The Role of Telenephrology in the Management of Chronic Kidney Disease

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Chronic kidney disease (CKD) is a common illness across societies, affecting an estimated 13% of the population worldwide\(^1\). The prevalence of CKD is thought to be rising, likely due to a combination of an aging population and increases in comorbid chronic conditions such as obesity, diabetes and hypertension that contribute to its pathogenesis. In the United States, the prevalence is estimated at nearly 15% and Medicare spent $114 billion on CKD and end-stage renal disease (ESRD) in 2018\(^2\). While studies indicate that early referral to nephrologists may improve outcomes in CKD, many patients do not see nephrologists until late in the course of their disease. Barriers to early referral include geographic remoteness, with patients living far from available nephrologic care, and difficulties in traveling due to the burden of comorbidities\(^3-6\). Rural patients with CKD have been found to have poorer quality of care markers including timely measurement of urinary albumin excretion and appropriate use of angiotensin-converting enzyme inhibitors or angiotensin receptor blockers and experience a greater risk for hospitalization and all-cause mortality than urban CKD patients\(^5,6\).

Telemedicine, a video-based healthcare delivery technology, has the potential to attenuate these disparities and has been utilized in multiple chronic illnesses including heart failure, diabetes mellitus and chronic obstructive pulmonary disease. While the approach is not appropriate for all encounters, nephrology is in many ways particularly suited for telemedicine. The longitudinal follow-up of CKD patients is heavily dependent on repeat lab evaluations and detailed history taking. Though questions regarding changes in weight or edema can be critical, the majority of visits do not center on extensive physical examinations. Similarly, patient appointments for the management of hypertension are typically based on reviews of blood pressure logs and office measurements of vital signs while encounters for nephrolithiasis involve appraisal of labs and diet history. When conducted in concert with a dedicated nurse or other telemedicine healthcare provider on the patient side, management of these conditions often does not require a face-to-face visit with a physician. There are however clear exceptions.
Patients with rapidly progressive renal disease (and in particular those who would benefit from evaluation of urine microscopy) should always be seen for an in-person visit. In addition, many providers prefer (and often require) that patients be seen face-to-face for their initial consult visit. While the potential for the application of telemedicine to the care of renal transplant patients as well as those with ESRD on both peritoneal and hemodialysis is beyond the scope of this review, adaptation of telemedicine to these venues is critical and has been appraised elsewhere7,8.

Telemedicine may take a variety of forms. Utilizing web-based platforms and applications, primary care physicians may be remotely connected to specialists via videoconferencing for consultation, nephrologists at specialized care facilities may remotely see patients in primary care offices, web-based monitoring devices can be utilized to collect physiologic data such as blood pressure and weight and patients may even be seen for a virtual visit directly from their homes9. Initiatives such as the Specialty Care Access Network-Extension for Community Healthcare Outcomes (SCAN-ECHO) allow nephrologists and other specialists to provide educational sessions for primary care providers in rural or distant locations10. Interest in applying technology to the care of CKD patients is escalating commercially as well as clinically with a recent review finding at least 28 distinct smartphone applications targeting patients with CKD11. Depending of the specific modality under consideration, multiple factors may affect the logistic feasibility of establishing a telenephrology program for the management of CKD including equipment cost and availability, local regulations and practice specific information technology resources. Regardless of the means by which patients are seen, HIPAA compliance regulations require implementation of appropriate safeguards for patients’ protected health information. At a minimum, such protections entail encrypted internet access, assurances video transmissions are not stored unless specifically and pre-emptively requested by the
provider and authentication and password protected access control as well as the provider potentially signing a business associate agreement.

