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## Title page

**Emergency department admissions and economic costs burden related to  
*Ambulatory Care Sensitive Conditions* in older adults living in care homes**

**Admisiones en servicios de urgencias y costes económicos relacionados con  
*Ambulatory Care Sensitive Conditions* en adultos mayores que viven en centros  
residenciales**

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**Ethics approval and consent to participate**

As this was an observational study in which clinical and administrative data were collected retrospectively, informed consent was not requested. All information obtained was anonymised and confidentiality of the data was guaranteed. All Research Ethics Committees of the collaborating centres approved the project according to their regulations.

**Conflicts of interest**

The authors declare that they have no competing interests

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Sí

1     **Emergency department admissions and economic costs burden related to**  
2     ***Ambulatory Care Sensitive Conditions* in older adults living in care homes**

3  
4     **Abstract**

5     **Objectives.** To assess the frequency of emergency department admissions (EDA) for  
6     *ambulatory care sensitive conditions* (ACSC) and non-ACSC among older adults living  
7     in care homes (CH), to describe and compare their demographic and clinical  
8     characteristics, the outcomes of the hospitalisation process and the associated costs.

9     **Method.** This multicenter, retrospective and observational study evaluated 2,444 EDAs  
10    of older adults  $\geq 65$  years old living in care homes in 5 emergency departments in  
11    Catalonia (Spain) by ACSC and non-ACSC, in 2017. Sociodemographic variables, prior  
12    functional and cognitive status, and information on diagnosis and hospitalisation were  
13    collected. Additionally, the costs related with the EDAs were calculated, as well as a  
14    sensitivity analysis using different assumptions of decreased admissions due to ACSC.

15    **Results.** A total of 2,444 ED admissions were analysed. The patients' mean (SD) age  
16    was 85.9 (7.2) years. The frequency of ACSC-EDA and non-ACSC-EDA was 56.6%  
17    and 43.4%, respectively. Severe dependency and cognitive impairment were present in  
18    56.6% and 78%, respectively, with no differences between the two groups. The three  
19    most frequent ACSC were falls/trauma (13.8%), chronic obstructive pulmonary  
20    disease/asthma (11.4%) and urinary tract infection (7.4%). The average cost per ACSC-  
21    EDA was €1,408.24. Assuming a 60% reduction of ACSC-EDA, the estimated cost  
22    savings would be €1.2 million.

23    **Conclusions.** Emergency admissions for ACSC from care homes have a significant  
24    impact on both frequency and costs. Reducing these conditions through targeted

25 interventions could redirect the avoided costs towards improving care support in  
26 residential settings.

27 **Keywords:** ambulatory care sensitive conditions, hospitalisation, care home, aged

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42 **Abbreviations.** ACSC: Ambulatory care sensitive conditions; CH: Care homes; ED:  
43 Emergency department; EDA: Emergency department admissions; ACSC-EDA:  
44 Emergency department admissions by ACSC; EMR: Electronic medical record; CCI:  
45 Charlson Comorbidity Index score; MAT-SET: Andorran model of triage-Sistema  
46 Español de Triage

47

48 **Admisiones en servicios de urgencias y costes económicos relacionados con**  
49 *Ambulatory Care Sensitive Conditions* en adultos mayores que viven en centros  
50 residenciales

52 **Resumen**

53 **Objetivos.** Evaluar la frecuencia de admisiones en servicios de urgencias (ASU) por  
54 *ambulatory care sensitive conditions* (ACSC) y no-ACSC de personas que viven en  
55 residencias; describir y comparar sus características, y analizar los costes asociados.

56 **Método.** Este estudio multicéntrico, retrospectivo y observacional evaluó 2.444 ASU de  
57 personas  $\geq 65$  años que viven en residencias en 5 servicios de urgencias de Cataluña por  
58 ACSC y no-ACSC, en 2017. Se recogieron variables sociodemográficas, estado  
59 funcional y cognitivo, e información sobre diagnóstico y hospitalización. Se evaluaron  
60 los costes relacionados con ACSC-ASU y se efectuó un análisis de sensibilidad  
61 utilizando diferentes supuestos de disminución de ingresos por ACSC.

62 **Resultados.** La media de edad de la muestra del estudio fue de 85,9 (desviación  
63 estándar 7,2 años). La frecuencia de ACSC-ASU y no-ACSC-ASU fue del 56,6% y el  
64 43,4%, respectivamente. El 56,6% y el 78% presentaban dependencia severa y deterioro  
65 cognitivo, respectivamente, sin observarse diferencias entre los dos grupos. Las tres  
66 ACSC más frecuentes fueron caídas/traumatismos (13,8%), enfermedad pulmonar  
67 obstructiva crónica/asma (11,4%) e infección urinaria (7,4%). El coste medio por  
68 ACSC-ASU fue de 1.408,24 €. Suponiendo una reducción del 60% de las ACSC-ASU,  
69 el ahorro de costes estimado sería de 1,2 millones de euros.

