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Telenephrology care options for patients with kidney disease: protocol for a systematic review of modalities, implementation, and clinical outcomes

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ADMINISTRATIVE INFORMATION**Support** - NA.**Review Stage at time of this submission** - Piloting of the study selection process.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY2026100050

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 10 October 2026 and was last updated on 10 October 2026.

INTRODUCTION

Review question / Objective Review question: Across the spectrum of kidney disease (chronic kidney disease [CKD], acute kidney injury [AKI], dialysis, and kidney transplantation), which telenephrology options are available, and how do they affect clinical, patient-reported, process, and access outcomes compared with usual in-person nephrology care?

Objective: To systematically identify, categorize, and evaluate the available telenephrology options for patients across the spectrum of kidney disease, and to assess their effect on clinical, patient-reported, process, and access outcomes compared with usual in-person care.

Specific objectives:

1. To map telenephrology modalities across three functional domains (remote monitoring, patient education, delivery of care) and four delivery platforms (web-based applications, smartphone

apps, interactive video conferencing, wearable devices).

2. To evaluate the clinical efficacy, safety, and patient-reported outcomes of each modality.

3. To characterize barriers, facilitators, equity considerations, and implementation determinants.

PICOS: Population – patients of any age with CKD, AKI, kidney failure on maintenance dialysis, or a kidney transplant; Intervention – any telenephrology modality; Comparator – usual in-person nephrology care, no telehealth intervention, or an alternative telehealth modality; Outcomes – clinical, patient-reported, process/access, safety, economic, and implementation outcomes; Study designs – randomized and non-randomized comparative studies, with qualitative and mixed-methods studies for the implementation objective.

Rationale Telenephrology is increasingly organized into remote monitoring, patient education, and direct delivery of care, delivered through internet/web-based applications, smartphone apps,

interactive video conferencing, and wearable devices (Rohatgi et al., *Kidney International*, 2017; Koraisly and Rohatgi, *American Journal of Kidney Diseases*, 2020). Video-based telenephrology has been applied across all CKD stages with high patient satisfaction and outcomes reportedly comparable to in-person care, and expert consensus favors hybrid models that embed virtual contacts within conventional care (Young et al., *Clinical Journal of the American Society of Nephrology*, 2021; Lentini et al., *Journal of Nephrology*, 2026). However, controlled evidence for clinical efficacy and cost-effectiveness remains limited, the certainty of evidence for eHealth interventions is low, and digital inequity threatens vulnerable populations (Stevenson et al., *Cochrane Database of Systematic Reviews*, 2019; Ladin et al., *JAMA Network Open*, 2021). A rigorous synthesis is needed to inform clinical practice and health system implementation.

Condition being studied Kidney disease across all stages, including chronic kidney disease (CKD, stages G1-G5), acute kidney injury (AKI) and the AKI-to-CKD transition, kidney failure treated with maintenance dialysis (in-center hemodialysis, home hemodialysis, and peritoneal dialysis), and kidney transplantation. These populations require longitudinal specialist follow-up, repeated clinical and laboratory surveillance, and complex medication management, which telenephrology aims to deliver remotely or in hybrid form.

METHODS

Search strategy Databases: MEDLINE (via PubMed), Embase, CENTRAL (Cochrane Central Register of Controlled Trials), CINAHL, and Scopus. Trial registers: ClinicalTrials.gov and the WHO International Clinical Trials Registry Platform (ICTRP).

The strategy combines controlled vocabulary (MeSH in MEDLINE; Emtree in Embase) with free-text terms in two concept blocks joined with AND:

Concept 1 (telehealth): telemedicine OR telehealth OR telenephrology OR "remote monitoring" OR eConsult OR "store and forward" OR mHealth OR "mobile application" OR wearable OR smartwatch OR videoconferenc* OR "virtual visit" OR eHealth

Concept 2 (kidney disease): "chronic kidney disease" OR CKD OR "renal insufficiency" OR dialysis OR hemodialysis OR "peritoneal dialysis" OR "kidney transplant*" OR "acute kidney injury" OR nephrology

Combination: (Concept 1) AND (Concept 2)

No date restriction will be applied at the search stage; limits will be applied at screening. No language limits will be applied. The strategy will be adapted to the syntax and controlled vocabulary of each database, and the full reproducible PubMed strategy will be reported in an appendix to the final review. Reference lists of included studies and relevant systematic reviews will be hand-searched.

Participant or population Patients of any age with kidney disease, including chronic kidney disease (stages G1-G5), acute kidney injury, kidney failure treated with maintenance dialysis (in-center hemodialysis, home hemodialysis, or peritoneal dialysis), or a kidney transplant. Where relevant, their care partners and clinicians will also be included.

Intervention Any telenephrology modality, including synchronous video consultation; asynchronous/store-and-forward care and electronic consultation (eConsult); remote home monitoring (blood pressure, weight, symptoms, and home dialysis machine data); wearable sensors and smartwatches; home point-of-care testing and biosensors; and web- or app-based patient education and self-management tools. Modalities will be classified by functional domain (remote monitoring, patient education, delivery of care) and delivery platform (web-based applications, smartphone apps, interactive video conferencing, wearable devices).

