select the correct responses. Test-taking is not just about selecting a correct response; it should be an assessment of knowledge.

If an individual being assessed with that scale might be able to identify the medications, but nothing else in that item, a single score would definitely not be accurately measuring that individual's knowledge of any construct (aspect) of the CKD guideline. Because item #7 is presented in a complicated way, a test-taker might perceive it as being difficult. In fact, the calculated item difficulty index for that item (see Table 11) is .17; difficult (Oermann & Gaberson, 2019). Adding to the item's complexity, were three correct responses out of five choices. Only 16% of the APRNs in this study got item #7 correct. Item construction was a major flaw of the scale to determine knowledge of CKD practice guideline.

Typically, the first construct that aligned under a factor would be used as the name of the factor, and usually, the remaining factors would bear some form of resemblance to each other, contributing to the relatedness of factors, items, and constructs. That was not possible for this scale as the 10 distinctly different areas of knowledge had various combinations under their respective factors (see Table 8). The conclusion was that the extracted factors were not representative of the aforementioned 10 areas.

***Research Question 3.*** *Which attributes of the instrument contribute to its suitability for assessing APRNs' knowledge of the CKD practice guidelines?*

(Aim #2: Assess the psychometric properties of the questionnaire that determined CKD knowledge.)

At this point, after discovering that the basic internal structure of the scale is not valuable, a new scale should be selected to determine knowledge of CKD practice guidelines. Since no alternatives existed, further analyses were done to determine its suitability for use in this study. Assessing its psychometric properties spoke to its usefulness.

The Cronbach's alpha (.71) showed that it was acceptable at measuring what it should measure. The mediocre mean score expressed in percentage rather than raw score gives a better understanding of its value (M = 60.08, SD = 21.26) (see Table 9). It was consistent with the findings of the Physicians' study (M = 61.9, SD = 12.8). Although the mean for the latter was almost two percent higher than the APRNs' mean scores, both had poor standard deviations due to the large numbers. The physicians' scores were not as spread out as the APRN study and both studies allude to a non-normal distribution due to the large standard deviation. The variance (39.19) is still an indication of how widely the scores were dispersed; it adds nothing new.

While face validity was confirmed in this and the original study by board certified physicians, it really does not bear much weight as it is a subjective assessment and not scientifically based. Content validity, however, was assessed (see Table 8) in attempting to name the factors on the basis of similar themes among their loadings. The instrument lacked content validity.

No supporting evidence accompanied the physician study, to account for the scores. An explanation for the APRNs' scores, however, was concluded from analyzing the short-responses from the pre-and post-survey forms. Based on the fact that the majority (55.1%) reported not practicing Internal or Family Medicine, but offered a wide variety of sub-specialties, it was clear that they were no primary care providers, so it was not necessary for them to know the practice guidelines to the extent that the survey required. That reasoning alone is enough to determine that they would not be familiar with the detailed areas of knowledge that the instrument was designed to measure, and that would lead one to conclude that the assessment would be difficult for them, supported by the item difficulty index range (0 - .5). It is not because they were somehow incompetent, they simply did not know because their jobs did not require them to know. The reason for the poor scores in physician studies might be a bit similar, but until those subjects are asked directly, the reason will remain unknown.

This study began on the assumption that since APRNs have graduate degrees and were trained in Internal and Family Medicine, they should know the guidelines. Findings showed that most of them worked in specialized areas and that they were not even familiar with the basics of kidney disease. Awareness of CKD, independent of the practice guidelines, was deduced from some of the responses.

Determining the variance, item difficulty index, validity, and any other psychometric property of the scale turned out to be less important than previously thought, due to the information gleaned in this study from the participants' firsthand accounts. The conclusion drawn up to this point is that the instrument clearly and accurately articulated areas of the CKD practice guidelines, instrument development surrounding its factor structure was very weak, and it was not suitable for measuring APRN knowledge of CKD practice guidelines. Knowing what affected APRNs' awareness of the guidelines, including the barriers they faced, was a surprising turning point in this study that statistical measures could not capture. Their responses were the contributions that confirmed the instrument's unsuitability. Cronbach's alpha might be the best attribute of the instrument that contributed to its suitability.

Based on the item difficulty index, *P*, the scale was moderately difficult (see Table 11); there were no easy items since $P \geq .80$ are easy (Oermann & Gaberson, 2019). The most difficult item for the APRNs was item #15 ($P = 0$). Only .39% (one) participant received credit for it, an item with four correct responses out of eight choices (see Table 12). In that question, *knowledge of laboratory evaluation* was the construct being measured, but also included in the responses choices were *knowledge of CKD management* and *medications used in CKD*, adding complexity to the question. The single score obtained does not accurately measure the APRNs' knowledge of the intended construct, *knowledge of laboratory evaluation*.

The least difficult item, item #11, had a difficulty index $P = .5$, moderately difficult (see Table 11), if $P \geq .80$ is easy (Oermann & Gaberson, 2019). Half (50.39%) of the APRNs received credit for it (see Table 11), an item with three correct responses out of four choices (see Table 12). That item also assessed the construct, *knowledge of laboratory evaluation*, per the question itself, but the response choices contained other constructs that included *knowledge of*:

*indications for referral to nephrologist*, *complications of CKD*, and *medications used in CKD*. Similar to most of the questions in the survey, the single score obtained does not accurately measure the APRNs' knowledge of the intended construct, in this case, *knowledge of laboratory evaluation*. The APRNs would need to be knowledgeable about not just the construct in the body of the question, but all of the response choices in order to make the correct selections.

***Research Question 4.*** *Does the instrument have the ability to discriminate across groups of participants?*

(Aim #2: Assess the psychometric properties of the questionnaire that determined CKD knowledge.)

The idea behind this research question was to see if significant ($p<.05$) associations between the variables existed. This would indicate that the instrument was dependable and its suitability for this study would be supported. The variables and the decision to use them were previously described. Since this study is the first of its kind, it is still unknown if those variables were good choices. Combining uncertain variables with a thus far weak instrument might not be such a good idea, but the results would still add meaning to the overall study. Significant associations are just that; an indication that a relationship exists. Further analyses would need to be performed in another study to determine more information about those associations.

Pearson's Chi-square analysis was used to determine if associations existed between the scores and the variables that described characteristics associated with the APRNs. The resulting significant ($p<.05$) associations could be indicative of the instrument's ability to discriminate across APRN subgroups (the descriptors). Significant associations were observed between scores and APRNs' awareness of the CKD guidelines $\chi^2$ (1) = 5.459, $p < .05$ and also between scores and APRNs' confidence in referring patients to nephrologist $\chi^2$ (1) = 6.568, $p < .05$. However,

through the short-response questions, it was discovered that the term *referral to nephrologist* was misunderstood by the participants and that it was not reflective of the guidelines. Although a significant association was found between scores and confidence in referring patients to nephrologist, it was established on a basic misunderstanding so it is this study's position that it should not be relied upon.

