Characteristics and Costs of Prehospital Care for Chronic Kidney Disease Patients: A Longitudinal Cohort Study

José Antonio Sarria-Guerrero
Faculty of Medicine and Health Sciences, School of Nursing. University of Barcelona

Eva Maria Guix-Comellas (✉ evaguix@ub.edu)
Faculty of Medicine and Health Sciences, School of Nursing. University of Barcelona

Francesc Xavier Jiménez-Fábrega
Emergency Medical System of the Department of Health of Catalonia

Llúcia Benito-Aracil
Faculty of Medicine and Health Sciences, School of Nursing. University of Barcelona

Raül Sancho-Agredano
Faculty of Medicine and Health Sciences, School of Nursing. University of Barcelona

Núria Fabrellas Padrés
Faculty of Medicine and Health Sciences, School of Nursing. University of Barcelona

Research Article

Keywords: Chronic kidney disease, telephone triage, emergencies, hospital emergency, cost analysis, comorbidity

DOI: https://doi.org/10.21203/rs.3.rs-110321/v1

License: ☑️ 🔗 This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License
Abstract

Background The global cost associated with substitute treatment for patients with chronic kidney disease has been calculated, but there is a lack of information about the characteristics and costs deriving from pre-hospital care with transport and admission to hospital emergency services. Therefore, the aim of this study was to identify the characteristics of urgent telephone requests to Emergency Medical Services for patients with chronic kidney disease in Catalonia, Spain, and make a cost estimation of prehospital care and admission to the emergency department, grouped by comorbidities.

Methods Retrospective longitudinal observational study. Patients who required urgent prehospital care based on telephone triage were enrolled. Sociodemographic, clinical, and financial variables were collected. The data were gathered by means of a review of the clinical records in the Emergency Medical Services database. To explore the possible relation among the qualitative variables the $\chi^2$ test was used, for the relation between a quantitative variable and dichotomy qualitative variable the student t test was used with prior testing of the normal deviation of quantitative variables, and the Mann-Whitney U test was then employed if they did not fulfil normality criteria. For all calculations an alpha error of $p <0.05$ was assumed.

Results A total of 252 phone calls were analyzed. Some 98.4% of patients (n=248) were prioritized through phone triage and classified as very severely ill: resuscitation or emergencies. The most prevalent initial diagnoses were intense dyspnoea, accidental fall, abdominal pain, and disease decompensation; there were 11 cases of cardio-respiratory arrest (4.36%), half of which were associated with hypertensive heart disease (HHDT). The average cost of prehospital care was €480.06/patient (SD=256.74), but in patients with comorbidities this rose to €550.77 for HHD and €508.73 for diabetes mellitus (DM). No statistically significant differences were found between total cost/patient and comorbidity ($p=0.361$), or between the costliest comorbidities, HHD and DM ($p=0.330$).

Conclusions Patients telephoned for help when they were in serious condition, in line with the levels established by telephone triage. The cost of prehospital care was high, and this increased in the presence of comorbidities.

Background

Chronic kidney disease (CKD) affects 10% of the world’s population and presents financial challenges to societies throughout the world (1). Hospital admissions of people with CKD to the emergency department (ED) represent a cost that is difficult to plan for and an enormous social burden in terms of comorbidities and use of health resources (2).

Because the number of people with CKD is on the rise and their life expectancy is greater, the number of serious medical situations is also on the increase, associated with problems arising in therapy such as decompensations of their comorbid conditions. These situations warrant healthcare intervention, often with emergency transport and admission to hospital (3). In Spain, in a situation of risk, professionals, the
patient, or the patient’s relatives contact the Emergency Medical Services (Servicios de Emergencias Médicas—SEM), who provide prehospital care and transfer of patients to hospital once they are stabilized (4). The reasons why these patients with CKD require assistance or transport are diverse, and the situations triggering them remain difficult to forecast and manage (5).

Worldwide it is calculated that the costs associated with CKD patients are of particular importance in relation to the various types of hemodialysis (HD). The global cost associated with these substitute treatments is estimated to be some $57.1 million (6). In Europe, the European Kidney Health Alliance (EKHA) dedicates €15 million per year to substitute kidney treatment, which amounts to 2% of the overall healthcare cost for the 0.1% of patients with CKD. The indirect costs arising from prehospital emergencies, consultations, and emergency transport are not included in this calculation (7).

