Using Telenephrology to Improve Access to Nephrologist and Global Kidney Management of CKD Primary Care Patients

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Most chronic kidney disease (CKD) clinical guidelines recommend that patients with CKD stage 3b to 5 be referred to a nephrologist for specialized evaluations and treatment.1,4,5,8,18,21 Unfortunately, this recommendation is difficult to follow because of a lack of specialists, a problem especially critical in developing nations, where scarcity has reached a critical level.4,5,53–58 The consequences include long waiting lists, lack of opportune diagnosis and/or treatment, and impaired health outcomes.

Telenephrology (TN), also known as telehealth in nephrology, is digital connectivity strategy to improve access to specialists.6–9,59–520 It has been reported that TN facilitates distance clinical care as well as

REFERENCES
1. Remport A, Ivanyi B, Mathe Z, et al. Better understanding of transplant glomerulopathy secondary to chronic antibody-mediated rejection. Nephrol Dial Transplant. 2015;30:1825–1833.
2. Loupy A, Hill GS, Jordan SC. The impact of donor-specific anti-HLA antibodies on late kidney allograft failure. Nat Rev Nephrol. 2012;8:348–357.
3. Abreu R, Carvalho F, Viana H, et al. Morphologic patterns and treatment of transplant glomerulopathy: a retrospective analysis. Clin Transplant. 2017:31.
4. Wan SS, Ying TD, Wyburn K, et al. The treatment of antibody-mediated rejection in kidney transplantation: an updated systematic review and meta-analysis. Transplantation. 2018;102:557–568.
5. Moreso F, Crespo M, Ruiz JC, et al. Treatment of chronic antibody mediated rejection with intravenous immunoglobulins and rituximab: a multicenter, prospective, randomized, double-blind clinical trial. Am J Transplant. 2018;18:927–935.
6. Eskandary F, Regele H, Baumann L, et al. A randomized trial of bortezomib in late antibody-mediated kidney transplant rejection. J Am Soc Nephrol. 2018;29:591–605.
7. Choi J, Aubert O, Vo A, et al. Assessment of tocilizumab (anti-interleukin-6 receptor monoclonal) as a potential treatment for chronic antibody-mediated rejection and transplant glomerulopathy in HLA-sensitized renal allograft recipients. Am J Transplant. 2017;17:2381–2389.
8. Patri P, Seshan SV, Matignon M, et al. Development and validation of a prognostic index for allograft outcome in kidney recipients with transplant glomerulopathy. Kidney Int. 2016;89:450–458.
9. Loupy A, Aubert O, Orandi BJ, et al. Prediction system for risk of allograft loss in patients receiving kidney transplants: international derivation and validation study. BMJ. 2019;366:i4923.
as communication and education among healthcare teams, patients, family members, and the general public. TN also provides easy access to specialists for patients with CKD in rural, remote, and hard-to-access regions.6–9,59–520

In Chile, the first TN program was implemented in 2012 and was restricted to 2 cities in the country (Methods in Supplementary Material and Supplementary Figure S1). The objectives of this study are to evaluate the clinical results and the waiting time required before receiving nephrologist care, before and after TN program onset, for CKD patients referred from primary health centers (PHCs).

RESULTS

We studied 4668 teleconsultations to nephrologist in 2 Chilean cities between October 2012 and October 2018 (70.1% in Concepción and 29.9% in Talcahuano). Patient age was 69.5 years (SD, 13.2 years); 78.4% were older than 60 years; and 59.4% were women. The principal diagnosis was CKD (92.6%), and 85.1% of patients were in stage 3a to 5 (Supplementary Figure S2).

The response time ranged from 1 to 3 days; 88.2% of the teleconsultations were answered within 24 hours, and the remaining 11.8% were answered within 3 days.

In total, 2676 patients (57.3%) who did not require in-person nephrologist consultations were referred to PHCs with treatment recommendations from the specialists as follows: adjustments to hypertension and/or diabetes treatments (51.9%), confirmation of the diagnosis and preventive recommendations (32.3%), and requests for further clinical information or complementary exams (15.8%).