***Research Question 5.*** *How can the instrument be modified so that it will be more suitable for use with the participants?*

(Aim #3: Modify the instrument to improve its suitability for determining APRNs' baseline knowledge of CKD practice guidelines.)

Although the factors were distinguishable from each other (Research Question 1), as evidenced by a five-factor solution that explained 52% of the variance, it was not indicative of a strong model. Polit and Beck (2021) assert that 60% should be the minimum. By that standard, the scale is weak with even weaker subscales that did not achieve the minimum Cronbach's alpha (.7). It would be an unfair assessment of the instrument if it was not mentioned that the subscales contained only two to six questions, including subscales that had an extra count (because the cross-loadings were retained to help describe the results). Normally, subscales contain several questions that have the ability to stand alone and can sometimes be used independently of the complete scale, but that was not the case with the Physicians'. It was clear during analysis, that it had not undergone the customary steps in instrument development and was therefore not a good choice of instruments to be analyzed in that way. However, this study maintains that the Physicians' questionnaire had excellent face validity and would have been appropriate for primary care providers who managed CKD cases.

To improve the scale to make it suitable for the majority of the APRNs in this study (who are not primary care providers), the items could be rewritten with simpler questions that represent a single concept of CKD (see Figure 2), which would result in a less cluttered matrix (see Table 13). Improvements to the scale would need to include its design, which would include Confirmatory Factor Analysis to verify the factor structure. Simply rewriting the questions to make them less complex does not solve the problem of an unreliable factor structure. A more meaningful approach was to develop a new instrument. Instrument development includes careful and accurate theory-guided steps to selection of the construct, create several items more than necessary and have them reviewed by experts in the field, beta testing, factor analyze the scale, assess reliability, to name a few (DeVellis, 2016). Instrument development was not possible for this study, but a very small sample of 12 items was developed (see Figure 2) and a suggested Component Matrix (see Table 13) that would be expected as a result of factor extraction and rotation was also developed to offer a demonstration of what would be expected from a survey that was suitable for non-Nephrology APRNs.

**The Physician Studies**

This study is about establishing the suitability of the instrument that determined APRNs' baseline knowledge of CKD practice guidelines. It was necessary to look at its suitability because it was designed for internal medicine residents, not for APRNs. It was used because, as this is the first known study of its kind, non-nephrology APRNs' knowledge of the practice guidelines have not been studied and therefore, no instrument exists for such a study. All of the supporting literature so far were included to show the expanse and seriousness of CKD and the lack of knowledge of the guidelines among patients with CKD and physicians, the largest group of primary care providers. The physician studies all used different scales to measure different

aspects of the guidelines, and they used arbitrary cutoff scores to operationalize knowledge of the guidelines, making it difficult to level comparisons among them.

Agaba et al. (2012), for example, used a 30-item scale with a mixture of item formats to assess non-Nephrology Internists and Family Medicine physicians on the following six areas of the CKD guidelines: definition and staging, risk factors, laboratory evaluation, management, complications, and referral while Agrawal et al. (2009) covered 10 areas. The instrument for the former was not available, they admitted to an arbitrary minimum score (70%), and that they might not have done a thorough assessment of their subjects, in an attempt to address all of the areas of the guideline

Agrawal et al. (2009) did not suggest the same about their scale, but this study found that it had done the same thing. It measured 10 constructs with 15 items and as it turned out, multiple constructs wound up in several of the items. Their response choices were also varied from one to eight in an attempt to fit as much information as possible into the scale. Both studies concluded that the physicians lacked CKD knowledge.

As this is a study about the suitability of the scale used to determine CKD knowledge, having access to the scales from several other studies for comparison, would have been beneficial. There is no knowledge of the scales' structure to make a comparison with that from Agrawal et al. (2009) or the one created for this APRN study (see Figure 2). Choukem et al. (2016) included their close-ended, 18-item scale, that measured physicians' knowledge of CKD and their attitudes toward referral. The finding of poor attitude and CKD knowledge deficit resulted in a recommendation for CKD education.

An observational study to determine the performance of an online instrument that determined improvement of medical residents' CKD knowledge resulted in the post-tests

showing improvement, but overall poor knowledge among the graduating participants (Estrella, et al. (2012). However, Israni et al. (2009) investigated physicians' characteristics for an association with their knowledge of CKD management and found several areas of knowledge deficit, although internal medicine specialists were more likely to recognize CKD than family practice and older physicians.

This study assessed physicians and "other health sciences professionals'" (Wolide et al., 2020, p. 2) knowledge, attitude, and practices toward CKD on a 29-item multiple response scale and found that they had "adequate knowledge, positive attitude and good practices" (p. 5) toward CKD because they scored 70% or greater. Yaqub et al. (2013) investigated general practitioners' knowledge and approach toward CKD and found knowledge deficits in various areas of the guidelines. They recommended education to raise awareness of the guidelines but were not specific about how it should be completed.

Aside from reporting scores, the previous physician studies were not very effective in explaining the reasons for the scores, the format of the recommended CKD education, or how education would fit into busy health care practitioners' schedules. The APRN study brought several things to light after being asked specific questions in addition to the survey items. It is a good idea to ask the participants open-ended questions to ensure that there will be explanations to the responses that were quantified. For example, the literature continues to show poor knowledge among physicians; instead of administering another survey and assigning a score, the APRNs were asked about factors that could influence their knowledge of the guidelines. It is possible that many of the sampled physicians, although they area primary care physicians, do not work in that role because they are a part of a team with other more qualified professionals who handle complicated or specialist cases. They could also be working in leadership roles wherein

they never provide patient care, or if they do, it is minimal care. As seen with the APRNs, time constraint and access to CKD educational resources can be challenging when there are other practice guidelines for other specialties that require their attention too.

## Conclusions

This study proposes, based on the statistical findings and the quotes from the participants, that the Physicians' questionnaire cannot be improved because it has deficiencies that originate at the core of its development—the factor structure and the lack of relatedness of the items to the resultant factors. So, following guidelines for instrument development and validation to build an appropriate instrument, was a better option than attempting to improve it. A standard and reliable instrument is needed, as evidenced by various physicians creating and administering their own surveys to investigate various aspects of the CKD guidelines (Agaba et al., 2012; Agrawal et al., 2009; Choukem et al., 2016; Estrella et al., 2012; Israni et al., 2009; Tahir et al., 2014; Wolide et al., 2020; Yaqub et al., 2013), in addition to none being available for non-Nephrology APRNs.