Comparator Usual in-person nephrology care, no telehealth intervention, or an alternative telehealth modality. Single-arm descriptive studies without a comparator will be included for the mapping and qualitative objectives only.

Study designs to be included Randomized controlled trials, non-randomized comparative studies, prospective and retrospective cohort studies, and controlled before-after studies. Qualitative and mixed-methods studies will be included for the implementation and feasibility objectives, and single-arm descriptive studies for the mapping objective only. Narrative reviews, editorials, and conference abstracts without extractable data will be excluded.

Eligibility criteria Inclusion: studies meeting the population, intervention, comparator, and study design criteria above. Exclusion: studies not focused on kidney disease; purely technical or engineering reports without patient outcomes; animal or in-vitro studies; narrative reviews,

editorials, and conference abstracts without extractable data. No language restriction will be applied; non-English records will be translated where feasible.

Information sources Electronic databases: MEDLINE (via PubMed), Embase, CENTRAL (Cochrane Central Register of Controlled Trials), CINAHL, and Scopus. Trial registers: ClinicalTrials.gov and the WHO International Clinical Trials Registry Platform (ICTRP), to identify ongoing and unpublished studies. Other sources: hand-searching of the reference lists of included studies and relevant systematic reviews, and grey literature from major nephrology societies (Kidney Disease: Improving Global Outcomes [KDIGO], American Society of Nephrology [ASN], and European Renal Association [ERA]).

Main outcome(s) Clinical outcomes: blood pressure control; CKD progression or change in estimated glomerular filtration rate (eGFR); hospitalization; mortality; dialysis-related complications; and transplant outcomes.

Patient-reported outcomes: satisfaction, quality of life, and self-efficacy.

Effect measures: risk ratios for dichotomous outcomes and mean differences for continuous outcomes, each with 95% confidence intervals, where data permit quantitative synthesis. Outcomes will be extracted at the time points reported by the included studies.

Additional outcome(s) Process and access outcomes: medication adherence, visit completion and no-show rates, time to specialist access, and travel burden.

Safety: adverse events, false-positive alerts from remote monitoring, and resulting patient anxiety.

Economic outcomes: cost and cost-effectiveness.

Implementation outcomes: feasibility, acceptability, barriers, facilitators, and equity impact.

Data management Records retrieved from all sources will be imported into reference management software, de-duplicated, and screened in a systematic review platform (e.g., Covidence or Rayyan). Two reviewers will independently screen titles and abstracts and then full texts against the eligibility criteria; disagreements will be resolved by discussion or by a third reviewer. The selection process will be reported in a PRISMA 2020 flow diagram.

Two reviewers will independently extract data using a piloted, standardized form, with discrepancies resolved by consensus or adjudication. Data items: study characteristics (design, country, setting, year, funding); population (kidney disease type and stage, age, sample size); telenephrology modality and platform; comparator; duration and intensity of the intervention; outcomes and measurement tools; implementation determinants; and equity-relevant variables (age, rurality, income, digital access).

Quality assessment / Risk of bias analysis Two reviewers will independently assess risk of bias using the Cochrane Risk of Bias 2 (RoB 2) tool for randomized trials, ROBINS-I for non-randomized comparative studies, and an appropriate appraisal tool (e.g., the Critical Appraisal Skills Programme [CASP] checklist) for qualitative studies, with discrepancies resolved by consensus or adjudication. The certainty of evidence for key outcomes will be rated using the GRADE approach.

Strategy of data synthesis A narrative, structured synthesis will be organized by telenephrology modality and by kidney disease population (CKD, AKI, dialysis, transplantation). Where studies are sufficiently homogeneous in population, intervention, comparator, and outcome, random-effects meta-analysis will be performed, reporting risk ratios or mean differences with 95% confidence intervals; statistical heterogeneity will be assessed with the I² statistic. If meta-analysis is not feasible, findings will be synthesized using Synthesis Without Meta-analysis (SWiM) methods.

Subgroup analysis Where data permit, subgroup analyses will be performed by kidney disease type and stage (CKD, AKI, dialysis, transplantation); telenephrology modality; age group (including older adults); setting (rural vs. urban); and study design.

Sensitivity analysis Sensitivity analyses will (1) restrict the analysis to studies at low risk of bias, (2) restrict the analysis to randomized controlled trials, and (3) exclude studies with high attrition.

Language restriction No language restriction; non-English records will be translated where feasible.

Country(ies) involved United States (author affiliation). The review itself has no geographic restriction.

Other relevant information Reporting standard: the review will be conducted and reported in accordance with PRISMA 2020; SWiM reporting guidance will be followed if meta-analysis is not feasible.

Review stage at registration: preliminary searches have been completed and piloting of the study selection process is ongoing. The protocol is being registered before formal screening of search results and data extraction. Any amendments to the protocol will be documented and reported in the final review.

Keywords Telenephrology; telemedicine; chronic kidney disease; dialysis; kidney transplantation; remote monitoring; eHealth; mHealth; wearable devices; patient education.

Dissemination plans Findings will be submitted for publication in a peer-reviewed nephrology journal and presented at a relevant scientific congress.

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