In Spain, more than €800 million per year is dedicated to substitute treatment. The percentage of the Spanish healthcare budget dedicated to these patients is on the order of 2.5% while they are 0.1% of the population, so they are significant consumers of healthcare resources (8). In 2018, the total number of patients receiving kidney substitute treatment in Spain was 61,764, with an incidence of 6,883 and a rate of 147.3/million people (9).

The elevated economic and social costs of people with CKD should be a subject for attention. However, the available information is scarce and focused principally on hemodialysis (8,10–13). A number of studies have calculated the average cost of CKD patients in terms of the substitute therapies used to treat them (14,15). Other studies have calculated the costs of scheduled health transport in Spain but without reference to emergencies or urgent transport (16,17). Yet other studies have calculated the risk of hospital admission for complex chronic patients, among whom CKD patients with comorbidities are a significant component; decompensations lead to unplanned, lengthy, and costly, hospital stays (18,19). A number of studies have analyzed the distinct types of cost but not the additional costs associated with CKD (1,7,20). Admission of these patients to the ED represents a further cost.

In the SEM the average cost of urgent prehospital attention and transport to hospital emergency services varies according to the resources assigned through telephone triage, both materially (rapid vehicle, ambulance, helicopter) and in terms of personnel (attending team), with great variability in both (21, 22).

The aims of the present study were to describe the characteristics of urgent telephone requests to the SEM for CKD patients in Catalonia, Spain, during the year 2017, and to estimate the cost of prehospital care, transfer, and admission to the hospital ED in relation to comorbidities.

**Methods**

**Design**

This was a retrospective, observational, longitudinal, descriptive study.

**Setting and participants**
Included were all patients attended by the SEM and with a diagnosis of CKD according to the following classification, and who, in their telephone contact, required attention or transfer to their reference hospital: International Statistical Classification of Diseases and Related Health Problems (CIE-10) for the year 2017. Excluded were those patients who cancelled their telephone request for assistance before it was carried out.

**Variables and data collected**

The data were gathered by means of a review of the clinical records in the SEM database.

The following sociodemographic variables were collected: age and sex. The clinical variables collected were telephone triage level, orientative diagnosis, comorbidity, assistance resource type required, need for transfer/admission to ED, and the hospital to which transfer was made. The financial variables were cost of the prehospital attention and cost of admission to the ED.

The resource types specified by the Spanish Ministry of Health and Social Policy are as follows. There is ambulance service with vehicles equipped to provide technical and health assistance *en route*, consisting of two classes: class B, providing basic life support (BLS) and initial care, and class C providing advanced life support (ALS). Class C ambulances are operated by a qualified driver, as are class B, but in addition they have on board a nurse with a university degree in nursing. In addition, when the care to be provided so requires there is also a physician on board with a degree in medicine (23).

The average cost of care and emergency transport on land or by air with specialized personnel ranges, according to the service time, from €2,500 to €6,000; for type C ambulance service the cost runs from €600 to €1,000; and for type B service the range is from €200 to €500. In addition, the cost just for admission to a high technology ED is €111.81. These costs are orientative, as agreed upon by the ministry of health and/or the health departments of the autonomous regional authorities (21, 22, 23).

In this study the degree of initial seriousness of the condition of the patients was determined from the telephone triage in accordance with the Spanish Triage System (SET), as follows: 1 (resuscitation), 2 (emergency), 3 (urgent), 4 (less urgent), and 5 (not urgent).

**Data analysis**

Data analysis was made using the statistical package SPSS version 26.0. For the qualitative variables descriptive analysis was made by calculating frequencies and percentages. For the quantitative variables the mean and the median were calculated as measures of the main trend, and standard deviation (SD) or interquartile range were calculated as a function of the normality of the variable. To explore the possible relation among the qualitative variables the $\chi^2$ test was used, for the relation between a quantitative variable and dichotomy qualitative variable the student t test was used with prior testing of the normal deviation of quantitative variables, and the Mann-Whitney U test was then employed if they did not fulfil normality criteria. For all calculations an alpha error of $p < 0.05$ was assumed.
Ethical considerations

This study was carried out with the permission of the Clinical Management Board of the SEM (project approval by Junta Clínica, dated on 16th September 2015). All methods were carried out in accordance with relevant guidelines and regulations. Confidentiality and anonymity of patient data were guaranteed at all times, by means of a data coding process that complied with the prevailing legal norms (Organic Law 3/2018 December 5 concerning the protection of data of a personal nature). The participants were further informed about how the collected data would be handled, stored and presented/published and about their rights as participants. Informed consent was obtained from all subjects in order to participate.