The CKD clinical practice guidelines are saturated with salient and highly specialized nephrology material, as would be expected from any other body system practice guideline. Like physicians in other studies of knowledge of the guidelines (Estrella et al., 2013; Yaqub et al., 2013), the respondents in this study stated that the length and complexity of the CKD guidelines prevented them from being more aware of the content. Access to more condensed renditions of the guidelines are needed for physicians and APRNs as suggested by the following, (Agrawal et al., 2009; Estrella et al., 2013; USDVA, 2015b; Yaqub et al., 2013). While the unvalidated APRN survey (see Figure 2) does not address a condensed version, it incorporates simple, non-technical language, avoids specific laboratory parameters, medications, and treatment decisions,

while emphasizing awareness of the disease, risk factors, and the definition of CKD. The definition of CKD is an important inclusion because it provides a simple yet accurate way to describe its classification so that the guidelines could be established. KDIGO and KDOQI have agreed upon the definition (Inker, 2014; KDIGO, 2013). Furthermore, it sought to educate APRNs about CKD and assess their knowledge simultaneously.

The "educate while assessing" approach was the idea throughout the scale, and it was beneficial to the APRNs in this study, as evidenced by their statements of what they intended to change and/or incorporate into their practice as a result of their participation in this study.

**Which Non-nephrology APRNs Need to Know the CKD Guideline?**

APRNs who do not directly work in nephrology but have a patient co-management arrangement with a supervising nephrologist or other physician, then APRNs might not need to know the specifics of the guidelines, although being aware of them would be beneficial to their patients and their overall practice. Respondents stated that they referred patients with CKD to specialty care or that they had physician partners or supervisors who would handle those cases. Clearly, those APRNs did not demonstrate knowledge of the guideline.

In this study, 55.1 % of the participants were classified as *Other* in reporting their main practice area, while 44.9% reported Internal and Family Medicine. A few of the *Other* reported specialty areas (some with nuanced differences) include "cardiology", "cardiac surgery", "urgent care/emergency", "emergency medicine", "obstetrics and gynecology", "ob/gyn midwifery", "women's health, family planning, and STDs", "hepatology/transplant", "general surgery", "vascular surgery", "surgical oncology", "urology", "endocrinology", "diabetes management", "onsite workplace wellness clinic", "psychiatry", "home assessment visit for insurance company", and "retail". The exhaustive list is an eye-opener, and it also presents more thought-

provoking issues like, how many of the APRNs believe that because they work in those specialty areas, patients with undiagnosed CKD never visit their practice; or how many patients who are at risk were never told, simply because their providers were not aware of the CKD risk factors.

Having a basic understanding of CKD instead of a good command of the practice guideline would be beneficial to APRNs working in the aforementioned areas. All of the stated areas of practice have the potential for patient contact, although the interaction might be brief. If a chance discovery was made, that a patient was at high risk for CKD the ethical thing to do is inform the patient about his/her risk status. However, if the APRN has no knowledge of the guidelines, nothing can be done. Many patients with CKD do not know they have it until the disease has progressed. This study posits that if more health care providers intervene at the first sign of disease onset or even before, by recognizing the risk factors, less patients could develop kidney damage.

## Implications

### Theory

#### *Knowles' Adult Learning Theory*

Knowles' Adult Learning Theory guided this research from inception through execution, based on its constructs that were applicable to the APRNs who are considered the learners (this study sought to educate them about CKD guidelines while assessing their CKD knowledge). The constructs are: learner's self-concept; learner's experience; readiness to learn, life-centered, task-centered, or problem-centered orientation to learn; and internal motivation.

**Learner's Self-concept.** The APRNs (n = 254) remained in the self-paced study, demonstrating that they were in control of their learning experience through a moderately difficult ($0 \geq P \geq .5$) knowledge survey. The majority of them voluntarily answered the short-

response questions that provided a wealth of information about their experiences with CKD practice guidelines and affirmed that they would learn more about aspects of the guidelines that they determined that they needed to improve upon professionally (see Table 16). This was an assumed outcome of the study.

**Learner's Experience.** It was assumed that the APRNs would draw from their professional experiences and prior graduate studies in order to make inferences to answer the questions. While there was no concrete evidence from their quantified performance on the Physicians' questionnaire that they did, their statements confirmed it (see Table 14). Fifty percent of the responses (n = 122) stated interventions that they applied when they cared for patients with CKD. They demonstrated the ability to integrate their experiential sources along with sound reasoning—an expectation of a professional adult learner.

**Learner's Readiness to Learn.** The APRNs were expected to be engaged in assessing their own knowledge of CKD practice guidelines and they demonstrated this by their feedback about what they learned and how they planned to use that information in their practice (see Table 16). Their responses (n = 518) exceeded the expectation of *their readiness to learn* more about the following six specific aspects of the guidelines: laboratory evaluation, disease management, referral to nephrologist, medication use, management of bone and mineral disorder, and management of anemia of CKD. Two hyperlinks were provided to them at the end of the study, that led to CKD practice guidelines because it was assumed that they would want to learn more. While there is no way to assess if they followed through to use those hyperlinks, their previous actions and Knowles' theory suggest that they will.

**Life-centered, Task-centered, or Problem-centered Orientation to Learn.** One of the reasons for choosing the Physicians' questionnaire for this study was its inclusion of vignettes

with some items. It was a way to involve Knowles' theory as it was expected that the APRNs would be able to find the vignettes relatable to their professional lives. However, when the APRN survey was created in response to Research Question #5 (see Figure 2), it was done so deliberately with the expectation of creating a *problem-centered orientation to learn* (Knowles, 1984). Research Question #5 introduced specific actions commonly carried out by nurses. Two of them are discharge planning (item 2) and teaching (item 3). The survey was structured on one of the most important evaluations that US nurses must take, the National Council Licensure Examination (NCLEX), again in preparation for this study to be guided by the Knowles' theory.

**Learners' Internal Motivation.** Although some participants said that a barrier to preventing them from being current on the CKD guidelines was lack of motivation (see Table 15), others reported that they actively sought CKD information. This study assumed that the APRNs would be motivated to learn more about CKD, and by their admission, they planned on learning more about six specific areas of the guideline that were also the focus of the Physicians' questionnaire (see Table 16). Some even stated that they would make self-improvement changes as a result of their participation in the study (see Table 16). This study assumes that the APRNs' internal motivation to succeed or improve themselves professionally, drove their progression throughout the study.

### *Nursing Theory*

Nursing theory lacks a standard definition for the terms *knowledge of practice guidelines*, *knowledge of CKD*, and *awareness of CKD*. They are needed so that they will mean the same thing each time they are used, despite the population or study in which they are used. The meanings of the terms as they have appeared in the literature did not have a common definition and no evidence-based standard by which the scores were quantified, rendering those tools

ineffective in terms of their generalizability to other settings and populations. When consistency in definitions and measurements are achieved, the information will become a part of the body of science and be the standard by which more studies can be conducted.

This study has made a small contribution toward arriving at a definition, by demonstrating that any future definitions will need to consider the population of non-nephrology APRNs who have no need for an in-depth command of CKD practice guidelines. Their CKD knowledge was quantified, but their statements verified that that their knowledge was affected by other things (see Table 15) that are pertinent to APRNs. Some statements implied that the APRNs practiced in a state in which they were not granted full practice authority, so they relied on their supervising physicians' knowledge of the CKD guidelines as needed; "*I cannot practice outside of my supervising physician's scope of practice and he doesn't treat CKD*", and "*I refer to nephrology as soon as indicated, and they are often willing to simply review a case to give advice on refer or not to refer*". It is possible that more than one definition will be needed for the groups that will be studied, based on their level of involvement with patient care.

