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Morbidity and medication consumption among users of home telecare services

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Abstract
Telecare is a healthcare resource based on new technologies that, through the services offered, attempt to help elderly people to continue living in their homes. In this sense, first-generation telecare services have quickly developed in Europe. The aim of this work was to define the profile, pattern of medication consumption and disease frequencies of elderly users of a telecare service. The cross-sectional study involved 742 Spanish community-dwelling elders (85.3% of the total users aged 65 years and over who used a telecare service before the end of the data collection period). Data were collected between March and September 2012. Subjects' mean age was 83.3 (SD 6.6) years, and the majority lived alone (78.3%) and were female (85.8%). The mean Charlson comorbidity index score was 1.13 (SD 1.1), and the mean number of prescribed medications per day was 5.6 (SD 3.0). The most frequent diseases were hypertension (51.1%) and rheumatic disorders (44%); and the most consumed medications were those for the cardiovascular (75%) and nervous (65.2%) systems. For the total sample, the three main determinants of polymedication (five or more medications) were hypertension, anxiety-depressive symptoms and coronary heart disease. Regardless of the social elements contributing to the implementation of telecare services, specific health characteristics of potential users, such as morbidity and polypharmacy, should be carefully considered when implementing telecare services in the coming years.

Keywords: comorbidity, elderly people, healthcare characteristics, polypharmacy, telecare, user's profile

Introduction

Current population estimates highlight the increasing trend of elderly individuals over 60 years. In fact, this population is expected to increase by 22% by 2030 (Bloom *et al*. 2014). In Europe, people aged 65 and over represent 17.9% of the population (Eurostat, 2015), and this percentage rises to 18.3% in Spain and to 23.7% in Galicia (Spanish Statistical Office [Instituto Nacional de Estadística] 2014), an autonomous community in the northwest of Spain. This increase implies significant changes to the national health services to address this demographic change (Brown 2003). Ageing is characterised by a decrease in individuals' functional capacity, with the decrease varying by age and sex (Spanish Statistical Office [Instituto Nacional de Estadística] 2008, Millán-Calenti & Maseda 2011). Furthermore, ageing is associated with an increased difficulty in adapting to external requirements and increased likelihood of becoming ill (Millán-Calenti & Maseda 2011), thus leading to a need for caring support. In the majority of cases, such support will

be provided by the family circle through 'informal caregivers'. In Spain, 32% of the population over 65 have some type of disability, and among them, 55.8% are dependent on others to perform daily activities (Spanish Statistical Office [Instituto Nacional de Estadística] 2008).

This increase in terms of the number, health status and life expectancy of older people, coupled with the decrease in the number of families with the financial capacity to pay for care, has resulted in and will continue to result in significant consequences for socioeconomic and health factors. Therefore, both the public and private sectors have sought to develop formulas that, as far as possible, help to alleviate the current needs and to plan for the near future given that 'prevention is better than cure'; such prevention is the aim of telecare (Brown 2003). In this sense, in the early 1990s, and as a result of the evolution of the new technologies applied (Valero *et al*. 2007), telecare and telehealth services arose. These services have evolved considerably from the first generation to the third generation (Kubitschke *et al*. 2010, Parker & Hawley 2013). Sixsmith *et al*. (2007) define the telecare classifications as follows: A 'first generation' of telecare refers to community alarms that are widely used by elderly and vulnerable individuals to raise an alert when assistance is required. The 'second generation' includes smart sensors that incorporate a degree of intelligence to monitor and interpret a person's movements and automatically raise an alarm even if the person is incapacitated and unable to do it himself. The 'third generation' involves intelligence within non-PC products and devices so that everyday appliances and electronic environments can communicate with each other and transform digital technology into an integral and intuitive part of daily life. As a consequence of this evolution, telecare service has become a home support system (Barlow *et al*. 2007, Botsis *et al*. 2008, Daniel *et al*. 2009, Milligan *et al*. 2011, Parker & Hawley 2013, Sintonen & Immonen 2013). Based on the portfolio of services offered, call receivers try to meet the current need by themselves or by mobilising other human or material resources (Galimany-Masclans *et al*. 2011), providing obvious benefits to the user (i.e. quality of life), informal caregiver (i.e. providing reassurance), professional caregiver (i.e. additional options for care), statutory services (i.e. avoidance of hospital admission), industry (i.e. new market opportunities) and government (i.e. save money associated with care; Audit Commission, 2004; Davies *et al*. 2013). Furthermore, such services provide benefits to healthcare systems in the sense of decreasing service demand and hospital institutionalisations (Department of Health, 2011). More financial support will be necessary to enhance the introduction of new telecare services for the care of elderly people while bearing in mind the fact that future success will depend on new technologies' ability to support family caregivers, as opposed to replacing them (Callan & O'Shea 2015). The user has to make a 'cost–benefit' analysis by considering that there could be a loss of privacy but gains in mobility, safety, self-determination and empowerment (Melander-Wikman *et al*. 2008).

