



# European nephrologists' views on remote patient management for end-stage kidney disease

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Remote patient management (RPM) involves the collection of clinical, treatment-related and subjective patient data outside clinical settings to be used by healthcare professionals to monitor and adapt treatments remotely. In the area of kidney replacement therapy (KRT), various applications are being used, with different features such as remote monitoring (continuous and automatic data collection), data analysis software (detecting deviating values and providing alerts) and communication tools (e.g. shared patient records, messaging service) [1].

RPM may give patients more confidence to perform home dialysis and could reduce patients' administrative burden [1–3]. Moreover, the use of RPM was associated with better clinical parameters [4], better treatment adherence [5], fewer hospital visits [4–6], less travel time [6] and lower costs [5, 6].

As with other forms of telemedicine, several barriers may limit the implementation and diffusion of RPM. Broens *et al.* [7] distinguished five categories of barriers: technical (e.g. users' skills, data accessibility, presence of infrastructure such as Internet), acceptance (e.g. users' motivation and beliefs, evidence about efficacy), financial (e.g. implementation and maintenance costs), organizational (e.g. changing work practices, team roles and responsibility) and policy and legislation (e.g. patients' physical security and information security).

It is yet unknown how often RPM is used by European nephrologists and the barriers they experience to use this technology. Some qualitative studies [8] describe experiences of RPM users, but studies on barriers for non-users do not report about nephrologists' experiences [1]. Moreover, results from non-European countries cannot be generalized to Europe due to differences in geography, healthcare systems, digital skills and technical infrastructure. Therefore we studied the use of, attitude towards and added value of RPM and barriers for non-users among European nephrologists treating adults with KRT.

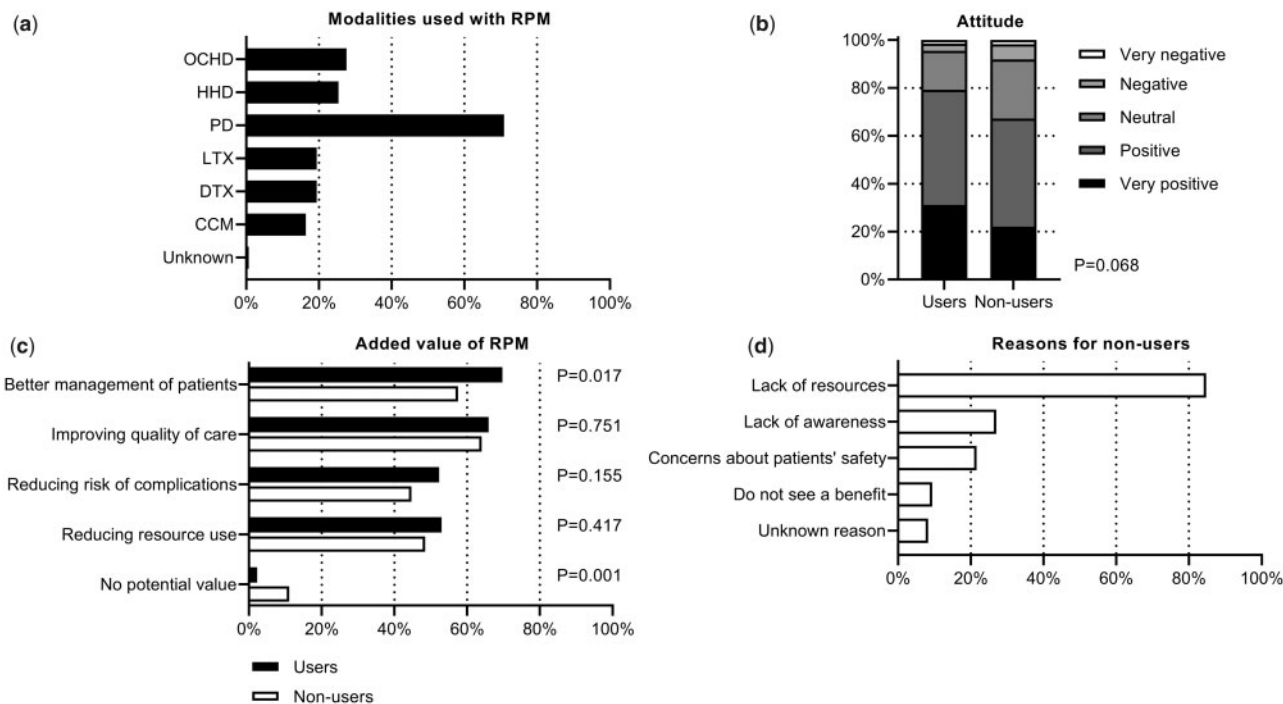
Between March and May 2019 we surveyed nephrologists with the Effect of Differing Kidney Disease Treatment Modalities and Organ Donation and Transplantation Practices on Health Expenditure and Patient Outcomes (EDITH)

nephrologist survey [9]. The Medical Ethics Committee of Amsterdam UMC, location AMC in Amsterdam, The Netherlands waived the need for ethical approval and individual participants provided informed consent. In this study we included nephrologists who provided information on sex, age and centre characteristics. We reported quantitative results as proportions and performed thematic content analysis of responses from open questions using Broens' model [7] to categorize barriers of non-users.