**Practice and Education**

This study has implications for clinical practice and nursing education. It can now be said, based on the findings that include their own statements, that non-nephrology APRNs in specialized practice areas do not need to know the CKD practice guidelines in-depth because many of them do not routinely care for patients with CKD. Most of them had supervising physicians or other team members who are more qualified to address CKD (see Table 15). There are aspects of the guidelines, however, that are beneficial in the practice setting, and do not require complicated treatments or medication management. Recognition of CKD risk factors and knowing the definition of CKD are very important areas of the guidelines that are credited in

delaying disease onset, progression, and complication in many individuals (HP2020, 2015). When asked to state the CKD practice guidelines that they knew, most APRNs could not name them, but they detailed the interventions that they have made or would make in certain clinical scenarios, and some shared how they accessed the information and physical help that were necessary in the clinical setting. They clearly knew more than the survey could determine. Assessing their knowledge of the guidelines can be approached more effectively from an *educate and assess* model in which the information is given, then they arrive at an answer using their experiences and professional judgment—similar to Knowles' Adult Learning Theory.

Some of the participants stated that they were unaware of the CKD guidelines for a variety of reasons that included being new graduates and that the information was not covered in their graduate studies. If faculty in schools of nursing in the southeastern region were aware of the prevalence of CKD in the *CKD Belt*, they might be more inclined to include the topic in their programs of study. Undergraduates formally learning about CKD and how it affects their own communities could normalize screening and risk assessments for generations to come.

Governing bodies like The American Academy of Nurse Practitioners (AANP) and Nephrology Nurses Association (ANNA) would do well to periodically offer free continuing education credits to non-nephrology nurses, using the *educate and assess* approach, while recognizing that the goal is to raise awareness about CKD. Those are suggested in response to studies that suggest that more CKD education is needed among health care providers, and study participants' statements that, in addition to time, affordable access to CMEs and conferences that focus on CKD prevented them from keeping up to date on the subject. This study also suggests that the NCBON recognize the CKD problem within the CKD Belt and offer CKD education to all of its registrants as a part of their routine license renewal.

### *Education*

Physician studies with poor CKD knowledge results have speculated that physicians need more CKD education (Agaba et al. 2012; Agrawal et al. 2009; Choukem; Israni et al. 2009). Estrella et al. (2012) found that an online training module was effective in improving aspects of CKD among PGYs one through three, but none of the studies offered substantial suggestions on how to educate non-Nephrology physicians who had completed their studies. In this study, non-Nephrology APRNs stated numerous challenges to being current on the guidelines, and lack of time was a recurring theme.

CKD education can be delivered to working professionals through CMEs, conferences, and lighter versions of the CKD guidelines as suggested by the APRNs in this study who expressed a need for more information on the guidelines. This study showed that the literature is lacking in studies about APRNs' CKD knowledge and that CKD is a problem in the southeastern region. Schools of nursing are in a unique position to introduce the topic of CKD to its pre-licensure students, and devise new ways to deliver CKD information to their graduate nursing students.

### Research

This study has already declared the need for a suitable, standardized instrument that can determine APRNs' knowledge of CKD practice guidelines, based on its findings. Robust studies with a reliable and valid instrument can deliver consistent results. The results indicate that there is also a need to make APRNs aware of CKD, and that awareness and education need to be prioritized over instrument development if they cannot be done concurrently. This adds to the body of knowledge that patients and physicians lack CKD knowledge. CKD knowledge and

knowledge of the CKD practice guidelines, however, are very different and should not be misconstrued when the results of studies are stated.

Further studies to obtain more information about the association between scores and the APRN descriptors should be pursued. So far, since this is the first study that has shown that scores alone cannot truly account for knowledge of CKD practice guidelines among APRNs, and since no variables were associated with their scores prior to this study, this is a good point to continue further scientific inquiry. Pearson's Chi-square test of independence was appropriate in determining associations of the scores and descriptors in this study, but consideration must be given to the fact that the scale that generated those scores was barely reliable and was deemed unsuitable for the study.

Qualitative studies that determine the best way to offer CKD education to busy non-Nephrology healthcare providers, with limited time, are needed. First person accounts from the subjects of research are best since speculation is avoided by the researcher.

Based on this study, it is only fair that extenuating factors that affect APRNs' knowledge of the CKD practice guidelines be mentioned at the same time as the results. Results from research studies (like poor or good scores) should be reported with some contextual background, to convey transparency. National and international studies that investigate the reasons for APRNs' lack of knowledge on CKD practice guidelines could confirm the results of this study and determine additional variables that might help to explain survey results.

## Limitations

### The 15-item Physicians' Scale

Two main reasons limited the scale's internal consistency. (1) It did not contain enough items per subscale to accurately determine their respective Cronbach's alpha. The five subscales

had from two to six items, not nearly enough to determine their reliability. The more items that are in a subscale, the greater the chance of an increased Cronbach's alpha, and the better its reliability. (2) The scale was also limited in its ability to establish relatedness of the items to the derived factors as there were multiple constructs being measured per item and that contributed to the inability to name the extracted factors. The expectation was for only one construct to be measured per item.

**Beta Testing**

Including APRNs in beta testing would have provided more insight into the fact that, despite the literature, most of the participants in this sample from the NCBON did not practice in the primary care role, an indicator that trying to determine their knowledge of the CKD guidelines with such an in-depth survey was not the best choice. Non-nephrology non-primary care APRNs do not need to know CKD management, an in-depth aspect of the guidelines, but would be better off knowing other aspects like the definition of CKD and its risk factors.

APRNs should have been included in beta testing since they were the target group. Prior to launching the study, less than 15 registered nurses with graduate degrees in nursing participated in beta testing via Qualtrics, but none of them were APRNs. Post hoc review of the completed study (n = 254) revealed that measures could have been taken to make it more specific to the participants had there been input and advice from APRNs from its inception to execution. This was an anonymous study in which the results were reported aggregately. The identities of the participants remain unknown to the Principal Investigator (PI) and the experts supervising the dissertation because the database was irreversibly de-identified as soon as it was acquired. It is still unknown how their inclusion in beta testing would guarantee that those specific APRNs

were also excluded from the actual survey without tainting its integrity and violating its anonymous nature.

**One State Sampled**

The study was restricted to APRNs within North Carolina (NC), and although a wealth of information was obtained from their short-responses, independent of the main Physicians' survey, restricting the study to one state prevents it from being generalizable to the APRN population outside of NC. The responses did not appear to be especially unique because of the participants' training and residence status within the Stroke Belt and the *CKD Belt*, a term that this study has coined to describe the disease prevalence within the southeastern region. However, those questions would need to be asked of the APRNs outside of NC in order to: obtain a broader perspective of their lived experiences, incorporate into future studies, and to consider when designing and making CKD information accessible to them. While the sample size exceeded the minimum requirement for Exploratory Factor Analysis, extending the study to capture a national sample could have increased the variety of responses, including the short responses that have provided depth to APRNs' experiences with CKD.