At the European level, Spain (791,180 users; IMSERSO 2014) is among the countries with an estimated moderate take-up level (first generation), including France and Italy, among others (1–3% of older people). Coverage is high in Denmark and Finland (6–10%) and very high (14–16%) in the United Kingdom and Ireland; by contrast, it is low (<1%) in Portugal and Belgium, among others. The forecasts are that the potential market for telecare and telehealth services will experience substantial growth in Europe in the coming years (Kubitschke *et al*. 2010). New technologies can be viewed as simply another resource to be employed alongside family and friends, community organisations and local media. Furthermore, such technologies have the ability to rapidly create local, national and global networks around specific issues that may provoke a radical shift in the way health systems function (Lucas 2008).

In this sense, a number of previous reviews have examined the beneficial aspects of telecare and telehealth from the economic point of view, but few have focused specifically on the users' characteristics to describe who actually uses telecare services analysing a large sample size. This is in line with research by Finch *et al*. (2007), suggesting that if telehealth care is to become patient-centred, knowledge of users' priorities and preferences is needed. Besides, in the present study, we will quantify the magnitude of differences (effect size) found between the groups to establish the power to support our hypothesis. Therefore, the objective of this work was to define the health

profile and to examine the gender and age differences of the users of a first-generation telecare public service to deepen our knowledge of their health status, which will enable telecare developers to acquire a detailed understanding of the users' needs.

Methods

Study design and participants

A retrospective, cross-sectional, descriptive study was conducted between March and September 2012 with a sample of older people aged 65 years and over who used a first-generation telecare service provided by the A Coruña City Council as a concerted entity. To be eligible, from the 850 telecare users, potential participants had to fulfil the inclusion criteria defined in Figure 1. A Coruña is the second largest city in Galicia (in north-western Spain). Participants were all users registered in the service database before the end of the data collection period (1 September 2012).

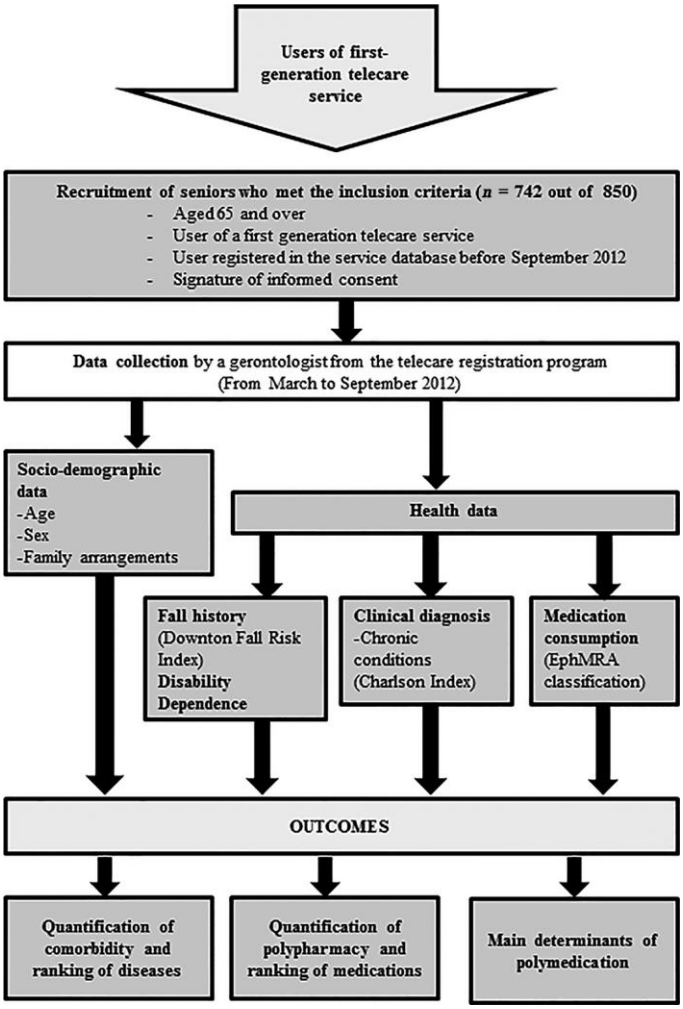

Figure 1. Flow chart, study protocol. EphMRA, European Pharmaceutical Marketing Research Association.

Ethics approval for the study was obtained by the Ethics Committee of the participating university, and the study conforms to the Declaration of Helsinki, which requires all users to sign informed consent forms, being completed during the telecare registration process.