70 **Conclusiones.** Las admisiones en urgencias por ACSC procedentes de entornos  
71 residenciales suponen un impacto significativo tanto en la frecuencia como en los

costes. La disminución de estas patologías mediante la aplicación de intervenciones específicas podría redirigir los costes evitados hacia la mejora del apoyo asistencial en los entornos residenciales.

**Palabras clave:** ambulatory care sensitive conditions, hospitalización, residencia, ancianos

## 96 **Background**

97 Up to 60% of care home (CH) residents may experience an emergency department  
 98 admission (EDA) each year <sup>1</sup>, and a remarkable number of EDAs have been classified  
 99 as potentially preventable or inappropriate. Furthermore, nearly 55% of EDAs among  
 100 CH residents may be for *ambulatory care-sensitive conditions* (ACSC) <sup>2</sup>, which have  
 101 been defined as health conditions-diagnoses for which timely and effective ambulatory  
 102 care could help to reduce the risk of hospitalisation, either by preventing the onset of an  
 103 illness or condition, controlling an acute episodic illness or condition, or managing a  
 104 chronic disease <sup>3</sup>.

105 Reducing avoidable admissions for ACSC has been a goal of policy makers,  
 106 commissioners and service providers for many years, based not only on the provision of  
 107 services in a resource-constrained healthcare system and the high avoidable costs, but  
 108 also because of the harmful outcomes of hospitalisation in frail older people <sup>4</sup>. In fact,  
 109 this population may suffer from advanced stage of disease, functional dependence or  
 110 severe dementia <sup>5</sup> and, for them, hospitalisation may be more deleterious than beneficial  
 111 <sup>4</sup> because of an increased risk of functional impairment <sup>6</sup>, delirium <sup>7</sup>, nosocomial  
 112 infections <sup>8</sup> or mortality <sup>2</sup>.

113 In Spain, a rate of up to 16.5% of ACSC-related hospitalisations has been documented  
 114 in people over 65 years of age living in the community <sup>9</sup>. However, there is a lack of  
 115 data on the frequency of ACSC among CH residents, their characteristics and the costs  
 116 associated with hospitalisation for ACSC in this population. Evaluation of these aspects  
 117 could be useful in the development of cost-effective interventions that lead to a  
 118 reduction of potentially avoidable hospitalisations and an improvement in the quality of  
 119 care in the residential setting.

120

## 121 **Aim**

122 The purposes of the study were threefold: 1) to assess the frequency of EDA due to  
 123 ACSC and non-ACSC among older people living in CH; 2) to describe and compare  
 124 their demographic and clinical characteristics, as well as the outcomes of the  
 125 hospitalisation process in both groups, and 3) to analyse the costs related to the ACSC  
 126 EDA as well as the potential cost-savings in the ACSC group.

127

## 128 **Material and methods**

### 129 **Design**

130 The present study represents a secondary analysis of the *Caregency* study <sup>10</sup>. The  
 131 Caregency study was a multicentre retrospective observational study covering the  
 132 period between January the 1st and December the 31st, 2017.

133

### 134 **Setting and participants**

135 The population were CH residents aged 65 years or older who were admitted to the EDs  
 136 of five public university hospitals in Catalonia, Spain, for any type of acute medical or  
 137 non-medical disease. These hospitals provide health coverage for 10,517 CH beds <sup>11,12</sup>,  
 138 in both urban and rural areas. CHs could be owned and operated by public  
 139 (governmental), non-profit or for-profit entities.

140

### 141 **Procedures**

142 The electronic registers were used to identify all visits by residents over 65 years of age  
 143 who were referred to the EDs from the CHs in 2017. The study sample was randomly

selected within each hospital for further review and data collection. This ensured that data from all seasonal periods per hospital were examined. Using a data collection sheet, a trained team of medical or nursing professionals from each participating hospital collected the study variables by reviewing the participants' electronic medical record (EMR) and collecting data from the Minimum Basic Emergency Department Data Set (CMBD-UR)<sup>13</sup>.