Within the broader context of telemedicine, telehealth refers to the direct provision of remote healthcare. This can involve synchronous encounters (interactive video conferencing or phone consults) as well as asynchronous systems such as web-based electronic consultations/advice platforms and text messaging. Clinical video telehealth (CVT) is the most common form of telehealth and frequently takes the form of specialist physicians seeing patients located in other offices for real-time interactive video teleconferencing. In our experience, this modality is perhaps the most readily adoptable introduction to telehealth. For patients, while they will not be seen face-to-face by their primary provider, the act of going to a medical office and interacting with staff can be familiar and comforting and help allay concerns that new technology will disrupt the doctor-patient relationship. From a provider’s perspective, initiating telenephrology via an office-based model provides reassurance that patients will still be seen in an orderly and timely manner while surrounded by medical support staff. A videoconference monitor is kept in the physician’s office and a second monitor, variably enhanced with such accompaniments such as a high-resolution mobile digital video camera, stethoscope and ultrasound probe is located remotely in the patient examination room. A health technician trained in telenephrology is located with the patient and is available to measure vital signs and assist the physician as needed with remote physical examination. In the United States, the Veterans Health Administration (VHA) has been one of the earliest and wide spread adopters of telehealth and CVT. The VHA is the largest integrated health care system in the United States, providing care at 1,255 health care facilities, including 170 VA Medical Centers and 1,074 outpatient sites to over 9 million Veterans. Roughly 36% of VA patients reside in rural communities (as compared to 19% of the overall US population) and suffer from high rates of comorbidities that make travel difficult. The nationally integrated Computerized Patient Record
System (CPRS) allows for seamless access to remote records and while physicians need to be credentialed at both patient and provider sites, working within the VA system they can see patients in multiple states without requiring separate state medical licenses. The VHA is thus uniquely requiring of, and strategically positioned to provide, CVT. In 2016 12% of Veterans received elements of their care via telehealth spanning over 50 specialty areas of care. More than 307,000 Veterans used CVT with >150,000 utilizing Home Telehealth\textsuperscript{13}.

One of the pioneering sites for telenephrology has been the James J. Peters VAMC (JJPVAMC) in the Bronx, New York, where the impact of telenephrology on CKD patient adherence to appointments as well as its impact on clinical outcomes was studied by Tan and colleagues\textsuperscript{14}. The JJPVAMC serves as the primary referral center for the Hudson Valley VAMC but is located 65 miles away. In response to a “no-show” or cancellation rate of 53% for nephrology referrals, JJPVAMC instituted a Clinical Video Telehealth (CVT) program in 2011. Over the subsequent 3 years, 112 patients from Hudson Valley were seen via CVT telenephrology with a reduction of the “no show” or cancellation rate to 28%. When compared with 116 patients seen for face-to-face consults and follow-up at JJPVAMC, there was no difference over 2 year follow-up for a composite endpoint of death, ESRD or doubling of serum creatinine (p=0.96). In addition to increased patient adherence, significant financial savings were realized as travel distance for patients was reduced by 50% with patients not having to commute to the Bronx.

While the study by Tan et al. required patients to come to the Hudson Valley VA to connect to JJPVAMC via CVT, Ishani and colleagues conducted a randomized, prospective trial testing whether patient to provider home-based telemedicine improved clinical outcomes in CKD as compared to standard care\textsuperscript{15}. A total of 561 patients from the Minneapolis Veterans Affairs Health Care System were identified with an estimated glomerular filtration rate (GFR) of <60 mL/min/1.73 m\textsuperscript{2}. Patients were assigned in a 3:1 ratio to receive intensive home telenephrology
via a touch screen computer delivered by a robust interprofessional team including a nephrologist, nurse practitioner, nurses, clinical pharmacy specialist, psychologist, social worker and dietician, or usual care. The delivered telenephrology was augmented by peripherals such as home blood pressure cuffs, pulse oximeters, stethoscopes and glucometers but after one year no difference was seen in the primary composite endpoint of death, hospitalization, emergency room visits and admission to a skilled nursing facility. The authors did note that there was a trend towards a lower incidence of the primary outcome in the intervention group for rural patients but that the study was not powered to definitively demonstrate this.

