

Technology, Telehealth, and Nephrology: The Time Is Now

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The global health emergency of coronavirus disease 2019 (COVID-19) has brought telemedicine to the forefront of the US health system and transformed the way health care is delivered. Although the need for telehealth to improve social distancing, and protect both patients and providers, was first and foremost in this transition, it has provided a great opportunity to rethink the future of health care with telehealth fully integrated as an option for patients. Some of the known benefits of telehealth include improved access to care, decreased travel time, and cost savings (1), and as we have clearly understood with COVID-19, provision of care during an infectious disease epidemic/pandemic. Patients with CKD and ESKD have a high disease burden, limited resources, and require care in different settings from multiple health care providers, thus contributing to their burden of disease; this may be an ideal patient population to benefit from telemedicine. Technology-based strategies to improve care such as remote patient monitoring, synchronous telehealth visits for both CKD patients and dialysis rounds, and asynchronous dialysis education platforms can be applied to nephrology care to great effect (2,3). Here, we discuss some such strategies that have been used successfully to improve nephrology care and have come to the forefront during this current pandemic.

Ambulatory Use of Telemedicine and Remote Patient Monitoring

Remote monitoring of treatment adherence has been shown to achieve better BP readings in hypertensives and glycemic control in diabetics, both leading causes of CKD (4). A smartphone-based system to enhance self-care was successfully promoted in advanced CKD patients; prebuilt algorithms provided real-time feedback to patients and alerts to providers when treatment thresholds were exceeded or critical changes occurred (5). Telemedicine, with remote synchronous video visits, has demonstrated equivalent outcomes and reductions in cancelled or “no show” visits in two separate studies conducted at Veteran Affairs health systems (3). The Zuni telenephrology clinic successfully delivered advanced nephrology care to a remote area of Western New Mexico (6); a team approach was implemented using an on-site nurse manager, primary clinician, and pharmacy students, with the nephrologist

located remotely. Telenephrology has similarly benefited transplant medicine, enabling timely evaluation of eligibility for transplantation, improving access to care, and reducing travel and costs for the patients (7). In the current pandemic, there has been an exponential growth in telehealth implementation, with the University of Alabama at Birmingham (UAB) now performing 66% of transplant visits and 71% of nephrology clinic visits using telehealth, with excellent patient engagement.

Telenephrology Education Strategies

Inadequate CKD awareness and dialysis modality education among patients, and inconsistent detection of CKD among primary care providers (PCPs), remain major gaps in the care of patients with advanced CKD (8). Web-based learning, virtual support groups, text-based outreach, health apps, and online group classes for CKD and dialysis modality education offer a complementary solution to many care gaps. The Zuni telenephrology clinic delivered pre-ESKD education along with pre-ESKD care to patients living in rural areas (6). Another trial of dialysis modality education *via* telemedicine revealed remarkable success, where 90% of patients were able to make an informed decision and home modality choices doubled (9). At UAB, during COVID-19, CKD education and dialysis modality classes have been conducted successfully *via* a virtual format twice a month. Web-based education websites such as the National Kidney Disease Education Program and Empowering Patients on Choices for RRT decision (www.choosingdialysis.org) help educate patients regarding CKD and transitioning to dialysis (10). The Advancing American Kidney Health Initiative allows for telenephrology-directed CKD education, and will hopefully help develop sustainable solutions at a national level to provide patient-centered education in the comfort of patients' homes. Although tele-dialysis education can improve the dissemination of education, there is no standard curriculum that is followed for this education and, as such, standardized curriculums should be developed. In addition to tele-dialysis education for patients, training of PCPs in the form of provision of e-consultations as well as web-based group learning can both increase access to care and facilitate physician learning (8). Project ECHO

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(Extension Community Health Care Outcomes) uses videoconferencing to link PCPs to specialists, allowing peer learning by virtue of any provider asking questions or discussing clinical cases with a specialist (11).