## Measures

### Baseline characteristics of the residents involved in the EDA

Sociodemographic characteristics of the EDA were collected. Functional status was assessed using the standardised Barthel Index score (range 0-100) in the previous three months, if available in the EMR<sup>14</sup>. A lower score indicates greater dependence. Further, the following Barthel Index categories were also used: non-dependence (Barthel index  $\geq 95$ ), mild (61-95), moderate (41-60) or severe dependence ( $\leq 40$ )<sup>15</sup>. If the Barthel Index score was not available, the researchers' extracted information on the "level of dependence" (independent, mild, moderate or severe dependence) as indicated in the resident's EMR, if available. Subsequently, a new variable was created to define the "compiled level of dependence" of the resident, combining the categories of the Barthel Index with those of the variable "level of dependence", being the four resulting categories: non-dependence, mild, moderate or severe dependence. Cognitive status in the previous 3 months was assessed according to the information obtained from the EMR for this period. Thus, we gathered information on whether the resident had cognitive impairment and whether the resident had a diagnosis of dementia, **in which case researchers were asked to specify the severity of dementia. In order to obtain**

a wide picture of the study sample, severity of dementia was determined according to the information available in the EMR (i.e. mild, moderate or severe dementia), and no validated grading systems or psychometric tests were necessary, as this would have probably led to a big amount of missing values for this variable.

Multimorbidity was evaluated using the Charlson Comorbidity Index (CCI) score, with higher scores indicating greater 10-year mortality risk <sup>16</sup>.

The MAT-SET (Andorran model of triage-Sistema Español de Triage) scale was used to assess the emergency level (triage) of the resident on arrival at the ED with the triage categories provided by the scale (I-V) <sup>17</sup>.

Concerning the destination after ED discharge, the return to the CH, admission to another hospital or intermediate care wards and “mortality during EDA” were identified. Information on the type of acute hospital admission ward (internal medicine, acute geriatrics, traumatology, emergency short-stay, general surgery, pneumology and other wards) and the type of intermediate care wards (subacute care, post-acute care, palliative care, long-stay medical, psychogeriatric) was gathered. Regarding mortality, we collected data on “mortality during EDA” and “mortality 30 days after ED discharge”. “Short-term mortality” was considered for those cases that presented with either “mortality during EDA” or “mortality 30 days after ED discharge”.

#### **Ambulatory care sensitive conditions**

Among the main diagnoses, ACSCs were identified using the list of 16 ACSCs for CHs proposed by Walsh *et al.* This list was selected by a panel of experts with clinical and health services research experience in the field of long-term care, by assessing appropriate diagnoses for this population group <sup>18</sup>. For the present study, respiratory

infections were included in the chronic obstructive disease/asthma group. In this way, EDAs with a main diagnostic corresponding to an ACSC (ACSC-EDA) and EDAs with a main diagnostic unrelated to an ACSC (non-ACSC-EDA) were identified.

### **Costs estimation related to the ACSC-EDAs**

The costs related to each ACSC-EDA, which included both the costs generated by the ED admission *per se* and, where applicable, the subsequent costs of admission to other acute hospital or intermediate care wards, and hospitalisation at home, were calculated in euros (€). The unit rate and payment method established by the *Departament de Salut de la Generalitat de Catalunya*, adjusted to the year 2017, were used to measure costs<sup>19</sup>. The costs generated by EDA, other acute hospital wards or sub-acute care wards were generated by "discharge", while the costs generated by admission to the remaining intermediate care wards were determined according to the "days of stay" in these wards. As the number of "days of stay" in intermediate care wards was not available, a unit price was established according to the maximum stay recommended for each of these wards by the *Departament de Salut de la Generalitat de Catalunya*<sup>20</sup>. Supplementary Table 1 (Appendix A) shows the unit costs associated with each unit of admission (adjusted to 2,017).

### **Statistical Analyses**

EDA characteristics were described using mean and standard deviation (SD) for continuous variables and absolute numbers and percentages for discrete variables. T-test for normal variables and non-parametric Mann-Whitney U test were used for group comparisons (ACSC-EDA vs. non-ACSC-EDA) of continuous variables, while Fisher's

exact test was used for categorical variables. All tests were two-sided at the 5% level of significance ( $p = 0.05$ ).

The costs associated with ACSC-EDA were analysed. To calculate the average cost of an admission to an ED, hospital or intermediate care unit, the total number of admissions to these units and the total cost generated by these admissions were taken into account.

Following Walsh *et al.*<sup>18</sup>, a sensitivity analysis was performed to estimate the admissions and cost savings that could be achieved assuming a 20%, 40% and 60% reduction in ACSC-EDAs.

All analyses were performed using IBM SPSS Statistics version 25 (IBM Corporation, Chicago, IL).

## Results

A total of 12,580 EDAs of older adults living in CH were identified. Of these, a final sample of 2,444 EDAs was obtained after random sampling, corresponding to 1,982 older residents.

The characteristics of CH residents involved in EDAs and comparison between ACSC and non-ACSC EDAs are shown in Table 1. In brief, the global EDA were predominantly of women (67.7%), with a mean age of 85.9 years (SD 7.2), and a median (1st quartile-3rd quartile) of CCI of 3 (2-4). A wide proportion were functionally impaired (44.3% showed a severe compiled degree of functional dependence) and with cognitive impairment (78% of EDA). Among them, 56.6% suffered from advanced dementia.