Service description

The service, first-generation telecare operating 24 hours per day and 365 days per year, consists of a telephone signal transmitter/receiver unit and a button (pendant or bracelet) that the user carries at all times. If help is needed, the user presses the button and a telephone call is established with a control centre that identifies the user and visualises the registered data to diagnose the current situation and its urgency and mobilise the required resources. On a regular basis, the service calls the user to monitor the user's state.

Data collection and instruments

The data for this study were collected from the telecare registration programme (Figure 1). Users' information was entered by a social worker (personal and sociodemographic data) and by their general practitioner (health data). Personal and sociodemographic data included age, sex and family arrangements (the person lives alone, lives with relatives or does not live with relatives, missing data: 11/742 cases, 1.5%). Health data were also gathered, such as clinical diagnosis [missing data: between 10.4% (77/742 cases) and 11.7% (87/742 cases)], medication consumption (missing data: 21/742 cases, 2.8%), fall history (missing data: 40/742 cases, 5.4%) and presence of disability (missing data: 333/742 cases, 44.9%) and/or dependence (missing data: 289/742 cases, 38.9%). Missing data were due to incomplete or poor information in the telecare registration programme.

Clinical diagnoses were coded according to the Charlson comorbid diseases (Charlson *et al*. 1987), a method of classifying prognostic comorbidity in a geriatric population. We used a proxy (Gutiérrez-Misis *et al*. 2012) of the Charlson comorbidity index (CCI) to include myocardial infarct and congestive heart failure into one category: coronary heart disease. In addition, other prevalent diagnoses were included: hypertension, rheumatic disorders (osteoporosis and arthrosis), anxiety-depressive symptoms, dizziness/vertigo and digestive problems.

The medications that participants consumed were classified according to the Anatomical Classification of Pharmaceutical Products developed by the EphMRA (2014). This classification includes 16 main divisions: Alimentary tract and metabolism; Blood and blood-forming organs; Cardiovascular system; Dermatologicals; Genito-urinary system and sex hormones; Systemic hormonal preparations (excluding sex hormones); General anti-infectives systemic; Hospital solutions; Antineoplastic and immunomodulating agents; Musculo-skeletal system; Nervous system; Parasitology; Respiratory system; Sensory organs; Diagnostic agents; and Various. Polypharmacy or polymedication was defined as the concomitant use of five or more different prescription medications (Gnjidic *et al*. 2012).

To determine the risk of falls, the Downton Index (Downton 1993) was completed for every user based on data obtained from the register. This scale incorporates aspects referring to five situations: existence of a past history of falls, medication consumption, sensory deficits, mental status and ability to walk. Scores range from 0 to 11, with a score of 3 or more indicating a high risk of falls.

Data analysis

The software package IBM SPSS Statistics v.21.0 was used for data analysis. Quantitative variables were expressed as the mean and standard deviation (SD). Qualitative variables were expressed through frequency tables in absolute values and percentages. Between-group comparisons were made using a chi-square test for categorical variables and a Student's *t*-test for continuous variables. For proportions, Cohen's *w* values were reported as indicators of effect size (ES) and calculated as the square root of the ratio of the square of Pearson's contingency coefficient divided by one minus that square. We interpreted the importance of the ES using the benchmarks for 'small ES' ($w = 0.1$), 'medium ES' ($w = 0.3$) and 'large ES' ($w = 0.5$) for measuring the distance between unpaired proportions. Effect sizes for continuous variables are reported in terms of Cohen's *d* using the benchmarks for 'small ES' ($d = 0.2$), 'medium ES' ($d = 0.5$) and 'large ES' ($d = 0.8$). Both ES were proposed by Cohen (1988).

For the independent variable age, two intervals (65–79 years vs. extremely elderly individual aged ≥80 years) were established based on population projections indicating that the number of extremely elderly octogenarians or older is rising quickly and the capacity at age 65 is very different from that at 80 (WHO 2015). For the independent variable, sex, masculine and feminine were used as references based on the expected results. A multiple forward stepwise logistic regression analysis (Wald method) was performed to identify which independent variables [19 reported diseases – 14 from the CCI: coronary heart disease (including both myocardial infarct and congestive heart failure), peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, diabetes, hemiplegia, moderate or severe renal disease, diabetes with end-organ damage, any tumour, and moderate or severe liver disease; and 5 prevalent diagnoses – hypertension, rheumatic disorders, anxiety-depressive symptoms, dizziness/vertigo and digestive problems] modified the presence of polymedication. Three models were developed in the analysis: the first model included all the samples; the second model included only women; and the third model included only men. Odds ratios (OR) and 95% confidence intervals (CI) were calculated for each covariate included in the model. The level of significance was set to $P < 0.05$.