In addition to the VHA, telenephrology for the management of CKD has also been utilized by the Indian Health Service (HIS). Rates of both diabetes and CKD are high amongst HIS patients but access to nephrologists is often limited in rural communities. Narva et al. examined a program established to allow nephrologists located at the National Institute of Health (NIH) in Bethesda, Maryland to delivering care to patients at the Zuni Comprehensive Health Center, located 150 miles west of Albuquerque, New Mexico\(^\text{16}\). Beginning in 2007, a program was established where patients from an exam room at the Zuni Indian Hospital would be seen remotely by a nephrologist located at the NIH during a twice-monthly clinic. There was no specific eGFR threshold a patient had to meet to be referred but referring physicians were strongly advised to complete a form documenting data on eGFR trends, albuminuria, presence of diabetes, screening labs and medications. Over nine years, 1870 visits were conducted. During this period 44 patients were referred for initiation of dialysis. While data is not available comparing hard outcomes with a control group, this program demonstrated the feasibility of connecting nephrologists to a large number of CKD patients who otherwise likely would not have received specialized care.

Outside of the United States, Australia has long been a pioneer and leader in telehealth in general as well as telenephrology owing to its expansive rural areas and great distances
between population centers. Venuthurupalli and colleagues investigated the impact of
telenephrology on CKD care at a referral hospital in Queensland\cite{17}. All patients over a six year
period seen in renal clinic (prevalent and incident) residing ≥50 km away were offered follow-up
care through video teleconference (TC), accessed at their local hospital or clinic. 234 (referred
to as “almost all”) patients agreed to be seen via TC and outcomes were compared with 817
historic controls. Patient experience with TC was very positive with >98% of those being seen
expressing a preference to continue to be seen in this manner once enrolled. There were few
differences between the groups in regards to demographics or comorbidities though the TC
groups exhibited a higher prevalence of diabetes, diabetic nephropathy and arthritis. Compared
to controls, TC patients demonstrated increased adherence to appointments and a greater
likelihood of visit accompaniment by a family member or care giver. Over the course of the
study, patients seen via TC had a statistically significant reduction in incident RRT (2.0 vs 3.5
cases per 100 patient-years) and overall mortality (4.5 vs 5.3 cases per 100 patient-years). The
number of hospital admissions per patient trended lower in the TC group, 1.63 vs 2.25, but did
not reach statistical significance. TC patients lived an average of 417km round trip from the
referral hospital and thus benefitted from significant reductions in travel time and cost by being
seen remotely from local facilities.

In the Netherlands, Scherpier-de Haan et al. studied Web-based nephrology
consultations between primary care providers and hospital-based nephrologists\cite{18}. After
receiving a consult question containing abstracted clinical and laboratory data, the nephrologists
could either reply to the question, request additional data or recommend that the patient be sent
for an in-person evaluation. 122 consults were placed, with PCPs identifying 43 (35%) of them
as cases that would have been referred for consultation absent the Web-based option. Critically,
after evaluating the consultation, nephrologists determined that only 7/43 (16%) would actually
have required such an evaluation. In addition, of the 79 patients where PCPs would not have
otherwise placed a consult, nephrologists determined that in 10/79 (13%) such a referral would have been appropriate. These data suggest that even when a face-to-face nephrology consult is indicated, prior screening via telemedicine can more accurately triage appropriate cases. A second, much larger study on ~3000 patients in the Netherlands did not find any difference in referral rates for face-to-face nephrology consults when general practitioners were randomized to first use or not use a new electronic consult system but overall referral rates were much lower than anticipated and the trial may have been underpowered. The utility and challenges of telenephrology have also been explored in Jordan, France and Chile.