There were no statistically significant differences between the two groups studied (ACSC and non-ACSC EDA) in terms of sociodemographic characteristics, multimorbidity, and functional and cognitive status.

*[Please include Table 1 around here]*

The characteristics and outcomes of the EDA, as well as the outcomes according to the presence of ACSC as main diagnosis are shown in Table 2.

The majority of residents were discharged to CH (52.6%), with 44% experiencing hospitalisation (either in acute, intermediate care wards or hospital at home).

Differences in admission units were found between non-ACSC-EDA and ACSC-EDA.

Finally, higher short-term mortality was observed in non-ACSC-EDA vs. ACSC-EDA (17.9% vs. 14%;  $p=0.009$ ).

*[Please include Table 2 around here]*

The frequency of each ACSC and the top 10 non-ACSC diagnoses, as well as the frequency of admission to other acute or intermediate care wards for each diagnose are described in Table 3.

*[Please include Table 3 around here]*

Table 4 displays the detailed costs related to ACSC by unit of admission and the average cost per EDA admitted to an ED, acute or intermediate care units.

263 The overall costs of ACSC-EDAs was €1,948,997.30 with an average cost per EDA of  
 264 €1,408.24.

265 Table 5 provides the results of the sensitivity analysis. Based on these analyses, between  
 266 400 and 1200 admissions per year and between €390,000 and €1,170,000 in costs could  
 267 be avoided by achieving these percentage reductions in ACSC-EDA.

268

269 *[Please include Table 4 around here]*

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271 *[Please include Table 5 around here]*

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## 273 **Discussion**

274 The present study found that, in a sample of 2444 EDA in 5 university hospitals in  
 275 Catalonia (Spain) of CH residents, more than half of the EDA (56.6%) had ACSC as a  
 276 main diagnosis. Globally, EDA were predominantly women, with a mean age of 85.9  
 277 years, high multimorbidity and high levels of functional and cognitive impairment.  
 278 EDA presenting with ACSC did not differ from those without ACSC in these  
 279 characteristics. Furthermore, about 44% of all EDA required hospital admission, with  
 280 similar proportions among ACSC and non-ACSC EDA. Short-term mortality was  
 281 slightly higher in the group without ACSC, which could be explained by a tendency  
 282 towards a higher severity level at triage in this group. The most frequent ACSC  
 283 identified in our study were falls/trauma, chronic obstructive pulmonary disease/asthma,  
 284 urinary tract infection and congestive heart failure.

285 Previous international studies have reported varying proportions of ACSC-EDA (often  
 286 named as ACSC hospitalisations) among CH residents, with ACSC-EDAs ranging from

19% to 43%<sup>21–23</sup>. The different populations studied and the ACSC lists used could explain these variations. For example, Walsh *et al.*<sup>18</sup>, using an ACSC list similar to the one used in the present study, reported ACSC-related hospitalisation frequency of 39% but their study population included not only CH residents but also people receiving community-based services. Conversely, Ouslander *et al.*<sup>24</sup>, documented higher ACSC hospitalisation rates (67%) than those observed in our study.

With regard to the ACSC identified, international research has also identified chronic obstructive pulmonary disease/asthma, urinary tract infection, falls/trauma and congestive heart failure, among the top ACSCs<sup>18,25,26</sup>.

In terms of costs, the present study found that the average cost per ACSC-EDA was 1,408.24 € (including the costs of ED and admission to hospital or intermediate care wards after ED discharge), resulting in an overall cost for all ACSC EDA of around 2 million €. Our sensitivity analysis suggested that the cost savings could have ranged from 390,000 to 1,170,000 €. Thus, the research team considered that at least this amount of money could have been invested in interventions to prevent ACSC-related EDA.

Reducing ACSC-related admissions in CH has been an important goal in different healthcare systems for years<sup>27–29</sup>, and several interventions have been reported that could help achieving this aim.

Young *et al.*<sup>30</sup>, identified four factors that were significantly associated with reduced ACSC admissions among CH residents: effective communication between nursing staff and physicians regarding the resident's condition, physicians being able to treat residents within the CH and transferring them to hospital as a last resort, providing