Telenephrology and its Role in Outpatient Dialysis Settings

Home dialysis visits *via* telenephrology are an effective way to decrease the burden of clinic visits; this method of care pioneered at UAB has undergone huge expansion, and during the COVID-19 pandemic, telehealth has accounted for 90% of home dialysis visits. In addition, innovative technologies allow medical information to be obtained directly from the peritoneal dialysis (PD) or home hemodialysis machine, as well as parameters self-monitored by the patient (2). The “Nx2me connect” app allows direct transmission of treatment parameters such as access blood flows, vital signs, and prescription details to the dialysis unit *via* a simple web-based application; such advances may help reduce treatment burden, and potentially lead to reduced attrition, improved compliance, and better sense of being “connected” with the treating physician (12). Remote monitoring in high-risk dialysis patients has been linked to decreased hospitalizations, improve quality of life, and cost savings in hemodialysis patients (13), and decreased emergency room visits, reduced disease burden, and improve compliance in PD patients (14). Innovative technology is being used to create simpler machines with touch screens, intuitive setup, and verbal feedback to the patient (15,16). Cloud-based platforms now allow a secure connection with many PD cyclers; this allows remote viewing of treatment summaries including prescription details, ultrafiltration, and any lost dwells, and in some cases allows the nurse or the physician to instantaneously change the prescription for the next cycle of PD (15). Wearable artificial kidneys and implantable artificial kidneys are under investigation, and telenephrology will likely play a central role in the implementation of these once they become available (17).

Similar outcomes were shown in studies comparing care provided in remote hemodialysis units without on-site nephrologists, *via* videoconference, compared with their urban counterparts with on-site nephrologists (18,19). Such a strategy, where all four hemodialysis visits can be conducted *via* telehealth, has been temporarily allowed during the COVID-19 pandemic, and the proposed changes in the Advancing American Kidney Health Initiative allow a reduced number of in-center hemodialysis visits, without a reduction in remuneration; this is an ideal time to think about strategies to streamline care of patient in-center dialysis units, with emphasis on individualized care, with more time spent on sicker patients, dialysis modality education, and long-term health outcomes using a combination of in-person visits and telehealth.

Telenephrology in the Inpatient Setting

Telenephrology programs, such as those of UAB and Emory University in partnership with Sanderling LLC, have pioneered inpatient telenephrology, allowing the provision of consultative care and dialysis to many patients in rural hospitals, thus decompressing larger city hospitals,

reducing unnecessary travel, and providing backup and support for community nephrologists. Another use of telehealth, crucial during the COVID pandemic, is that of video isolation. At UAB, iPads in COVID-19 rooms help implement video isolation to allow for examination of patients and provide necessary consultative services, without having the consultant enter the room; this ensures judicious use of personal protective equipment and limits exposure for health care workers, with minimal disruption in access to care for the patient. The next key step in this direction would be the provision of dialysis, both hemodialysis and PD, in nursing homes and rehabilitation facilities with the help of telenephrology; this may potentially improve access to care for dialysis, minimize the need for transportation, improve patient engagement, and decrease health care costs.

Telenephrology and Health-Related Apps

There is growing evidence that incorporation of smart apps helps support self-management in patients with CKD (5). Several health apps and patient portal apps provide the ability to record and track health data, like BP and medications, and the ability to set reminders for medications; others provide educational material on chronic medical conditions. As telemedicine grows, the use of artificial intelligence and chatbots will likely increase, and potentially narrow the patient and clinician gap by using machine learning algorithms, if used in a strategic way.

Telenephrology and Future Directions

The rapid spread of COVID-19 found the US health system staring at large gaps in access to care, with disastrous consequences for the health of our patients. Unfortunately, telehealth in nephrology was underdeveloped due to regulatory issues and a lack of reasonable reimbursement. Modifications of the telehealth regulations and billing considerations under the 1135 waiver and Coronavirus Aid, Relief, and Economic Security (CARES) act have led to an opportunity to rapidly grow telehealth. In-center dialysis units can now be sites that perform telehealth visits for the monthly capitated payment, which, before COVID-19, was only allowed in Critical Access Hospitals. The home is now an appropriate originating site for video visits, and the rural/urban restriction, which was a major operational hurdle, has been removed. Innovative strategies are now emerging to both improve access to care and protect our patients in ways that were always possible, but never practical during pre-COVID times. It is in these times that we realize the true extent of innovation. The future of technology-based solutions in nephrology is bright. We must strive to integrate all data and documentation such that we do not end up with an even more fragmented health care system. We must continue to put the patient first when deploying technology. The future of nephrology needs telehealth.

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Author Contributions

G. Jain conceptualized the study; M. Ahmad and G. Jain wrote the original draft; and G. Jain and E. Wallace reviewed and edited the manuscript.

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