Over the past six months, the burgeoning field of telehealth has undergone the cataclysmic challenge of adapting on the fly to unprecedented disruptions in world healthcare systems engendered by the COVID-19 pandemic. An extraordinary number of providers were forced to adopt telehealth almost overnight with a mandate to provide high quality and safe care during a period of extreme uncertainty and upheaval. In light of the temporary closing of many offices, the model of delivering telehealth to the home via remote provider visits has experienced a rapid increase in utilization and data on outcomes associated with it are under intense study, though few results are yet available. Chen et al. developed a cohort in China of 1164 patients with CKD who had received a kidney biopsy between 2017 and 2019. At the beginning of the COVID-19 pandemic, 82% were being seen for regular follow-up and 45% were being treated with immunosuppression. Face-to-face clinic visits were interrupted in 836 (72%). As a result, 60%, 67%, and 27% reported difficulties in laboratory examinations, medicine adjustments, and medicine purchases, respectfully. In an attempt to maintain follow-up, 255 patients (22%) utilized telemedicine, including video telehealth visits 122 (10%), instant message tools 62 (5%), telephone consultation 48 (4%), and email 23 (2%). Approximately 80% of telemedicine users were generally satisfied with the experiences. In contrast to much pre-COVID data, the utilization of telemedicine was not statistically associated with the patients’
location (urban vs. rural) nor was it impacted by sex, age or education. In patients receiving immunosuppressive treatments, 32% partook in a telemedicine experience compared to 17% of patients not receiving immunosuppression, ($p < 0.001$).

Spurred by changes wrought by COVID-19, telehealth is likely to have an expanded and permanent role in many, if not most, nephrology practices going forward. Never-the-less, several hurdles exist to widespread adaptation that must be overcome before telehealth is fully integrated into clinical practice. These barriers can be designated into 3 broad categories: (1) Clinical/Societal, (2) Legal/Privacy/Security and (3) Reimbursement. Advantages and challenges of telenephrology are shown in Table 1.

**Societal/Clinical**

For thousands of years, the distilled essence of the practice of medicine has been the physician, as confidant and healer, laying hands upon a patient. It is not hyperbole to call the uncoupling of this relationship via telehealth profoundly revolutionary. It will be critical to acknowledge the difficulty some providers and patients may have in utilizing the new technology and in accepting telehealth visits as legitimate replacements for traditional face-to-face interactions. For some patients, such as those with impaired hearing, being seem remotely may never be able to fully replicate an in-person office visit. Nonverbal cues may not be picked up on camera for the provider to notice and address. In addition, it takes practice for the provider to consistently look at the camera rather than at the video screen or around the room. Such a technique is critical however to maintain “eye contact” and convey a sense of physical presence to the patient, even at a distance. Such challenges need not limit the adaptation of telehealth but will require understanding and patience on behalf of providers and patients. To assuage public concerns about any diminution in quality of care associated with a conversion to telehealth, the development and adaptation of accurate qualities assessment and evaluation metrics for telehealth is especially critical. The National Quality Forum recently published an
extensive study outlining organizing principles and recommendations for the development of a framework for quality assessment measures\textsuperscript{24}. Such efforts should be enthusiastically embraced and expanded upon. Care should be taken to ensure continuity between patients and providers to the greatest extent possible. It is likely that physician uptake will not initially be universal, with providers coming to telehealth over time based on specifics of their practices and work-flow. Older patients who are perhaps less comfortable and familiar with technology may prefer traditional visits. However, such generalizations may no longer be appropriate in the era of COVID-19 when caution dictates attempting to minimize exposure of the elderly to healthcare settings.

**Privacy/Security/Legal**

As the generation and transmission of remote data becomes more commonplace, concerns about data security and the potential for liability will necessarily increase. Patient privacy and confidentiality must be protected, but in a way so as not to render telemedicine encounters unduly cumbersome or impractical. In much the same way that the US healthcare system as a whole lacks standardization, guidelines and requirements for telehealth security and privacy are discordant between federal and state regulatory bodies\textsuperscript{25}. Multiple entities have proposed administrative, physical, and technical safeguards to enhance security but a piecemeal adaptation during this inchoate period risks the inauguration of an unworkable patchwork of regulations\textsuperscript{26,27}. With telemedicine still in its infancy, it remains possible to envision the establishment of a comprehensive national policy governing security, privacy and confidentiality standards for telemedicine\textsuperscript{28}. It will be critical to develop such a consensus guideline before the disparate standards becomes too entrenched.