**Exclusion of Other APRNs**

Certified Registered Nurse Anesthetists (CRNAs) and Clinical Nurse Specialists (CNS) were excluded from the study because they were thought to have less opportunities to care for patients in a primary care setting and on a continuum, important aspects of CKD management. The findings of the study indicated that 55.1% of the sample also did not work in a primary care setting because they worked in other specialty areas. This study asserts that those APRNs would still benefit from knowing other aspects of the guidelines, like the definition of CKD and its risk factors. As such, CRNAs and CNSs could have been invited to participate as their short-

responses would also add to the body of knowledge that, prior to this study, were not researched. It is possible that the two excluded groups of APRNs did, in fact, have the opportunity to interact with renal cases or work on a team that did, like some participants stated that they did, although they did not practice primary care. This study was wrong to assume traditional roles of the APRNs, based on their designated classification through the NCBON database, and as such limited the findings.

**Questionnaire Design**

A difficult questionnaire or a design flaw in the online study could have limited the number of surveys returned. The online survey was designed to avoid forced responses to prevent attrition in the event that they were frustrated about items that they found difficult. The decision to allow participants to leave responses unanswered and progress through the questionnaire created a problem of missing data for variables of critical interest to the study because some participants responded only to the pre- and post-surveys, but not the main 15-item Physician survey. As a result, several cases were discarded. A future study might consider a combination of approaches; forcing some responses and allowing others to be skipped.

Another way to ensure that participants remain in the study is to give them another response choice, "*I do not know*". In this study, permission was not sought from the original authors to amend their questionnaire to add an "*I do not know*" option to the items. That was not an apparent need until a participant wrote, "*I am psychiatry. Wish you had more "I don't know" boxes in questionair*".

**Unverified Baseline Knowledge**

A limitation of this unsupervised online study was that the responses were not verified to be the APRNs' baseline knowledge, without help from other sources. If they used other sources

to respond to the main survey, the Physicians' CKD survey, then the scores could have been inflated, causing the study results to be unreliable. Participants were asked to refrain from using other sources because their baseline knowledge of the CKD guidelines were being sought. There is no evidence that they did not follow the directions, although a response to the question, "*If you are aware of ANY clinical practice guideline for chronic kidney disease (CKD), please state it/them*", yielded the following response with an active hyperlink: "*https://www.kidney.org/professionals/guidelines/guidelines_commentaries/chronic-kidney-disease-classification*".

**Mismatched Survey and Participants**

The survey did not match the participants' assumed primary care status. Either a group of primary care providers using the Physicians' questionnaire, or the acquired sample of APRNs with a less in-depth questionnaire would have been a better combination. Quantitative findings determined that the survey was moderately difficult, while the narrative revealed that the majority of the respondents' main areas of practice were in sub-specialty areas, allowing for no patient care on a continuum and/or no patients with CKD. By their account, the APRNs did not actively diagnose and treat patients with CKD, so they would have no reason to be versed on CKD guidelines. To the item on the General Survey Form that asked, *If you are not up to date on CKD clinical practice guidelines, please list the top two barriers that prevent you from keeping up to date*, the responses include: "*Not applicable to my practice*" "*my specialty does not involve any screening measures for CKD*"; "*Specialize in heme*"; and "*Retail clinics do not treat CKD*". The content of the main CKD survey was, indeed, heavily focused on disease complication, laboratory results and their parameters, management, and clinical decision-making, things that the participants did not do. Based on that discovery, the instrument was not

suitable for the APRNs. The aim of the study was to establish the suitability of the instrument that determined APRNs' baseline knowledge of CKD practice guidelines.

### Visual Appeal and Structure of the Survey

Another limitation included the visual appeal and structure of the main CKD survey. Adding to the fact that it may have been too difficult for the participants, the uniformity in the length and number of the response choices could have added an element of confusion or anxiety. The length of the response choices was different, and the number of choices ranged from one to 10, while the number of correct choices also ranged from one to eight. Oermann and Gaberson (2019) caution against factors that can decrease test performance. The questionnaire was not structured like the standardized assessments with which APRNs have experience, beginning as undergraduates who took the National Council Licensure Examination (NCLEX). Poorly structured assessments run the risk of returning low scores, despite the knowledge base of the participants (Oermann & Gaberson, 2019).

## Summary

The instrument used to determine non-nephrology APRNs' knowledge of CKD practice guidelines was unsuitable due to its factor structure and in-depth CKD management content, which is not required for the majority of the non-nephrology non-primary care participants who do not manage CKD cases. A validated survey that targets non-nephrology APRNs is required to assess their knowledge of CKD, instead of the practice guidelines that are more appropriate for practitioners who manage the disease. Non-nephrology and non-primary care providers who do not manage CKD should, at a minimum, be cognizant of its risk factors and definition since knowledge of both has the potential to prevent disease onset, progression, and complication in many individuals. Awareness of CKD among APRNs should begin at the undergraduate level in

schools of nursing, and as working professionals, they should have better access to a variety of CME credits and easily referenced guidelines. This study provides many foundational points for consideration in instrument development, item development, access to CKD information, and hopes to influence curricular adjustments for schools of nursing within the *CKD Belt*.

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APPENDIX A: GENERAL SURVEY FORM

## General Survey Form for APRN

**Instructions**

This survey seeks your individual responses. Information on race/ethnicity, gender, and age are being collected to account for representation by different demographic groups. Age is required because national studies have shown a relationship between age and healthcare providers' knowledge of chronic kidney disease (CKD). Information about gender and race/ethnicity are collected to account for representation by different groups. You will need to have access to a computer with which you will be required to type very short responses and make selections with a mouse. Please choose the best response. There is no right or wrong answer. You may save your responses at any point and return to the questionnaire.