1  
2 310 better training and support for nursing staff and aides regarding end-of-life care, and  
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4 311 facilitating access to complementary test results.  
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7 312 Some interventions based on the management of certain commonly referred conditions  
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9 313 (often classified as ACSC) have been suggested. Loeb *et al.* <sup>31</sup> compared the use of a  
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11 314 clinical care pathway with usual care for CH residents who developed symptoms of  
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13 315 pneumonia and other lower respiratory tract infections in 22 nursing homes in Ontario,  
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15 316 Canada. Their results showed a reduction in the rate of hospital admissions, resulting in  
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17 317 substantial cost savings.  
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21 318 Other research studies have more widely focussed on reducing potentially 'avoidable' or  
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23 319 'preventable' hospital admissions among CH residents. In fact, several definitions of this  
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25 320 concept have been used <sup>32</sup>, including ACSCs but also aspects other than ACSCs such as  
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27 321 the priorities and wishes of the CH residents' and the availability of resources in CHs,  
28  
29 322 among others <sup>33</sup>.  
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33 323 Selected multifactorial interventions including, among other activities, regular visits by  
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35 324 general practitioners or geriatricians, additional training for care centre staff or the  
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37 325 improvement of relationships between care providers have shown positive results in  
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39 326 reducing potentially preventable hospitalisations <sup>34–38</sup>. Recently, Carter *et al.* <sup>39</sup> found  
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41 327 promising evidence for the effectiveness and cost-effectiveness of a nurse led, early  
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43 328 intervention program in preventing unnecessary hospital admissions in CH.  
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47 329 Finally, some studies have analysed the effects of interventions aimed at reducing  
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49 330 hospital admissions among CH residents in general. Graverholt *et al.* performed a  
50  
51 331 systematic review on this topic and concluded that, although the quality of the evidence  
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53 332 is low, several interventions may have an effect on reducing hospital admissions in this  
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55 333 population <sup>40</sup>. Conversely, Kane *et al.* <sup>41</sup>, in a randomised controlled trial using the  
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INTERACT training and implementation support, which included tools that help CH staff identify and evaluate acute changes in CH resident condition and document communication between physicians, care paths to avoid hospitalization when safe and feasible, advanced care planning and quality improvement tools, found no benefits in rates of hospitalisation or ED visits among CH residents.

To the best of our knowledge, the present study is the first one providing national data for Spain on the frequency of EDAs related to ACSCs in a large sample of CH residents, as well as the characteristics of the CH residents involved in these EDAs, their requirements for admission to acute or intermediate care wards, the specific ACSC involved, and the associated costs. The results of this study could be used for the development and implementation of interventions aimed at preventing potentially avoidable hospitalisations among frail older adults living at CH.

Other strengths of the present study are its multicentre design, and the long time-period covered, which favoured the understanding of the economic impact of EDA throughout a one-year period.

This study has limitations. The retrospective study design is prone to measurement errors and missing data. However, data were carefully obtained from each participant's medical record by a group of trained researchers who were medical or nursing professionals from each participating hospital. **Due to a relevant number of missing values for the Barthel Index, the level of dependence of the participants was measured using a non-validated instrument in many cases, which could have led to an over or infra-estimation of this variable. Furthermore, due to a lack of data, an estimation was done for the days of admission to intermediate care, which may have led to an over or infra-estimation of the costs. Finally, potentially avoidable**

hospital admissions were measured by identifying only ACSCs, and no data could be collected on other aspects of appropriateness, such as care preferences or priorities of participants and their caregivers, or on secondary diagnoses.

## Conclusions

The present study found that EDA due to ACSC are frequent among CH residents, being falls/trauma, chronic obstructive pulmonary disease/asthma, urinary tract infection and congestive heart failure the most frequently identified ACSCs. The cost savings associated with reducing EDA due to ACSC could be invested in the implementation of interventions aimed at preventing potentially avoidable hospitalisations in this population. The results of this study may provide a basis for the development of cost-effective interventions with this aim.

## Appendix A.

Supplementary Table 1. Unit costs related to each unit of admission (adjusted to 2017)

## Appendix B.

Group authorship

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**Table 1. Characteristics of the CH residents involved in EDA (n=2,444) and comparison between ACSC-EDA and non-ACSC-EDA**