Results

A total of 252 CKD patient calls to SEM were examined; 162 (64.3%) were men and 90 (35.7%) women, with an average age of 57.6 years (SD=14.32). The majority of the patients, 237 (94%), required attention at home and urgent transfer to hospital. The remaining telephone requests were resolved at home without transfer being required.

The classification of the patients using the telephone triage system of the SEM was as follows: level 1 (resuscitation), n=61 (24.2%); level 2 (emergency), n=187 (74.2%); level 3 (urgent), n=1 (0.4%); level 4 (less urgent), n=3 (1.2%); level 5 (not urgent), n=0. The most frequent initial orientative diagnoses were intense dyspnea, n=36 (14.3%); accidental fall or contusion, n=32 (12.7%); abdominal pain, n=27 (10.7%); and CKD decompensation, n=22 (8.7%). Eleven patients were recorded as suffering cardiac arrest (CA), (4.36%).

The main comorbidities in the patients were as follows: arterial hypertension (AHT) (n=104; 41.26%) with 13 diagnoses of thoracic pain, diabetes mellitus (DM) I or II (n=58; 23.01%) with 10 diagnoses of CKD decompensation, chronic obstructive pulmonary disease (COPD) (n=35; 13.88%) with 20 diagnoses of intense dyspnea, acute myocardial infarction (AMI) (n=29; 11.50%), and arterial occlusive disease (n=25; 9.92%) (Table 1).

Table 1. Main comorbidity in chronic kidney disease patients (n= 252 patients). (See some patients with more than one comorbidity)
| Condition                        | Frequency | %    | Average age of patients | Standard Deviation |
|---------------------------------|-----------|------|-------------------------|-------------------|
| Hypertension                    | 104       | 26.53| 60.8                    | 13.0              |
| Type II Diabetes Mellitus DMII  | 40        | 10.20| 51.2                    | 8.9               |
| Chronic Obstructive Pulmonary   | 35        | 8.93 | 64.9                    | 9.3               |
| Disease                         |           |      |                         |                   |
| Acute myocardial infarction     | 29        | 7.40 | 49.0                    | 6.7               |
| Occlusive Vascular Disease      | 25        | 6.38 | 51.4                    | 13.7              |
| Ulcer disease                   | 24        | 6.12 | 53.0                    | 17.7              |
| Cerebrovascular accident        | 21        | 5.36 | 65.8                    | 9.4               |
| Type I Diabetes Mellitus        | 18        | 4.59 | 37.7                    | 5.1               |
| Hemiplegia                      | 18        | 4.59 | 57.4                    | 19.3              |
| Hepatopathy                     | 16        | 4.08 | 60.9                    | 10.9              |
| Congestive Heart Failure        | 16        | 4.08 | 51.4                    | 13.7              |
| Acute or chronic asthma         | 15        | 3.83 | 55.5                    | 16.2              |
| Neoplasia                       | 14        | 3.57 | 63.2                    | 4.3               |
| Behaviour disorder              | 7         | 1.79 | 35.3                    | 4.9               |
| Leukaemia                       | 6         | 1.53 | 56.7                    | 19.0              |
| AIDS                            | 4         | 1.02 | 42.6                    | 11.2              |
| **Final comorbidities**         | **392**   |      | **100**                 |                   |

Comorbidities were categorized as cardiovascular (n=99; 48.1%; cost €521.91); metabolic (n=42; 20.4%; cost €445.14); respiratory (n=37; 18.0%, cost €473.97); neurological (n=28; 13.6%; cost €483.23), and without comorbidity or not recording (n=46). There was no statistical difference between different comorbidities groups and their total cost (p=0.523).