1) What is your main area of practice?

| |
|---|
| Pediatrics |

| |
|---|
| Nephrology |

| |
|---|
| Other – please state |

2) What is your age?

| |
|---|
| years |

3) What is your gender?

| |
|---|
| |

4) What is your race/ethnicity?

| |
|---|
| |

5) From which region in the United States did you graduate with an Advanced Practice Nursing degree? Select a state from the drop-down list.

| Region | Select a state here: |
|---|---|
| ▪ Northeast<br>▪ Midwest<br>▪ South<br>▪ West | |

6) Since graduating, how long have you been in practice as an Advanced Practice Registered Nurse?

| years | months |
|---|---|
| | |

7) Which of the four types of Advanced Practice Registered Nurse best describes you? Please indicate if more than one category exists.

| |
|---|
| Certified Nurse Practitioner (CNP) |
| Clinical Nurse Specialist (CNS) |
| Certified Registered Nurse Anesthetist (CRNA) |
| Certified Nurse-Midwife (CNM) |

8) If you are aware of ANY clinical practice guideline for chronic kidney disease (CKD), please state it/them.

| |
|---|
| I am not aware of any CKD practice guidelines. |
| Please indicate the guidelines here. |

9) How confident are you in referring patients to a nephrologist as soon as it is indicated?

| | | |
|---|---|---|
| Very confident | Confident | Not confident at all |

10) Chronic kidney disease (CKD) increases the risk of stroke. Do you believe that healthcare practitioners who work in the Stroke Belt of the United States should be more knowledgeable of the risk factors for a stroke, including, but not limited to CKD?

| Yes | No | I am not sure |
|---|---|---|
| | | |

11) The southeastern states have more incidence and prevalence of CKD. Do you believe that healthcare practitioners in the southeastern United States should be more aware of CKD management in their patients?

| Yes | No | I am not sure |
|---|---|---|
| | | |

12) If you are not up to date on CKD clinical practice guidelines, please ***list*** the barriers that prevent you from keeping up to date.

| |
|---|
| |

APPENDIX B: PHYSICIANS' QUESTIONNAIRE FOR CHRONIC KIDNEY DISEASE

## Questionnaire for Chronic Kidney Disease

### Instructions

Your individual responses are required for this section. Please do not use alternate sources to assist with the answers because the aim of this exercise is to determine your current knowledge of chronic kidney disease clinical practice guidelines. Some questions require more than one response. Please select the best response(s).

**1)** You have a 49-year-old African American male patient in your medicine clinic. He is not hypertensive or diabetic. His labs show:

| Labs | Results |
|---|---|
| Serum creatinine | 1.3 mg $dL^{-1}$ |
| eGFR | 76 mL $min^{-1}$ 1.73 $m^{-2}$ |
| Urine dipstick | 1+ protein |

Further urine studies show proteinuria (quantitative) repeated twice in 3 months. According to the definition of CKD:

- He has CKD because he has proteinuria tested twice
- He needs to have GFR < 60 to have CKD
- He needs to have his urine tested again for proteinuria because three abnormal urine tests suggest CKD
- I don't know

**2)** What is the estimated glomerular filtration rate in a patient with CKD stage III?

- 60-90 mL $min^{-1}$ 1.73 $m^{-2}$
- 30-60 mL $min^{-1}$ 1.73 $m^{-2}$
- 15-30 mL $min^{-1}$ 1.73 $m^{-2}$
- <15 mL $min^{-1}$ 1.73 $m^{-2}$
- I don't know

**3)** What are the risk factors for CKD? (Check all that apply)

- o Age > 60 years
- o African American/Hispanic
- o Male gender
- o Diabetes Mellitus
- o Hypertension
- o Obesity
- o Systemic lupus erythematosus
- o Coronary artery disease
- o Daily NSAID use
- o Family history of CKD

**4)** What tests would you order to assess kidney damage in a patient who is at increased risk for CKD? (Check all that apply)

- o Serum creatinine alone
- o Serum creatinine to estimate GFR
- o Urinalysis
- o Urine dipsticks to estimate protein or albumin
- o Random urine albumin or urine protein
- o Random urine albumin creatinine ratio or urine protein creatinine ratio
- o 24-hour urine creatinine clearance
- o 24-hour urine protein excretion

**5)** Your 52-year old white female patient with type 2 diabetes mellitus comes to you with blood pressure (BP) 148/92 mm Hg and following labs:

| **Labs** | **Results** |
|---|---|
| Serum creatinine | 0.9 mg $dL^{-1}$ |
| eGFR | 70 mL $min^{-1}$ 1.73 $m^{-2}$ |
| Urine study | Microalbuminuria (58 mg $g^{-1}$) |

What is the goal BP in this patient?

- o <140/90 mm Hg
- o <135/85 mm Hg
- o <135/80 mm Hg
- o <130/80 mm Hg
- o <125/75 mm Hg

**6)** How do you manage her CKD? (Check all that apply)

- o Start her on ACE/ARB
- o Dietary protein restriction (0.6 g protein/kg $day^{-1}$)
- o Dietary salt restriction <2.4 g $day^{-1}$
- o Lipid control
- o Glycemic control
- o Weight loss
- o Smoking cessation

**7)** One year later she comes with BP 152/96 mm Hg and the following labs:

| **Labs** | **Results** |
|---|---|
| Serum creatinine | 1.2 mg $dL^{-1}$ |
| eGFR | 50 mL $min^{-1}$ 1.73 $m^{-2}$ |
| Urine study | Proteinuria (1100 mg $g^{-1}$) |

What is your action plan for CKD management at this time? (Check all that apply)

- o BP goal < 125/75 mm Hg
- o Refer her to a nephrologist as she has significant proteinuria
- o Refer her to a nephrologist as she had a progression of CKD (eGFR 70→50)
- o Evaluate for anemia of CKD
- o Evaluate for bone and mineral disorder of CKD

**8)** Which medications help reduce proteinuria independent of its effect on blood pressure? (Check all that apply)

- o ACE/ARB
- o Diuretics
- o Non-dihydropyridine calcium channel blocker (diltiazem, verapamil)
- o Dihydropyridine calcium channel blocker (amlodipine, nifedipine)
- o Beta-blockers

**9)** What are the potential complications of CKD when eGFR is <60 mL $min^{-1}$ 1.73 $m^{-2}$?

- o Anemia
- o Bone disease
- o Coronary artery disease
- o Stroke
- o Malnutrition

- Dementia
- Increased risk of diabetic complications like retinopathy and neuropathy
- Medication complications (e.g., acute renal failure)

**10)** When do you consult a nephrologist to prepare a patient for dialysis and vascular access?

- eGFR 45-60 mL $min^{-1}$ 1.73 $m^{-2}$
- eGFR 30-45 mL $min^{-1}$ 1.73 $m^{-2}$
- eGFR 15-30 mL $min^{-1}$ 1.73 $m^{-2}$
- eGFR < 15 mL $min^{-1}$ 1.73 $m^{-2}$
- I don't know

**11)** A 53-year-old white man comes to you with BP 178/98 mm Hg. He does not have a history of diabetes mellitus. He is on maximum doses of triamterene/hydrochlorothiazide, lisinopril and metoprolol. His labs show:

| Labs | Results |
|---|---|
| Serum creatinine | 1.9 mg $dL^{-1}$ |
| eGFR | 29 mL $min^{-1}$ 1.73 $m^{-2}$ |
| Urine study | no proteinuria |
| K+ (potassium) | 6.2 mmol $L^{-1}$ |

When is the appropriate action regarding nephrology consultation?