In addition, 1992 patients (42.7%) were sent for in-person nephrologist evaluations; these patients mainly had pre-dialysis stage 4 to 5 CKD (64.3%), glomerular syndromes (23.3%), and refractory hypertension (7.6%).

Table 1 shows the clinical and laboratory differences between the patients who were counter-referred to PHC and those sent to the hospital for in-person evaluations. The patients with stage 1, 4, and 5 CKD were referred to nephrology significantly more often than to PHC.

Opportune diagnosis and referral of patients with stage 4 to 5 CKD to the advanced renal care unit of the hospital allowed the percentage of patients undergoing peritoneal dialysis to rise from 5% to 16.3%; the proportion of patients admitted to hemodialysis with arteriovenous fistula access increased from 28.3% to 60.3%, and only 2 patients (0.9%) were admitted for dialytic emergency. In total, 25.3% opted for non-dialytic conservative treatment.

Evaluating patients via TN without the need for them to visit the hospital freed up outpatient appointments in the hospital nephrology unit, which, during first 6 months, shortened the waiting times for in-person evaluations from an average between both hospitals of 289 days (range, 257–321) with the traditional method to an average of 23 days (range, 16–30) after the initiation of TN, as shown in Figure 1 (changes in the waiting time for in-person evaluations at both hospitals during first 6 months of TN). After those first 6 months (April 2013 onward), the waiting times remained relatively the same.

A multivariate logistic model analyzed the effects of age, sex, CKD stage, albumin/creatinine ratio, and hemoglobin variables on the likelihood of being referred for an in-person visit with a nephrologist. These factors were all independently associated with referral and were statistically significant (Table 2).

In total, 48 (87.3%) of the PHC doctors completed the satisfaction survey and reported an 86.7% approval rating for TN. The PHC doctors highlighted the short response times from the nephrologist, continuing education, and easy access to a specialist for collaborative patient management in their responses.
DISCUSSION

In this report, we present the first Latin American study on the use of TN in real practice. We showed an average response time of 2.5 days and the identification of 57.3% of patients who did not require in-person consultations, who were able to continue treatment at the original PHC center according to the specialist’s recommendations. This outcome allows patients to avoid incurring transportation costs, as well as unnecessary consultations, unnecessary examinations and delays in treatments, among others. Although we described the outcomes of the intervention without a control, which can be viewed as an important limitation of this study, we cannot identify any other intervention observed in the Chilean health system over the last 6 months that could explain a difference of this magnitude (289 days vs. 2 days for TN evaluations and, if required, 23 days for in-person evaluations).

In addition, the analysis showed that waiting times for specialty consultations decreased continuously over a 6-month period, and that the designated 10-minute time frame (50% less than the time assigned for in-person consultations) was sufficient to adequately respond to the teleconsultations, in accordance with previous reports.\(^7\) This time frame saves time, allows more outpatient appointment opportunities in the nephrology unit at hospitals, and reduces the waiting times for patients who require in-person evaluations by a nephrologist to a maximum of 30 days.

Most patients (85.1%) referred to our TN platform had CKD between stages 3a and 5, a point at which early evaluation and treatment by a nephrologist has a greater impact on progression to advanced stages, preventing complications, improving survival, and decreasing hospitalizations.\(^1,2,5,6,25-28\) Telenephrology programs have been proposed as a strategy to address and to solve the health challenge presented by the growing proportion of CKD patients referred from PHC\(^25-28\) and the lack of nephrologists.\(^4,5,25-28\) Our program would confirm this proposal and provide data that could be very valuable for health systems around the world like that in Chile that face similar constraints.\(^6-9,59-60\) As a result, the Ministry of Health of Chile decided in 2019 to extend the TN strategy throughout the country’s health network.