The hospitals receiving the most transferred patients were high technology university centers, n=153 (62.4%). Some 152 ambulance transfer (60.3%) were class B for BLS, 99 (39.3%) were class C for ALS, and 1 helicopter (0.4%) was used for air ALS. The attending teams were made up of two emergency technicians, n=152 (60.3%), doctor, nurse, and technician, n=70 (27.8%), nurse and technician, n=29 (11.5%), and pilot, copilot, physician, and nurse, n=1 (0.4%).
The average cost of prehospital resources used was €368.25/patient (SD=256.75); adding to this the initial cost of admission to the hospital ED, this figure increases to €480.06/patient (SD=256.74). The total cost of the urgent healthcare resources used including prehospital attention, transfer, and admission to the ED comes to €119,297.97 for the entire patient group. In terms of comorbidities, the costliest patient groups were as follows: behavioral disorders (€578.47), AHT (€550.77), and DM (€508.73), although we found no statistically significant differences between total cost/patient and these comorbidities (p=0.361), nor were there statistically significant differences between the two most common and costliest comorbidities, AHT and DM (p=0.330).

Discussion

The vast majority of patients with CKD, 98.4% (n=248), who requested urgent medical attention by means of a telephone call were classified by the healthcare personnel attending them with serious triage levels—resuscitation or emergency. In addition, the transferal of 237 of these patients to the ED was justified by their serious clinical state. It should be noted that as chronic patients tend to be quite conscious of their illness, the patients in this study, or their family members, perceived their condition as emergencies to the same degree as did the experts who subsequently assigned triage levels to their cases; this is in sharp contrast to what has been described in other populations, such as the pediatric (24). Initial telephone triage proved a useful instrument for routing these patients to the ED, as other studies have also discovered (25). Although the literature mentions other factors that may interfere with assignment of the triage level, such as anxiety of the person making the call and the experience of the healthcare personnel (26), these appear not to have been factors with the CKD patients in the present study.

Another important factor was the comorbidities of the patients. The most prevalent were AHT and DM, both of which represent a direct cardiovascular risk as evidenced in other studies (27,28), and which resulted in the sudden death of 4.36% (n=11) of cases. AHT was present in half of the CAs. The European Kidney Health Alliance (7), in its recommendations regarding manageable kidney disease, reports that cardiovascular comorbidity in CKD produced 7,000 more hemorrhaging strokes and 12,000 sudden deaths in England than in individuals without cardiovascular comorbidity, thereby increasing the human cost associated with the chronic illness, as in our study.

Regarding the financial costs, urgent hospital admission, which is quite common in CKD, is associated with increased renal deterioration and poorer quality of life, which in turn implies a sharper increase in costs. Some authors have indicated that the costs and the demands placed on healthcare services by CKD patients increase with the progression of kidney disease and the rise in its comorbidities (29,30). This progression, however, was not a factor in our study, as the stratification of CKD patients was not one of the study aims. As to the monitoring of patients with important comorbidities, one study confirms that around 35% of terminally ill CKD that are hospitalized require readmission within 30 days of discharge. The authors stated that a considerable number of these unexpected admissions could be avoided with proper planning for follow-up, which would in turn reduce costs (31).
Two comparative studies have been made in Spain to calculate the additional cost represented by telephone emergency calls for patients with CKD; internationally, however, these extraordinary costs have been calculated in association with comorbidities, with resulting recommendations that they be reduced through greater monitoring and wider prevention of the comorbidities (27).

Several international studies have analyzed the different cost types, but they did not calculate the additional costs associated with CKD (1,7,20). None of these studies makes reference to costs arising from emergency admissions for serious situations that necessitate prehospital assistance and urgent transfer to hospital.

To reduce the hospital costs associated with CKD patient emergencies, some authors propose that telemedicine or telenephrology be considered for use (32,33) as alternatives to the telephone call for emergency attention. Telemedicine and e-health would also help in planning the follow-up at hospital discharge of these patients (31,34).

As a limitation of this study, the authors admit that data collection was carried out in a single country, so given the economic variability among countries it would need to be repeated in others with similar income levels, thereby making it possible to compare results internationally.