In total, 519 nephrologists, 54% male, 29%  $\leq 40$  years of age, 55% between 41 and 60 years of age and 16%  $\geq 61$  years of age, from 33 European countries were included. The majority were employed in academic (57%) and public centres (78%) in urban areas (93%). Three-quarters (77%) worked in a centre that treats  $\geq 100$  patients per year with end-stage kidney disease. Thirty-three percent lived in a country with low gross domestic product (GDP), 38% in a middle-GDP country and 30% in a high-GDP country [9].

Twenty-six percent already used RPM in their clinical practice, mostly for peritoneal dialysis (PD) (71%) (Figure 1A). Most nephrologists had a positive attitude towards RPM, with no significant difference between users and non-users (Figure 1B). Respondents believed that RPM could result in improved quality of care (64%), better patient management (61%), reduced resource use (50%) or fewer complications (47%) (Figure 1C). The most frequently selected reason for not using RPM was a lack of resources (85%); other reasons were a lack of awareness (27%), safety concerns (22%) and perceiving no advantages (9%) (Figure 1D).

We compared opinions from nephrologists living in low-, middle- and high-GDP countries in Europe and found no differences in the use of, attitude towards or barriers to the use of RPM. Remarkably, respondents from both low- and high-GDP countries more frequently saw resource reduction as a potential value (low 53%, middle 41%, high 57%;  $P < 0.05$ ), while those from middle-GDP countries more frequently reported reducing the risk of complications



**FIGURE 1:** Use of, attitudes towards and added value of RPM and barriers for non-users. (A) Modalities used with RPM, (B) attitudes, (C) added value of RPM and (D) reasons for non-users. OCHD, out-centre haemodialysis; HHD, home haemodialysis; LTX, living kidney donor transplantation; DTX, deceased kidney donor transplantation; CCM, comprehensive conservative management.

(low 42%, middle 54%, high 43%;  $P < 0.05$ ). RPM was more frequently used for PD in middle- and high-GDP countries (low 56%, middle 71%, high 83%;  $P < 0.05$ ).

We received 27 free-text comments from users and non-users on the added value of RPM (Supplementary data, Table S1). Respondents mentioned that RPM could improve care, especially for specific groups (older patients, working patients or remotely living patients). Moreover, RPM was believed to result in increased patient participation and home dialysis uptake. We received 41 free-text comments on reasons for not using RPM, covering all five categories of Broens' model [7] (Supplementary data, Table S1). These included absent or restrictive legislation, problems with acceptance of RPM by patients and nephrologists, insufficient technical infrastructure and additional financial burden.

Our findings show that European nephrologists were generally in favour of RPM and a quarter of the sample already used this technology. Many respondents thought that RPM would improve the quality of care and reduce resource use. Non-users frequently reported a lack of resources to use RPM. Several expressed concerns about the impact of the technology on daily practice and job satisfaction, but only a few were worried about safety.

There is controversy in our findings about resource use. Half of the nephrologists believed that RPM could reduce resource use, while many non-users reported a lack of resources to use RPM. Respondents may have interpreted 'resources' differently as financial, staff-related or technical means. We hypothesize that the influence of RPM on resource use is related to the application's features, practice organization (e.g. task division, arrangements about home visits) and the degree of RPM

experience of healthcare professionals. Moreover, introducing RPM may be expensive, while the resource reduction may only become visible at a later stage. The current evidence on resource reduction is inconclusive [5, 6, 10].

The current evidence on clinical outcomes and costs of RPM for patients receiving KRT is mainly based on small observational studies without a control group [4–6]. To the best of our knowledge, no studies have investigated long-term clinical outcomes of RPM such as complications, technique failure and patient survival. Furthermore, several studies were sponsored by pharmaceutical companies. Three ongoing randomized controlled trials from France (in chronic kidney disease, dialysis and transplanted patients) and Canada and Mexico (only PD patients) with different RPM applications may generate more evidence on patients' outcomes (clinical data, quality of life), healthcare professionals' experiences and costs [11–13].

The strength of our study is the large, multinational sample. Selection and sampling bias are associated with web-based surveys and may have caused an overestimation of the use of RPM. Moreover, we were unable to calculate a response rate due to the indirect distribution of the survey. Furthermore, respondents may have had a different interpretation of the definition of RPM. Lastly, this survey was completed before the coronavirus disease 2019 pandemic. Outcomes may have changed, as remote care provision is currently more desirable and more nephrologists may have gained experience with RPM.

The findings of our study suggest that most nephrologists support RPM, but the absence of resources is a substantial barrier. For successful implementation one should, next to

nephrologists, also involve nephrology nurses and patients. Older or vulnerable patients may also benefit from RPM but may experience more barriers to use this technology. Hopefully, ongoing studies will not only expand our knowledge on user experience, but also on costs and outcomes of RPM.

## SUPPLEMENTARY DATA

Supplementary data are available at [ndt online](https://ndt.online).

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## CONFLICT OF INTEREST STATEMENT

The content of this article represents the views of the authors only and is their sole responsibility; it cannot be considered to reflect the views of the European Commission or any other body of the European Union. The European Commission does not accept any responsibility for use that may be made of the information it contains. R.W.d.J., K.J.J, T.H.F.B. and V.S.S declare that they have no relevant financial interests.

## DATA AVAILABILITY STATEMENT

Data cannot be shared publicly due to the privacy of individuals who participated in the study.

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