Results

A total of 742 telecare users (85.3% of all users) were included in the study. The participants had a mean length of use of 4 years, 11 months and 16 days from the activation of the service. Table 1 shows the sociodemographic characteristics, medication consumption, Downton index and presence of disability and/or dependence of the participants. The mean age was 83.3 (SD 6.6) years, and 85.8% of the participants were women. Of all subjects, 78.3% lived alone; 97.5% consumed at least one medication per day, with an average of 5.6 (SD 3.0) medications per day. Furthermore, of the subjects, 59.4% consumed five or more different medications per day and 8.0% consumed 10 or more. A significant association ($P = 0.004$) was found between the number of medications consumed per day and age group.

Table 1. Sociodemographic characteristics, medication consumption, Downton Index and presence of disability and/or dependence according to sex and age categorised into two groups (65–79 years and ≥80 years)

	Total (*n* = 742)	Women (*n* = 637)	Men (*n* = 105)	*P*-value	Effect size (Cohen's *w/d*)	65–79 (*n* = 209)	≥80 (*n* = 533)	*P*-value	Effect size (Cohen's *w/d*)
Age, mean (SD)	83.3 (SD 6.6)	83.4 (SD 6.5)	83.0 (SD 7.2)	0.576	–	75.2 (SD 3.7)	86.5 (SD 4.5)	<0.001***	0.17
Whom they live with (*n*, %)				0.190	–			0.500	–
Alone (*n*, %)	575 (78.3)	500 (79.4)	75 (72.1)			156 (76.1)	419 (79.2)		
With relatives (*n*, %)	152 (20.7)	123 (19.5)	29 (27.9)			48 (23.4)	104 (19.7)		
With someone other than relatives (*n*, %)	4 (0.5)	0 (0.0)	4 (0.6)			1 (0.5)	3 (0.6)		
Number of medications, mean (SD)	5.6 (SD 3.0)	5.6 (SD 3.0)	5.3 (SD 2.7)	0.354	–	6.2 (SD 3.3)	5.4 (SD 2.8)	0.004**	0.50
Medication consumption (*n*, %)	703 (97.5)	605 (97.7)	98 (96.1)	0.319	–	195 (97.0)	508 (97.7)	0.601	–
Polymedicated users (five or more medications, *n*, %)	441 (59.4)	380 (59.7)	61 (58.1)	0.763	–	132 (63.2)	309 (58.0)	0.196	–
Polymedicated users (10 or more medications, *n*, %)	59 (8.0)	53 (8.3)	6 (5.7)	0.360	–	27 (12.9)	32 (6.0)	0.002**	0.11
Downton Index, mean (SD)	2.3 (SD 1.4)	2.4 (SD 1.4)	2.2 (SD 1.5)	0.456	–	2.3 (SD 1.4)	2.4 (SD 1.5)	0.093	–
History of falls (*n*, %)	294 (40.4)	252 (40.4)	42 (40.4)	0.049*	0.09	81 (39.5)	213 (40.7)	0.781	–
Disability (*n*, %)	210 (51.3)	181 (51.0)	29 (53.7)	0.710	–	65 (51.2)	145 (51.4)	0.965	–
Dependence (*n*, %)	81 (17.9)	67 (17.2)	14 (22.2)	0.332	–	21 (14.8)	60 (19.3)	0.246	–

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$ (*t*-test for means and χ^2 for percentages).

The mean score of the Downton index was 2.3 (SD 1.4). Users with a risk of falls or who had already fallen represented 40.4% of the total. Among these users, both genders reported a similar number of previous falls (40.4%) and this relationship between sex and history/risk of falls was significant ($P = 0.049$). Based on the calculation of the risk of falls with the Downton Fall Risk Index, subjects at severe risk of falling represented 41.7% of the sample, and disabled people presented a 2.4 times (95% CI, 1.61–3.64) higher risk of falling ($P < 0.001$).

Of the participants, 51.3% had some type of disability, with physical disability being the most common type. Moreover, 17.9% of the sample depended on others to carry out at least one basic activity of daily living. There were no significant differences in the variables between the genders.

With regard to medical diagnosis, the mean CCI score was 1.1 (SD 1.1). Of the sample, 68.2% did not have a comorbid condition (CCI = 0), 21.1% had a low level of comorbidity (CCI = 2) and 10.6% had a high level of comorbidity (CCI $\geq$ 3).