- Refer to nephrologist as he has uncontrolled BP despite being on 4 anti-hypertensives.
- Refer to nephrologist as he has hyperkalemia.
- Refer to nephrologist as he has GFR < 30
- He does not need a nephrology consult

**12)** Your patient with CKD comes with the following labs:

| Labs | Results |
|---|---|
| eGFR | 56 mL $min^{-1}$ 1.73 $m^{-2}$ |
| Phosphorus | 6.7 mg $dL^{-1}$ (normal 2.7-4.6) |
| Calcium | 9.9 mg $dL^{-1}$ (normal 9-11) |
| Parathyroid hormone | 130 pg $mL^{-1}$ (goal 30-70) |

How do you manage the mineral disorder? (Check all that apply)

- Dietary phosphorus restriction (800-1000 mg $day^{-1}$)
- Use of phosphate binders
- Check 25(OH) Vitamin D level
- Refer to nephrologist for management of bone and mineral disorder of CKD
- I don't know

**13)** What is the goal hemoglobin in a patient with anemia and CKD?

- o 10-11 g $dL^{-1}$
- o 11-12 g $dL^{-1}$
- o 12-13 g $dL^{-1}$
- o 13-14 g $dL^{-1}$
- o I don't know

**14)** A 64-year-old Hispanic male patient comes to you with the following labs:

| **Labs** | **Results** |
|---|---|
| eGFR | 46 mL $min^{-1}$ 1.73 $m^{-2}$ |
| Hemoglobin | 10.1 g $dL^{-1}$ |
| MCV | 79 fl (normal 80-98) |
| % saturation | 9% (goal ≥ 20%) |
| Ferritin | 45 ng $mL^{-1}$ (goal ≥ 100) |

How do you manage his anemia? (Check all that apply)

- o Give aranesp or epogen
- o Iron supplementation (orally or intravenously)
- o Measure serum erythropoietin
- o Check stool for occult blood and refer for colonoscopy if positive
- o Refer to nephrologist for management of anemia of CKD

**15)** You start a patient on ACE inhibitor and check his labs in 3 months. Which lab values are acceptable to you? (Check all that apply)

- o 30-50% decrease in GFR
- o <30% decrease in GFR
- o No change in GFR
- o <30% increase in GFR
- o 30-50% increase in GFR
- o $K^+$ level <4.5 mmol $L^{-1}$
- o $K^+$ level <4.5 - 5.5 mmol $L^{-1}$
- o $K^+$ level <5.5 - 6 mmol $L^{-1}$

*Note*: Adapted from "Questionnaire instrument to assess knowledge of chronic kidney disease clinical practice guidelines among internal medicine residents," by V. Agrawal, M. A. Barnes, A.

K. Ghosh, and P. A. McCullough, 2009, *Journal of Evaluation in Clinical Practice, 15*(4), pp. 733-738. 

APPENDIX C: POST-SURVEY FORM

**Post-survey Form for APRN**

1) Now that you have completed the exercise, what are the top three things that you will change and/or incorporate in your practice, as they pertain to chronic kidney disease practice guidelines?

| |
|---|
| 1. |
| 2. |
| 3. |

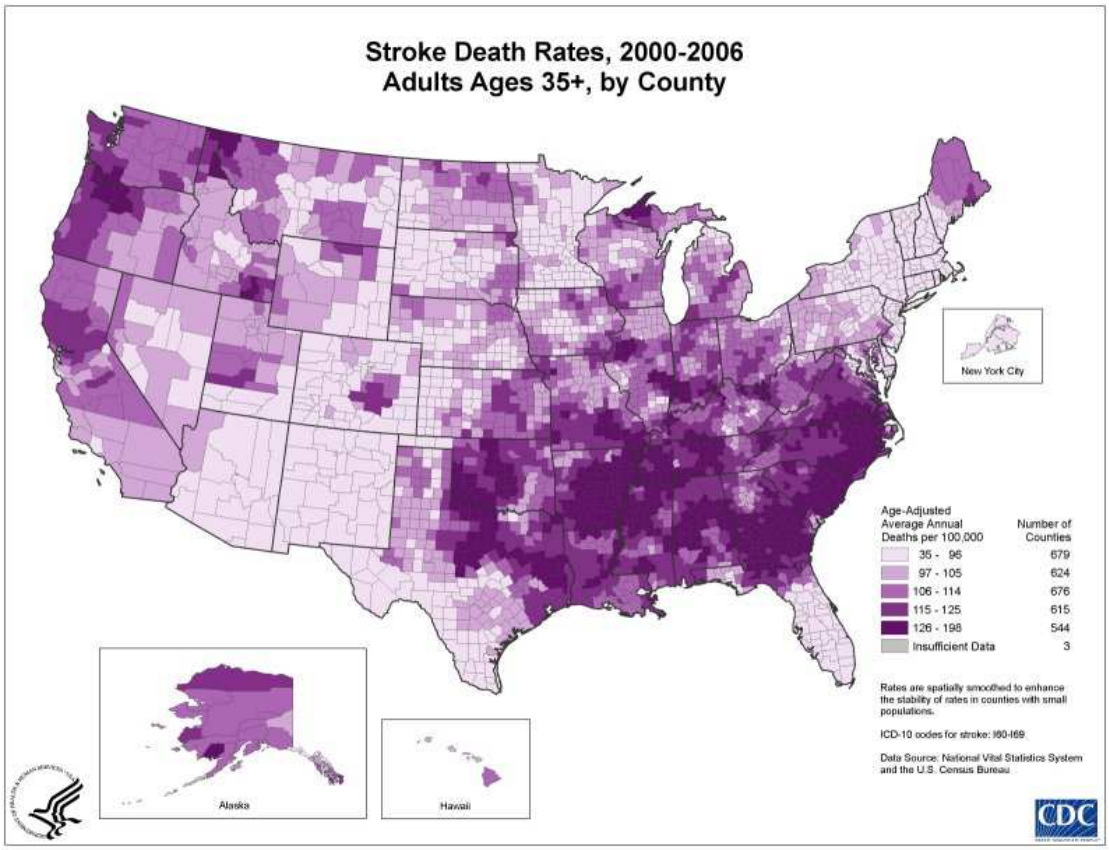
*Thank you for participating in this study.*