| Variables   | ACSC-EDA<br>(n,%)<br>(1384, 56.6) | Non-ACSC-EDA<br>(n,%)<br>(1060, 43.4) | <i>p</i> | Overall EDAs<br>(n=2,444) |
|---|-----------------------------------|---------------------------------------|----------|---------------------------|
| Age (years), mean (SD)  | 85.7 (7.3)                        | 86.2 (7.1)                            | 0.066    | 85.9 (7.2)                |
| Women, n (%)  | 946 (68.4)                        | 711 (67.1)                            | 0.513    | 1,657 (67.8)              |
| Charlson Comorbidity index (range 0-37)*, median (Q1-Q3)                    | 3 (2-4)                           | 3 (1-4)                               | 0.002    | 3 (2-4)                   |
| Cognitive Impairment, (n, %) **   | 1,031 (79.1)                      | 744 (76.4)                            | 0.125    | 1,775 (78)                |
| Missing values, <i>n</i>  | 81                                | 86                                    |          | 167                       |
| Dementia, n (%) **  | 741 (59.7)                        | 563 (60.3)                            | 0.791    | 1,304 (59.9)              |
| Missing values, <i>n</i>  | 142                               | 126                                   |          | 268                       |
| Severity of dementia, n (%)   |                                   |                                       | 0.816    |                           |
| Mild Dementia   | 69 (10.5)                         | 47 (9.4)                              |          | 116 (10)                  |
| Moderate Dementia   | 220 (33.4)                        | 165 (15.5)                            |          | 385 (33.6)                |
| Severe Dementia   | 369 (56.1)                        | 286 (57.4)                            |          | 655 (56.6)                |
| Missing values, <i>n</i>  | 75                                | 73                                    |          | 148                       |
| Barthel Index for activities of daily living (range 0-100)*, median (Q1-Q3) | 40 (10-70)                        | 45 (15-70)                            | 0.132    | 40 (15-70)                |
| Missing values, <i>n</i>  | 777                               | 601                                   |          | 1,378                     |
| Level of dependence, n (%) ***  |                                   |                                       | 0.278    |                           |
| Non-dependence  | 45 (7.7)                          | 49 (11.3)                             |          | 94 (9.2)                  |
| Mild  | 114 (19.5)                        | 80 (18.4)                             |          | 194 (19.0)                |
| Moderate  | 202 (34.5)                        | 148 (34.0)                            |          | 350 (34.3)                |
| Severe  | 224 (38.3)                        | 158 (36.3)                            |          | 382 (37.5)                |
| Missing values, <i>n</i>  | 192                               | 166                                   |          | 358                       |
| Compiled level of dependence, n (%) ****                                    |                                   |                                       | 0.124    |                           |
| Compiled-non-dependence   | 53 (4.4)                          | 59 (6.6)                              |          | 112 (5.4)                 |
| Compiled-mild   | 282 (23.7)                        | 221 (24.7)                            |          | 503 (24.1)                |

|                          |            |            |            |
|--------------------------|------------|------------|------------|
| Compiled-moderate        | 313 (26.3) | 234 (26.2) | 547 (26.2) |
| Compiled-severe          | 544 (45.6) | 380 (42.5) | 924 (44.3) |
| <i>Missing values, n</i> | 192        | 166        | 358        |

Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions; EDA, Emergency Department Admissions; EMR, Electronic Medical Record; SD, Standard Deviation; Q1, first quartile; Q3, third quartile

\* Underlined scores are most favourable.

\*\* Cognitive status was assessed according to information obtained from the EMR (dichotomous variable)

\*\*\* Residents without registered Barthel index.

\*\*\*\* Combination of the categories of the Barthel Index and “level of dependence” variables: compiled-non-dependence (Barthel index  $\geq 95$  or “non-dependence”), compiled-mild (Barthel index 61-95 or “mild”), compiled-moderate (Barthel index 41-60 or “moderate”), or compiled-severe (Barthel index  $\leq 40$  or “severe”) dependence.

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**Table 2. Characteristics and outcome of CH residents during their stay in the ED and comparison between ACSC-EDA and non-ACSC-EDA, including hospitalisations**

| Variables   | ACSC-EDA<br>(n,%)<br>(1384, 56.6) | Non-ACSC-EDA<br>(n,%)<br>(1060, 43.4) | <i>p</i> | Overall<br>EDA (n, %)<br>(n=2,444) |
|---|-----------------------------------|---------------------------------------|----------|------------------------------------|
| Triage Score, n (%)   |                                   |                                       | 0.066    |                                    |
| I-II  | 210 (15.1)                        | 182 (17.1)                            |          | 392 (16.0)                         |
| III   | 607 (43.8)                        | 455 (42.9)                            |          | 1062 (43.4)                        |
| IV-V  | 397 (28.6)                        | 256 (24.1)                            |          | 653 (26.7)                         |
| Missing values, <i>n</i>                                    | 146                               | 191                                   |          | 337                                |
| Discharge Destination, n (%)*                               |                                   |                                       | <0.001   |                                    |
| Care Home   | 738 (53.3)                        | 547 (51.6)                            |          | 1285 (52.6)                        |
| Hospital ward   | 389 (28.1)                        | 372 (35.1)                            |          | 761 (31.1)                         |
| Intermediate Care Ward                                      | 211 (15.2)                        | 79 (7.5)                              |          | 290 (11.8)                         |
| Hospital at home  | 16 (1.2)                          | 12 (1.1)                              |          | 28 (1.1)                           |
| Palliative Care at Home                                     | 3 (0.2)                           | 3 (0.3)                               |          | 6 (0.2)                            |
| Other   | 5 (0.4)                           | 1 (0.1)                               |          | 6 (0.2)                            |
| Admissions to hospital or Intermediate care wards, n (%) ** | 616 (44.5)                        | 463 (43.6)                            | 0.652    | 1,079 (44.1)                       |
| Acute Hospital Ward after EDA, n (%)                        | 389 (28.1)                        | 372 (35.1)                            | <0.001   | 761 (31.1)                         |
| Internal Medicine   | 195 (50.1)                        | 85 (30.4)                             |          | 280 (36.7)                         |
| Acute Geriatric Unit  | 103 (26.4)                        | 53 (14.2)                             |          | 156 (20.4)                         |
| Traumatology  | 6 (1.5)                           | 106 (26.0)                            |          | 112 (14.7)                         |
| Short-stay Unit (Emergency room)                            | 46 (11.8)                         | 22 (5.9)                              |          | 68 (8.9)                           |
| General Surgery   | 1 (0.2)                           | 30 (8.6)                              |          | 31 (4.0)                           |
| Pneumology  | 18 (4.6)                          | 6 (1.6)                               |          | 24 (3.1)                           |
| Other***  | 17 (4.1)                          | 62 (16.6)                             |          | 79 (10.3)                          |
| Missing values, <i>n</i>                                    | 3                                 | 8                                     |          | 11                                 |
| Intermediate Care Ward after EDA, n (%)                     | 211 (15.2)                        | 79 (7.5)                              | <0.001   | 290 (11.8)                         |