Table 2 shows the most frequent diagnosis according to sex and age group (65–79 vs. $\geq$80) and their possible association. The most frequently reported pathology was hypertension (HTN) (51.1%), followed by rheumatic disorders (44%) and coronary heart disease (34.7%). An association was found between masculine gender and coronary heart disease ($P = 0.002$), dementia ($P = 0.011$), ulcer disease ($P = 0.003$), diabetes ($P = 0.038$) and moderate or severe renal disease ($P = 0.012$) and between feminine gender and rheumatic disorders ($P < 0.001$). A significant association was found between the age groups and the medical diagnosis. Peripheral vascular disease ($P = 0.020$) increased with age, while anxiety-depressive symptoms ($P = 0.013$), chronic pulmonary disease ($P = 0.007$), connective tissue disease ($P = 0.006$), hemiplegia ($P < 0.001$) and moderate or severe liver disease ($P = 0.033$) showed a decreasing trend. However, the clinical significance of these results was low or very low, with small to very small effect sizes (Cohen's *w* values).

Table 2. Diagnosis (n, %, ordered by their prevalence in the studied sample) according to sex and age categorised into two groups (65–79 years and ≥80 years) and their possible association

Pathology	No. of subjects	General prevalence	Sex				Age (years)			
			Women	Men	*P*-value	Effect size (Cohen's *w*)	65–79	≥80	*P*-value	Effect size (Cohen's *w*)
Hypertension	666	340 (51.1)	295 (86.8)	45 (13.2)	0.376	–	89 (26.2)	251 (73.8)	0.198	–
Rheumatic disorders (Osteoporosis and arthrosis)	657	289 (44.0)	267 (92.4)	22 (7.6)	<0.001***	0.17	77 (26.6)	212 (73.4)	0.444	–
Coronary heart disease	665	231 (34.7)	184 (79.7)	47 (20.3)	0.002**	0.12	64 (27.7)	167 (72.3)	0.962	–
Anxiety-depressive symptoms	663	166 (25.0)	149 (89.8)	17 (10.2)	0.093	–	59 (35.5)	107 (64.5)	0.013*	0.10
Diabetes	665	130 (19.5)	104 (80.0)	26 (20.0)	0.038*	0.08	45 (34.6)	85 (65.4)	0.081	–
Peripheral vascular disease	659	107 (16.2)	91 (85.0)	16 (15.0)	0.785	–	20 (18.7)	87 (81.3)	0.020*	0.09
Dizziness/Vertigo	270	41 (15.2)	40 (97.6)	1 (2.4)	0.055	–	12 (29.3)	29 (70.7)	0.596	–
Chronic pulmonary disease	661	78 (11.8)	67 (85.9)	11 (14.1)	0.975	–	32 (41.0)	46 (59.0)	0.007**	0.10
Digestive problems	660	77 (11.7)	63 (81.8)	14 (18.2)	0.293	–	19 (24.7)	58 (75.3)	0.505	–
Cerebrovascular disease	660	54 (8.2)	45 (83.3)	9 (16.7)	0.595	–	19 (35.2)	35 (64.8)	0.211	–
Connective tissue disease	659	41 (6.2)	37 (90.2)	4 (9.8)	0.394	–	19 (46.3)	22 (53.7)	0.006**	0.11
Any tumour	655	33 (5.0)	27 (81.8)	6 (18.2)	0.520	–	14 (42.4)	19 (57.6)	0.057	–
Hemiplegia	660	12 (1.8)	9 (75.0)	3 (25.0)	0.282	–	10 (83.3)	2 (16.7)	<0.001***	0.17
Dementia	659	6 (0.9)	3 (50.0)	3 (50.0)	0.011*	0.10	2 (33.3)	4 (66.7)	0.767	–
Moderate or severe liver disease	660	6 (0.9)	5 (83.3)	1 (16.7)	0.864	–	4 (66.7)	2 (33.3)	0.033*	0.08
Moderate or severe renal disease	661	6 (0.9)	3 (50.0)	3 (50.0)	0.012*	0.10	2 (33.3)	4 (66.7)	0.770	–
Diabetes with end organ damage	660	5 (0.8)	3 (60.0)	2 (40.0)	0.098	–	2 (40.0)	3 (60.0)	0.544	–
Mild liver disease	660	5 (0.8)	5 (100.0)	0 (0.0)	0.360	–	1 (20.0)	4 (80.0)	0.693	–
Ulcer disease	656	5 (0.8)	2 (40.0)	3 (60.0)	0.003**	0.11	2 (40.0)	3 (60.0)	0.545	–

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$ (χ^2 for percentages).