For future reference, the hyperlinks to two widely used chronic kidney disease practice guidelines can be found at:

http://kdigo.org/home/guidelines/

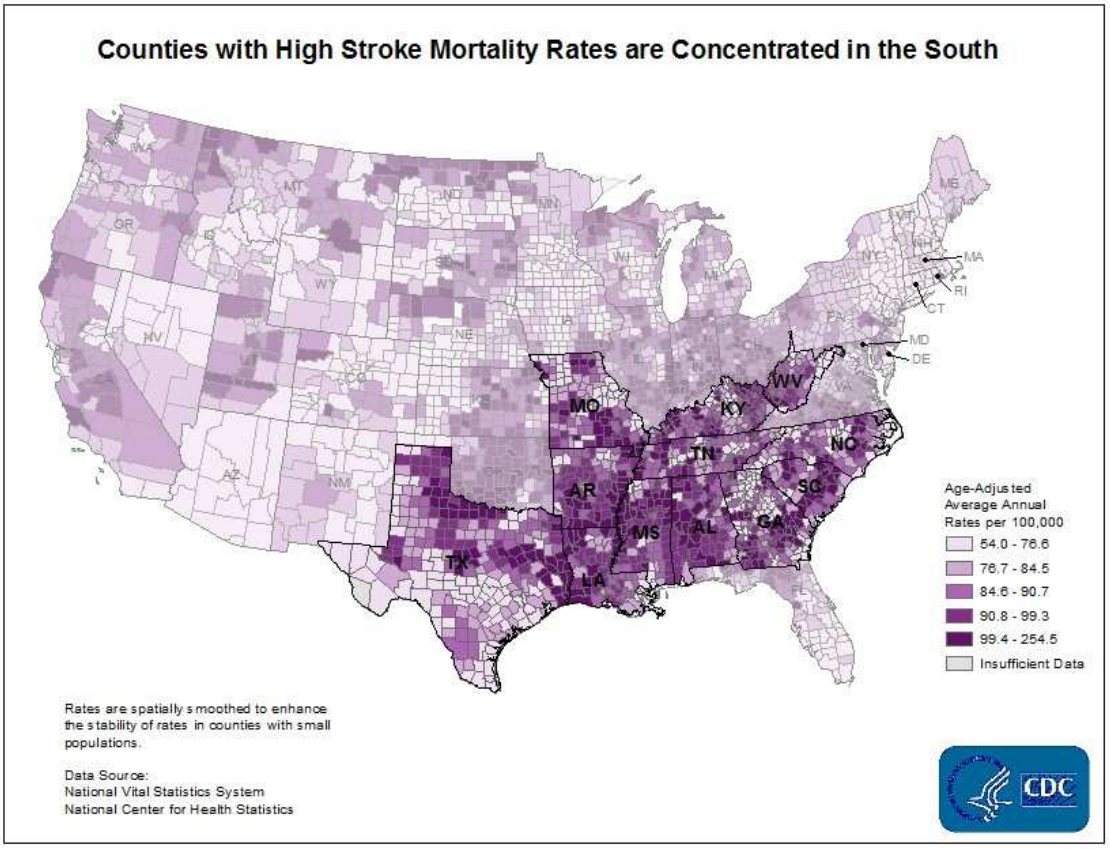
http://www2.kidney.org/professionals/KDOQI/guidelines_ckd/toc.htm

APPENDIX D: PREVALENCE OF STROKE DEATHS IN SOUTHEASTERN UNITED STATES (STROKE BELT) FROM 2000-2006



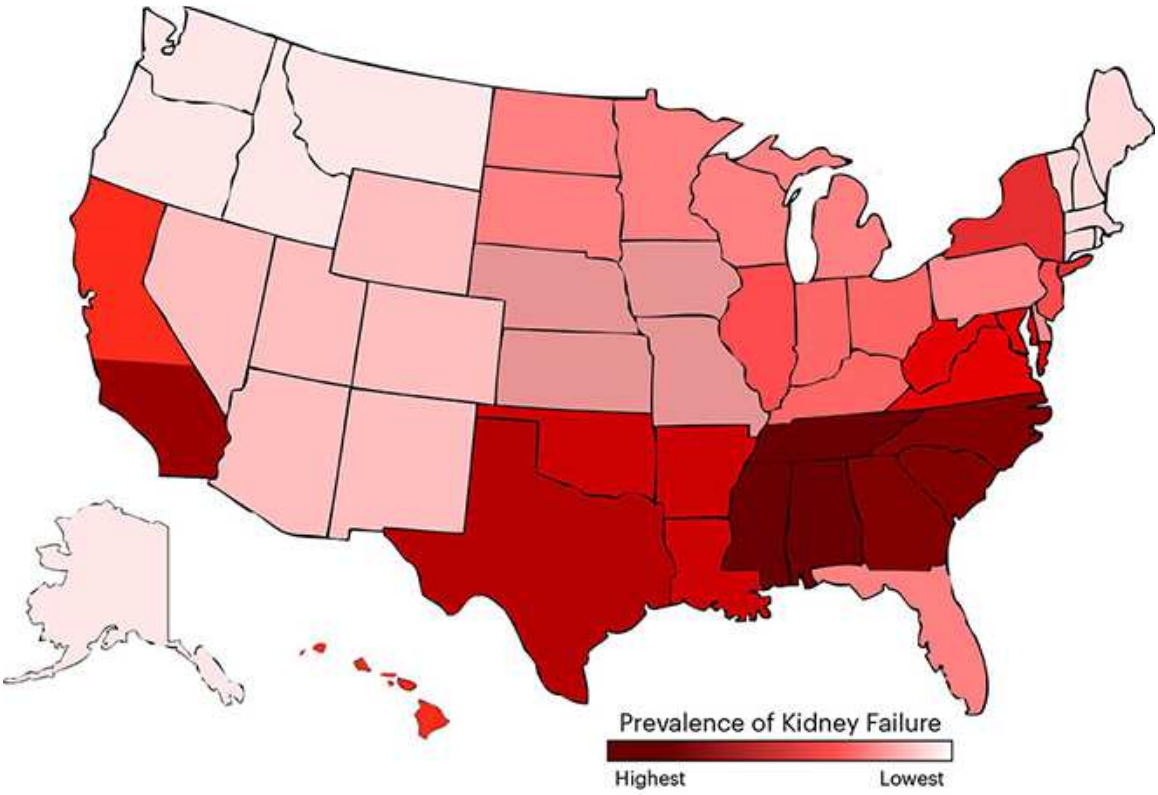

*Note*: Reprinted from "Stroke Maps and Data Sources", by Centers for Disease Control and Prevention (CDC), 2017. The dated 2000 - 2006 prevalence rates continued the trend of mainly affecting southeastern US.

APPENDIX E: PREVALENCE OF STROKE DEATHS IN SOUTHEASTERN UNITED STATES




*Note*: Reprinted from "Stroke Facts", by Centers for Disease Control and Prevention (CDC), 2020. More recent prevalence rates continue to affect southeastern US more than any other US region.

APPENDIX F: PREVALENCE OF KIDNEY FAILURE IN THE STROKE BELT OF THE UNITED STATES




*Note*: "Kidney disease-is your state hard hit?" by National Kidney Foundation (NKF), 2013. Reprinted with permission from National Kidney Foundation, Inc. The prevalence of CKD was in the southeastern region of the US at the time of publication of this map, and along with the Stroke Belt, the prevalence of Stroke and CKD in the region remains relatively unchanged in 2000 - 2006 (see Appendix D) and more recently in 2020 (see Appendix E).

APPENDIX G: PERMISSION DOCUMENT #1

**For Questionnaire to Determine Physicians' Knowledge of CKD Practice Guidelines**

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APPENDIX H: PERMISSION DOCUMENT #2

**For Questionnaire to Determine Physicians' Knowledge of CKD Practice Guidelines**

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