**Implications for clinical practice**

The results of this study may be used to highlight the importance of telephone medical attention services—both those already up and running in some countries and managed by nurses which are currently used to resolve health consultations and to activate emergency health units, and those telenursing services that have recently been implemented in others. Increasing the follow-up competence of the teleconsultation teams with CKD patients would represent a solid intervention aimed at lowering expenditure and reducing unforeseen costs.

**Conclusions**

People who suffer CKD request assistance by telephone in emergencies that may include clinically serious decompensations, while the level of gravity of the situation is assigned by telephone triage.

The average cost of prehospital care, transfer, and admission to the ED for these patients is high, and even more so when the CKD decompensations are in conjunction with comorbidities.

**Abbreviations**

CKD: Chronic kidney disease

ED: Emergency department

SEM: Emergency Medical Services (Servicios de Emergencias Médicas)
Declarations

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was carried out with the permission of the Clinical Management Board of the SEM (project approval by Junta Clínica, dated on 16th September 2015). All methods were carried out in accordance with relevant guidelines and regulations. Confidentiality and anonymity of patient data were guaranteed at all times, by means of a data coding process that complied with the prevailing legal norms (Organic Law 3/2018 December 5 concerning the protection of data of a personal nature). The participants were further informed about how the collected data would be handled, stored and presented/published and about their rights as participants. Informed consent was obtained from all subjects in order to participate.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

All data generated or analyzed during this study are included in this published article and its supplementary information files. The datasets supporting the conclusion of this article are available from the corresponding authors.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

None.

ACKNOWLEDGEMENTS
We are grateful to Dolores Andreu Périz, honorary director of the Journal of the Spanish Society of Nephrology Nursing, for her incalculable contributions and support in preparing the study and the manuscript.

References

1. Elshahat S, Cockwell P, Maxwell AP, Griffin M, O’Brien T, O’Neill C. The impact of chronic kidney disease on developed countries from a health economics perspective: A systematic scoping review. Barretti P, editor. PLoS One. 2020; 24;15(3):e0230512. doi: 10.1371/journal.pone.0230512

2. Otero A, de Francisco A, Gayoso P, García F, EPIRCE Study Group. Prevalence of chronic renal disease in Spain: results of the EPIRCE study. Nefrologia. 2010;30(1):78–86. doi: 10.3265/Nefrologia.pre2009.Dic.5732

3. Liabeuf S, Sajjad A, Kramer A, Bieber B, McCullough K, Pisoni R, et al. Guideline attainment and morbidity/mortality rates in a large cohort of European haemodialysis patients (EURODOPPS). Nephrol Dial Transplant. 2019; 1;34(12):2105–10. doi: 10.1093/ndt/gfw409

4. Ruiz-Fuentes M del C, Vargas-Rivas J, de Gracia-Guindo C, Ruiz-Fuentes N, de Teresa-Alguacil J, Osorio-Moratalla JM, et al. El paciente trasplantado renal en urgencias. Nefrología. 2015; 1;35(6):591–3. doi: 10.1016/j.nefro.2015.03.004

5. Mathew AT, Strippoli GFM, Ruospo M, Fishbane S. Reducing hospital readmissions in patients with end-stage kidney disease. Kidney Int. 2015; 88(6):1250–60. doi: 10.1038/ki.2015.307

6. Van der Tol A, Lameire N, Morton RL, Van Biesen W, Vanholder R. An international analysis of dialysis services reimbursement. Clin J Am Soc Nephrol. 2019; 14(1):84–93. doi: 10.2215/CJN.08150718

7. European Kidney Health Alliance. Recommendations for sustainable kidney care. 2015. http://ekha.eu/wp-content/uploads/2016/01/EKHA-Recs-for-Sustainable-Kidney-Care-25.08.2015.pdf. Accessed 12 Jun 2019.