Table 3 shows the medications distributed by classes according to the EphMRA classification as well as their possible association with sex and age group. The groups of medications that were not consumed by any user are not represented. Of the subjects, 75% consumed medications included in the cardiovascular system group; 65.2% included in the central nervous system group and 63.9% included in the alimentary tract and metabolism group. A significant association ($P < 0.001$) was found between feminine gender and the consumption of medications included in the central nervous system group and between masculine sex and the consumption of medications targeting the genito-urinary system ($P < 0.001$). With regard to age, an association was found between younger age and the consumption of different medications, such as those acting on the alimentary tract and metabolism ($P = 0.014$) and respiratory system ($P = 0.001$). Furthermore, medications acting on the cardiovascular system ($P = 0.014$) were more often consumed by older subjects. However, the clinical significance of these results was low or very low, with small to very small effect sizes (Cohen's *w* values).

Table 3. Medications consumed (n, %, ordered by frequency of consumption in the total sample) and their possible relationships with the variables sex and age categorised into two groups, 65–79 years and ≥80 years

Medication class	Sex					Age (years)			
	Total	Women	Men	*P*-value	Effect size (Cohen's *w*)	65–79	≥80	*P*-value	Effect size (Cohen's *w*)
Cardiovascular system	540 (75.0)	464 (75.1)	76 (74.5)	0.902	–	138 (68.7)	402 (77.5)	0.014*	0.09
Nervous system	469 (65.2)	420 (68.1)	49 (48.0)	<0.001***	0.15	138 (69.0)	331 (63.8)	0.188	–
Alimentary tract and metabolism	457 (63.9)	391 (63.8)	66 (64.7)	0.858	–	142 (71.0)	315 (61.2)	0.014*	0.09
Blood and blood-forming organs	430 (60.0)	360 (58.5)	70 (68.6)	0.054	–	128 (64.3)	302 (58.3)	0.141	–
Musculo-skeletal system	139 (19.4)	121 (19.6)	18 (17.8)	0.673	–	41 (20.4)	98 (19.0)	0.661	–
Respiratory system	77 (10.7)	67 (10.9)	10 (9.8)	0.746	–	34 (16.9)	43 (8.3)	0.001**	0.12
Genito-urinary system and sex hormones	53 (7.4)	31 (5.0)	22 (21.6)	<0.001***	0.22	13 (6.5)	40 (7.8)	0.551	–
Sensory organs	45 (7.0)	39 (6.9)	6 (7.5)	0.844	–	13 (7.3)	32 (6.9)	0.860	–
Dermatologicals	8 (1.1)	8 (1.3)	0 (0.0)	0.247	–	1 (0.5)	7 (1.4)	0.326	–

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$ (χ^2 for percentages).

Finally, a multiple logistic regression analysis (Table 4) selected the best determinants of polymedication (five or more prescribed medications). For the total sample, the three main determinants were hypertension ($P < 0.001$), anxiety-depressive symptoms ($P = 0.028$) and coronary heart disease ($P = 0.009$). The OR were 3.50 for hypertension, 2.10 for anxiety-depressive symptoms and 2.30 for coronary heart disease. This model accurately predicted 67.3% of the cases at risk of consuming five or more medications. The best determinants for women were also hypertension ($P < 0.001$) and coronary heart disease ($P = 0.002$), with 71.3% of cases of polymedication (≥5) correctly predicted. The OR were 3.59 for hypertension and 3.10 for coronary heart disease. For men, no determinants were identified.

Table 4. Logistic regression of major predictor diseases and presence of polymedication (≥5 prescription medications)

	Total		Women		Men	
	Odds ratio (95% CI)	*P*-value	Odds ratio (95% CI)	*P*-value	Odds ratio (95% CI)	*P*-value
Hypertension	3.504 (2.006–6.122)***	<0.001	3.588 (1.988–6.476)***	<0.001	–	–
Anxious-depressive symptoms	2.095 (1.085–4.047)*	0.028	–	–	–	–
Coronary heart disease	2.299 (1.227–4.305)**	0.009	3.098 (1.527–6.286)**	0.002	–	–
% Correct	67.3		71.3		–	

% Correct: Percentage correctly classified.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Discussion

The information and communication technologies, such as the first-generation telecare discussed in this work, can help people to remain at home longer (Botsis *et al*. 2008, Kubitschke *et al*. 2010, Galimany-Masclans *et al*. 2011), improving the user's and caregiver's quality of life and avoiding institutionalisation in many cases. Moreover, telecare services provide both an adequate substitution for traditional services and additional benefits, such as minimising the need to travel and providing the added reassurance of regular external surveillance (Rogers *et al*. 2011). However, for telecare to fulfil its function, it is necessary to know the profile of the 'potential beneficiary' in advance to determine the characteristics of the future service and thus, improve its efficiency. In this sense, our work, with a prospective vision, attempts to define the user's profile while taking into account health aspects, which are often ignored and, according to our findings, highly important for accurately evaluating the effects of the service. The different profile and needs of elderly people will vary the benefits and cost-effectiveness of telecare (Henderson *et al*. 2014). Impact will be also observed in the health and social care system (Odeh *et al*. 2015) due to the amelioration in the decline of some psychological aspects and quality of life (Hirani *et al*. 2014).