|  |            |            |        |            |
|--|------------|------------|--------|------------|
| Subacute Care ward                           | 202 (95.7) | 62 (78.4)  |        | 264 (91.0) |
| Post-acute Care ward                         | 1 (0.5)    | 4 (4.3)    |        | 5 (1.7)    |
| Palliative Care ward                         | 6 (3.0)    | 13 (14.1)  |        | 19 (6.5)   |
| Long-stay medical ward                       | 1 (0.5)    | 0 (0,0)    |        | 1 (0.3)    |
| Psychogeriatric ward                         | 1 (0.5)    | 0 (0.0)    |        | 1 (0.3)    |
| <i>Missing values , n</i>                    | 0          | 0          |        | 0          |
| Mortality during EDA, n (%)                  | 22 (1.6)   | 46 (4.3)   | <0.001 | 68 (2.8)   |
| Mortality 30 days after ED discharge,, n (%) | 169 (12.2) | 142 (13.4) | 0.631  | 311 (12.7) |
| <i>Missing values , n</i>                    | 17         | 11         |        | 28         |
| Short-term mortality, n (%)****              | 191 (14)   | 188 (17.9) | 0.009  | 379 (15.7) |

Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions; EDA, Emergency Department Admissions; ED, Emergency Department

\* Deceased in ED are excluded

\*\* Admissions to hospital at home are included

\*\*\* Admissions to Cardiology, Vascular Surgery, Digestology, Endocrinology, Nephrology, Neurosurgery, Neurology, Oncology, Psychiatry, Urology are included.

\*\*\*\* During EDA or 30 days after ED discharge

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**Table 3. Frequency of ACSCs and top 10 non-ACSC, and frequency of admission of EDA to hospital or intermediate care wards (n=2,444)**

| Main diagnoses                                   | Frequency of EDA<br>n (%)** | Frequency of EDA with admission<br>to other hospital or intermediate<br>care wards *<br>n (%)*** |
|--|-----------------------------|--|
| <b>ACSC</b>                                      | 1,384 (56.6)                | 616 (44.5)   |
| Fall or trauma                                   | 338 (13.8)                  | 12 (3.6)   |
| Chronic obstructive pulmonary disease, asthma    | 279 (11.4)                  | 182 (65.2)   |
| Urinary tract infection                          | 181 (7.4)                   | 88 (48.6)  |
| Congestive heart failure                         | 152 (6.2)                   | 112 (73.7)   |
| Pneumonia  | 129 (5.3)                   | 114 (88.4)   |
| Dehydration                                      | 52 (2.1)                    | 34 (65.4)  |
| Skin ulcers, cellulitis                          | 40 (1.6)                    | 8 (20.0)   |
| Anemia   | 39 (1.6)                    | 14 (35.9)  |
| Altered mental status, acute confusion, delirium | 31 (1.3)                    | 11 (35.5)  |
| Constipation or fecal impaction obstipation      | 31 (1.3)                    | 5 (16.1)   |
| Diarrhea, gastroenteritis                        | 28 (1.1)                    | 13 (46.4)  |
| Poor glycemic control                            | 28 (1.1)                    | 8 (28.6)   |
| Seizures   | 24 (1.0)                    | 6 (25.0)   |
| Psychosis, agitation, organic brain syndrome     | 21 (0.9)                    | 8 (38.1)   |
| Hyper- and hypotension: separate conditions      | 11 (0.5)                    | 1 (9.1)  |
| Weight loss, nutritional deficiencies            | -                           | -  |
| <b>Non-ACSC</b>                                  | 1,060 (43.3)                | 463 (43.6)   |
| Fractures  | 203 (8.3)                   | 112 (10.5)   |
| Pain   | 113 (4.6)                   | 16 (1.5)   |
| Ischemic stroke                                  | 68 (2.8)                    | 41 (3.8)   |
| Bronchoaspiration                                | 68 (2.8)                    | 40 (3.7)   |