8. De Francisco ALM. Sostenibilidad y equidad del tratamiento sustitutivo de la función renal en España. Nefrología. 2011 May 1;31(3):241–6. doi: 10.3265/Nefrologia.pre2011.Apr.10933

9. Sociedad Española de Nefrología (SEN), Registro Español de Enfermos Renales de las Comunidades autónomas, Organización nacional de transplantes (ONT) R español de enfermos renales. Dialysis and Transplantation Report 2018. Report 2018. Congress of the Spanish Society of Nephrology (SEN), 2019. Available from: https://www.senefro.org/contents/webstructure/SEN_2019_REER_modificada.pdf. Accessed 28 Nov 2019
22. Gobierno Vasco. Osakidetza-Servicio Vasco de Salud. Tarifa para facturación de servicios sanitarios y docentes para 2017. Acuerdo del consejo de administración del 15 de febrero de 2017: Boletín oficial del País Vasco, no 43, jueves 2 de marzo de 2017. 2017. Official bulletin. Available from: https://www.euskadi.eus/y22-bopv/es/bopv2/datos/2017/03/1701117a.shtml Accessed: 13 Apr 2019

23. Ministerio de la presidencia relaciones con las cortes e igualdad. BOE-A-2012. Real Decreto 836/2012, de 25 de mayo. Características técnicas, el equipamiento sanitario y la dotación de personal de los vehículos de transporte sanitario por carretera. 2012 p. 41589–95. Official bulletin of the Spanish state. Available from: https://www.boe.es/buscar/pdf/2012/BOE-A-2012-7655-consolidado.pdf. Accessed 23 May 2019

24. Sarria-Guerrero JA, Luaces-Cubells C, Jiménez-Fàbrega FX, Villamor-Ordozgoiti A, Isla Pera P Guix-Comellas EV. Impacto de las consultas y triajes telefónicos pediátricos en el uso del servicio de urgencias hospitalario. 2019;31:257–60.

25. Smits M, Keizer E, Ram P, Giesen P. Development and testing of the KERNset: an instrument to assess the quality of telephone triage in out-of-hours primary care services. BMC Health Serv Res. 2017; 2;17(1):798. doi: 10.1186 / s12913-017-2686-1.

26. Gamst-Jensen H, Lippert FK, Egerod I. Under-triage in telephone consultation is related to non-normative symptom description and interpersonal communication: A mixed methods study. Scand J Trauma Resusc Emerg Med. 2017; 15;25(1):52.

27. Vanholder R, Van Laecke S, Glorieux G, Verbeke F, Castillo-Rodriguez E, Ortiz A. Deleting Death and Dialysis: Conservative Care of Cardio-Vascular Risk and Kidney Function Loss in Chronic Kidney Disease (CKD). Toxins (Basel). 2018 Jun 12;10(6):pii E237. doi: 10,3390 / toxins10060237.

28. Mills KT, Xu Y, Zhang W, Bundy JD, Chen C-S, Kelly TN, et al. A systematic analysis of worldwide population-based data on the global burden of chronic kidney disease in 2010. Kidney Int. 2015 Nov;88(5):950–7. doi: 10.1038 / ki.2015.230.

29. Low S, Lim SC, Zhang X, Wang J, Yeo SJD, Yeoh LY, et al. Medical costs associated with chronic kidney disease progression in an Asian population with type 2 diabetes mellitus. Nephrology. 2019; 1;24(5):534–41. doi.org/10.1111/nep.13478.

30. Park, S; Kear TM. Current State-of-Practice: Transportation for Patients with End Stage Renal Disease. NEPHROL NURS J. 2017;44(4):309–16.
31. Briscoe G, A H, Kane C, Quatrara B. Using Post-Discharge Telephone Follow-Up by Nephrology Nurses to Reduce 30-Day Readmissions and Post-Discharge Complications for Adult Patients on Hemodialysis. Nephrol Nurs J. 2018;45(3):243–67.

32. Trnka P, White MM, Renton WD, McTaggart SJ, Burke JR, Smith AC. A retrospective review of telehealth services for children referred to a paediatric nephrologist. BMC Nephrol. 2015; 1;16(1):125. doi: 10.1186/s12882-015-0127-0.

33. Koraishy FM, Rohatgi R. Telenephrology: An Emerging Platform for Delivering Renal Health Care. Am J Kidney Dis. 2020;76(3):417–26. doi: 10.1053/j.ajkd.2020.02.442.

34. Stevanovic A, Beckers SK, Czaplik M, Bergrath S, Coburn M, Brokmann JC, et al. Telemedical support for prehospital Emergency Medical Service (TEMS trial): Study protocol for a randomized controlled trial. Trials. 2017;26;18(1):43. doi: 10.1186/s13063-017-1781-2.