With respect to the sample's sociodemographic profile, our findings are consistent with other studies, showing that users are of advanced age, generally over 80 years, and mainly women (Onor *et al*. 2008, Peeters *et al*. 2012, IMSERSO, 2014). A high percentage of these older adults live alone (78.3%), as found in other studies (Onor *et al*. 2008, Peeters *et al*. 2012) of telecare users. However, predictably, according to the service prioritisation conditions, the percentage is substantially higher than that for the general population, which in the case of the Spanish population, represents 37.9% (IMSERSO 2014).

The rate of disability (51.3%) is in line with the rate from the Survey on Disability, Personal Autonomy and Dependence Situations (EDAD; Spanish Statistical Office [Instituto Nacional de Estadística] 2008), which establishes that 30.3% of people over 65 have a disability. However, the rate is ostensibly higher than those included in Gispert Magarolas *et al*.'s (2009) work, which were obtained from the general population. In regard to dependence, 17.9% of subjects are dependent; this percentage is in line with the EDAD Survey (Spanish Statistical Office [Instituto Nacional de Estadística] 2008), which reports that 19% of the Spanish population are dependent, and is similar to those reported by studies in the USA (Kim *et al*. 2013) and Ireland (McDaid *et al*. 2013). However, this percentage is lower than that found by Millán-Calenti *et al*. (2010) for the Galician

population, as they found that 34.6% of their participants were dependent on others for at least one basic activity of daily living and that these participants were more frequently women. These results can be explained by the different origins of the samples, i.e. telecare users versus the general population. As expected, as the level of disability, dependence and comorbidity increases, the number of multigenerational households increases (Abellán-García & Ayala-García 2011).

The figures found by different studies vary in relation to various factors, such as the sample's origin, the data collecting system, and sex and age, among others. However, if we focus on health aspects, our work shows the high prevalence of chronic and incapacitating illnesses, reaching a mean comorbidity of 2.8 (SD 1.7) per subject, which matches other consulted studies (Peeters *et al*. 2012). This highlights the non-compliance of the first-generation systems, which mainly aimed to alleviate the social situation, and the need to implement more advanced systems that allow for the assessment and monitoring of some diagnosed chronic diseases, such as heart failure, diabetes and chronic obstructive pulmonary disease, among other chronic diseases (Greenhalgh *et al*. 2013).

Regarding type of diagnosed pathology, the results from the National Health Survey (Spanish Statistical Office [Instituto Nacional de Estadística] 2013b) indicate the prevalence of perceived chronic illnesses or health problems in Spain. Specifically, the survey reports that 73.4% of subjects aged 65 and over have at least one problem. The survey reports a lower prevalence than the current study for acute myocardial infarction and coronary diseases (16.9 vs. 34.7%) and the COPD (10.1 vs. 11.8%) and a higher prevalence for HTN (47.1 vs. 51.1%) and peripheral vascular disease (23.8 vs. 16.2%). Telehealth has demonstrated to improve the self-management of hypertension and control of blood pressure in elderly patients (Czaja *et al*. 2014, Jung & Lee 2017). Diabetes shows similar figures (19.3 vs. 19.5%). There are also differences in regard to sex, with coronary heart disease more often found in men than in women and found in higher proportion in the current study compared to other studies (Salminen *et al*. 2012). A multi-centre randomised controlled trial with patients with coronary artery disease or chronic heart failure has demonstrated that cardiac telerehabilitation adds positive effects and efficiency to the conventional centre-based cardiac rehabilitation programme, reducing the number of hospitalisation days and increasing the days alive and out of the hospital (Frederix *et al*. 2016). Concerning diabetes, some studies (Steinman *et al*. 2006, Bertera *et al*. 2007) indicate higher total rates and higher rates among men, but others, such as Griffith *et al*. (2010) and McDaid *et al*. (2013), submit lower figures. As previously stated, these figures can be explained based on the studied sample, which in our case, included 'healthy' subjects with sociosanitary problems, causing the figure to differ from those obtained from surveys of healthy populations or collected in a health setting, such as the National Health Survey carried out in Spain for the years 2011–2012 (Spanish Statistical Office [Instituto Nacional de Estadística] 2013a). Regarding anxiety-depressive symptoms, the results found in the literature vary, mainly according to the origin of the sample and the instruments used in the assessment (Onor *et al*. 2008, Spanish Statistical Office [Instituto Nacional de Estadística] 2013a), but in general, the results typically show a higher prevalence among women than among men (Herrera Molina *et al*. 2011). Lastly, telecare has also demonstrated its utility in the provision of rheumatology services with an impact in the care costs (Jang & Kraishi 2004), being the main contribution the improved access to doctors for patients and their referring physicians living in remote areas (Davis 2003). A multidisciplinary osteoporosis telehealth programme has demonstrated its adequacy for ensuring an optimal osteoporosis care (Dickson *et al*. 2008).