There is currently no standardized practice regarding liability insurance for telehealth practitioners and insurance providers have often extended coverage on a case-by-case basis. To date most liability carriers lean toward using the physician’s state of licensure rather than the
patient’s location when they are discordant to define coverage. With little legal precedence, providers seek guidance as to whether malpractice insurance will cover telemedicine and the extent to which such coverage will impact malpractice rates. In the face of this uncertainty, physicians responded to a recent AMA survey that liability coverage was a “must-have” for adoption of telehealth. Because telehealth service delivery frequently crosses state lines, telehealth providers are potentially confronted with the extremely burdensome need to fulfil licensing and credentialing requirements for each state and facility in which they “see” patients. In 2013, the Interstate Medical Licensure Compact (IMLC) was enacted to increase the efficiency in multistate licensing of physicians. Currently, 27 state legislatures have enacted the compact into state law, enabling their participation in the IMLC, while two additional states have passed it through the legislature but not yet implemented the compact.

**Reimbursement**

The majority of telehealth utilization prior to COVID-19 was in single-payer health organizations, either internationally or in the United Stated through Veteran Affairs or the Indian Health Service. A major reason for delayed uptake in the private insurance sector has been concerns regarding reimbursement. Providers have sought data assuring a return on the initial financial investment involved in establishing a telehealth program. Such a return could be realized either through increasing intake (improved efficiency, recruiting new patients, increasing number of patients visits), or by decreasing outlays (reduced overhead, improving outcomes with a resulting decrease in costly emergency room visits and hospitalizations). Crucially, Medicare has, in response to COVID-19 and under the CARES Act, waived the requirement for the use of video technology in the provision of telehealth, thus allowing full reimbursement for telephone visits for evaluation and management visits, behavioral health counseling and educational services. In addition, the Act waived requirements regarding the types of health care professionals that can provide telehealth services so as to include all those
eligible to bill Medicare for their professional services. While adjustments to these practices will surely be made once the COVID-19 crisis has abated, it will be critical that the Centers for Medicare & Medicaid Services continue working to adjust coding and billing requirements to meet the new telehealth world. With an overall movement toward value-based reimbursement, systematic data collection will be critical to document the economic advantages of telehealth in both fee-for-service and value-based models of care and payment.

Telenephrology, via multifaceted and innovative modalities, is poised to revolutionize the care of CKD and the means by which it is delivered. For many CKD patients of the future, obtaining care from a nephrologist will not involving traveling to a specialty clinic, nor, in many instances, even necessitate leaving their home. The potential benefits of this revolution in regards to the quality, efficiency and access to care are immense. Challenges remain, and providers and patients are to be commended for adapting on the fly during the extraordinarily challenging time of the COVID-19 pandemic. Despite hurdles, remote management of CKD is poised to continue expanding across practice settings with the potential to improve access, satisfaction and outcomes for patients and their providers.
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Table 1. Advantages and challenges to telenephrology

| Advantages to telenephrology                                                                 |
|---------------------------------------------------------------------------------------------|
| 1. Improved access to specialized care in rural or remote areas                              |
| 2. Improved access to care for patients with limited mobility and transportation barriers    |
| 3. Savings in time and expense via reduced travel                                             |
| 4. Reduction in requirements for limited clinic space allows increased number of providers   |
|     and reduced wait times for visit scheduling                                             |
| 5. Reduction in patient no-show rates                                                        |
| 6. Ability to maintain continuity of care during COVID-19 pandemic and environmental disasters|
| 7. Increased patient engagement and ownership with own healthcare via mobile apps           |
| 8. Opportunity for education and professional engagement with PCPs via SCAN-ECHO             |

| Challenges with telenephrology                                                              |
|---------------------------------------------------------------------------------------------|
| 1. Necessary alteration to doctor-patient relationship                                      |
| 2. Limited ability for physical exam                                                        |
| 3. Lack of standardization in cross-state and facility licensing and credentialing           |
| 4. Incomplete options for dedicated telemedicine coding                                     |
| 5. Uncertain malpractice and legal frameworks                                               |
| 6. Security of data and synchronous communications                                           |
| 7. Challenging for patients with hearing or visual impairments                              |
| 8. Costs and time required to acquire and train on equipment                                |