The variables of young age, male sex, advanced-stage CKD, elevated albuminuria, and low levels of hemoglobin were independent factors, and patients with these factors were sent to the hospital significantly more frequently than patients without these factors. Future studies should verify the clinical value of these associations among variables and morbidity and mortality, the number of hospitalizations, complications, and dialysis use.

An added value of our TN program was that it facilitated faster and more opportune access to the advanced renal care unit for stage 4 to 5 CKD patients. This benefit allowed for informed and consensus-
based decisions regarding treatment options, including dialysis/transplantation (74.7%) and conservative treatment (25.3%). In addition, the number of patients with arteriovenous fistula doubled, those who chose peritoneal dialysis tripled, and the number of admissions for dialytic emergencies was minimized.

One of this study’s limitations is that the patients’ level of satisfaction and the feasibility of following the recommended treatments through the TN method were not evaluated. Furthermore, we did not evaluate whether the specialist’s recommendations had an impact on disease progression and cardiovascular morbidity and mortality.

Another aspect that was not evaluated in our study was the costs associated with the TN strategy, opportunity access, and the treatment recommended by the specialist. Use of TN could potentially reduce costs by enabling online patient care through referrals from PHC.

In summary, the TN is a feasible intervention that can be implemented in a healthcare system like the Chilean public system. Use of TN is very likely to be responsible for a decrease in the demand for nephrologist consultations at the hospital level, a transference of resolution capacities to primary care, and a decrease in waiting times for specialist in-person evaluation. The opportune diagnosis and referral of stage 4 to 5 CKD patients allowed time for a consensus regarding the choice of elective renal replacement therapy or conservative treatment. Although further research should be undertaken to confirm these findings, we argue that the magnitude of the outcomes observed as well as the absence of other explanatory factors indicate that TN explains most of the observed effect.

DISCLOSURE
CZ has received speaker honoraria from Fresenius Kabi, AstraZeneca, and Grunenthal. ME has received honoraria from Novartis, Pfizer, Roche, Grunenthal, MSD, Merck, Boehringer Ingelheim, and Bayer. All the other authors declared no competing interests.

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SUPPLEMENTARY MATERIAL
Supplementary File (PDF)
Supplementary Methods.
Figure S1. Telenephrology workflow. Study protocol.
Figure S2. Teleconsultations according to stages of CKD and sex.
Supplementary References.
STROBE Statement.

REFERENCES
1. National Institute for Health and Care Excellence (NICE). Chronic kidney disease in adults: assessment and management. 2015. Available at: https://www.nice.org.uk/guidance/cg182/. Accessed July 15, 2019.
2. Smart NA, Dieberg G, Ladhani M, Titus T. Early referral to specialist nephrology services for preventing the progression to end-stage kidney disease. Cochrane Database Syst Rev. 2014;CD007333.
3. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Suppl. 2013;3:1–150.
4. Osman MA, Alrukaimi M, Ashuntantang GE, et al. Global nephrology workforce: gaps and opportunities toward a sustainable kidney care system. Kidney Int Suppl. 2018;8:52–63.
5. Sharif MU, Elsayed ME, Stack AG. The global nephrology workforce: emerging threats and potential solutions!. Clin Kidney J. 2016;9:11–22.
6. Gordon EJ, Fink JC, Fischer MJ. Telenephrology: a novel approach to improve coordinated and collaborative care for chronic kidney disease. Nephrol Dial Transplant. 2013;28:972–981.
7. Scherpbier-de Haan ND, Van Gelder VA, Van Weel C, et al. Initial implementation of a Web-based consultation process for patients with chronic kidney disease. Ann Fam Med. medicine. 2013;11:151–156.
8. Rohtagi R, Ross MJ, Majoni SW. Telenephrology: current perspectives and future directions. Kidney Int. 2017;92:1328–1333.
9. Osman MA, Okel J, Okpechi IG, et al. Potential applications of telenephrology to enhance global kidney care. BMJ Global Health. 2017;2:e000292.