Concerning medication consumption, the Spanish National Health Survey (Spanish Statistical Office [Instituto Nacional de Estadística] 2013b) finds that more than 83.3% of people over 65 years consume medications, with women showing high levels of consumption. In our series, 97.5% of the subjects consumed at least one medication, with a mean daily consumption of 5.6 (SD 3.0) medications and a great proportion of polymedicated subjects (≥5 medications/day) (59.4%). Similar figures are reported by other studies (IMSERSO 2014), with the resulting risk of therapeutic non-compliance, risk of falls and increase in morbidity and mortality (Márquez Contreras *et al*. 2012). Because 35% of telecare users are expected to have poor pharmacological

adherence (WHO 2004), it would be advisable to start or encourage strategies that improve therapeutic compliance, such as, in the case of telecare, the regularly scheduled telephone call.

Our results regarding the type of medication consumed by main groups (EphMRA, 2014) are similar to those from other authors (Jyrkkä *et al*. 2009, Lapi *et al*. 2009) that establish that the most frequently prescribed categories of medication have effects on the cardiovascular, metabolic and central nervous systems. Furthermore, hypertension, anxiety-depressive symptoms and coronary disease were the best determinants of polymedication for the total sample, and hypertension and coronary heart disease were the best determinants among women. These results are consistent with other studies linking polypharmacy to comorbidity (Galato *et al*. 2010, Sergi *et al*. 2011, Gnjidic *et al*. 2012), but our study establishes a new approach because we examine the predictive pathology of polymedication rather than simply the existence of associations. Concomitantly, the identification of medication consumed and the comorbidity level could be an effective way to identify frailty (Coelho *et al*. 2015) because telecare could be particularly useful to frail elderly people (Barlow *et al*. 2007).

Falls, with a high prevalence among elderly people, imply high levels of morbidity and mortality (Salvà *et al*. 2004) and are an under-diagnosed problem (Pujiula Blanch *et al*. 2003, Varas-Fabra *et al*. 2006). The most effective fall prevention strategy is multidimensional assessment, including the consumption of psychotropic medications (Moreno-Martínez *et al*. 2005). In our study, a high percentage of subjects presented a high risk of falls; therefore, the implementation of more advanced telecare models, such as those implemented in the United Kingdom (Yeandle 2009), could reduce incidence, severity and associated costs of falls.

Strengths and limitations

Our study is the first to attempt to define the social and health characteristics of the users of a first-generation telecare service in Spain, and the data provided can serve as a reference for other studies, which is the study's main strength. The review by Botsis and Hartvigsen (2008) found that many studies focused on telecare for elderly people had a small sample. Therefore, another strength of the current study is the large sample size used.

The study's main limitation is the lack of similar international studies, as such studies would allow us to contrast our results rather than comparing them with results from general populations or populations assisted by the health systems but not specifically telecare users. Overall, we understand that this study lays the foundation to better equip telecare systems to adequately meet the needs of their potential users, who are normally old aged, female, living alone, suffering from several chronic diseases and consuming various medications. Moreover, some findings should be interpreted with caution because there were very small or small effect sizes. Finally, the determinants proposed have been identified using stepwise method in an exploratory analysis and this procedure has limitations, i.e. the increased risk of unimportant determinants or inconsistencies among model selection algorithms (Whittingham *et al*. 2006) that do not report the real response in the population and may result in overfitting (Babyak 2004).

Conclusions and implications for practice

In conclusion, independent of the social elements contributing to the implementation of telecare services, the important health characteristics of the users are evident, including morbidity and polypharmacy. Moreover, the characteristics of the studied population of users of a telecare system may be useful in regard to designing systems to meet the users' needs. We understand that telecare services should be adapted both in regard to the specialisation of the service professionals, who should be both health promoters and advisors, and the portfolio of services offered, which should allow the inclusion of third-generation devices to control and monitor patients with chronic

illnesses. Therefore, this resource, if widely disseminated, may help to clear the sociosanitary system, improve the quality of life of the older person and decrease the burden on the family caregiver.

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Conflict of interest

No conflicts of interest have been declared.

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Authorship

JM, LL and AM contributed to the conception and design of the work, analysis and interpretation. SM contributed to the data acquisition. JM drafted the article. JM, SM, LL and AM participated in critically revising the article's content and have approved the final version submitted for publication. This study was part of a doctoral thesis submitted by SM at the University of A Coruña and directed by JM and AM, on September 2013.

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