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

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Research Article

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

Posted Date: December 2nd, 2020

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

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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 χ^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 χ^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)

	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 Disease	35	8.93	64.9	9.3
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)

HD: Hemodialysis

EKHA: European Kidney Health Alliance

BLS: Basic life support

ALS: Advanced life support

AHT: Arterial hypertension

DM: Diabetes mellitus

AMI: Acute myocardial infarction

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 Pérez, 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.

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