|                           |          |          |
|---------------------------|----------|----------|
| Sepsis                    | 56 (2.3) | 40 (3.7) |
| Respiratory failure       | 51 (2.1) | 36 (3.4) |
| Gastrointestinal bleeding | 39 (1.6) | 24 (2.2) |
| Arrhythmias               | 38 (1.6) | 17 (1.6) |
| Syncope/lipotimia         | 34 (1.4) | 5 (0.4)  |
| Ischaemia                 | 27 (1.1) | 18 (1.6) |

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Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions

\* Admissions to hospital at home are included

\*\* Percentages referring to whole study sample (n=2444)

\*\*\* Percentages referring to the number of EDA for each condition

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**Table 4. Costs related to ACSC-EDA according to the units of admission**

| Unit of Admission  | ACSC<br>n (€)        |
|--|----------------------|
| <b>Emergency Department Ward (n (€))</b>   | 1,384 (144,835.60)   |
| <b>Hospital Ward after EDA*** (n (€))</b>  | 405 (1,426,319.89)   |
| Medical Wards **   | 378 (1,298,180.52)   |
| Surgery Wards ***  | 11 (73,189.93)       |
| <b>Intermediate Care Ward after EDA (n (€))</b>  | 211 (377,841.81)     |
| Subacute Care Ward   | 202 (351,686.04)     |
| Post-acute Care Ward ****  | 8 (18,455.54)        |
| Long-stay Medical Care Ward ****   | 1 (6,685.28)         |
| <b>Overall Cost (including admission to the ED and other hospital or intermediate care wards)</b>  | 1,384 (1,948,997.30) |
| <b>Average cost <i>per</i> EDA (including admission to the ED and hospital or intermediate care wards)</b>   | 1,384 (1,408.24)     |
| Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions; ED, Emergency Department; EDA, Emergency Department Admission   |                      |
| * <i>Includes hospital at home</i>   |                      |
| ** <i>Medical wards include: cardiology, digestology, endocrinology, internal medicine, geriatrics, pneumology, neurology, oncology, psychiatry, nephrology, emergency short stay unit and intensive care unit.</i>    |                      |
| *** <i>Surgery wards include: traumatology, urology, general surgery, vascular surgery and neurosurgery.</i>   |                      |
| **** The cost is calculated on the basis of the number of days of admission according to the maximum stay recommended for each of these wards by the Departament de Salut de la Generalitat de Catalunya <sup>20</sup> |                      |

**Table 5. Results of sensitivity analysis on the estimated reduction in the frequency and cost of ACSC based on assumptions about the proportion of avoidable admissions to ED, other hospital and intermediate care wards that could be prevented.**

| Category   | Frequency of ACSCs, costs and admissions/savings assumptions |
|--|--|
| Overall admissions for ACSCs (n)   | 1,384  |
| Overall costs for ACSC (€)*  | 1,948,997.30   |
| Average cost <i>per</i> ACSC EDA (€)   | 1,408.24   |
| <b>Assumption 1: 20% of admissions defined as ACSC from an outpatient point of view are avoided. *</b> |  |
| Ambulatory Care-Sensitive Conditions prevented (n)   | 277  |
| Estimated cost savings for Ambulatory Care-Sensitive Conditions prevented (€)                          | 390,081.11   |
| <b>Assumption 2: 40% of admissions defined as ACSC from an outpatient point of view are avoided. *</b> |  |
| Ambulatory Care-Sensitive Conditions prevented(n)  | 553  |
| Estimated cost savings for Ambulatory Care-Sensitive Conditions prevented (€)                          | 778,753.98   |
| <b>Assumption 3: 60% of admissions defined as ACSC from an outpatient point of view are avoided. *</b> |  |
| Ambulatory Care-Sensitive Conditions prevented (n)   | 830  |
| Estimated cost savings for Ambulatory Care-Sensitive Conditions prevented (€)                          | 1,168,835.09   |

Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions

\* Includes admissions to ED, other hospital and intermediate care wards

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**Supplementary Table 1. Unit costs related to each unit of admission (adjusted to 2,017)**

| Unit of Admission                                   | Unit cost<br>(euros) |
|---|----------------------|
| Emergency Department Unit *                         | 104.65               |
| Hospital Ward after EDA                             |                      |
| Medical wards*                                      | 3,434.34 €           |
| Surgery wards*                                      | 6,653.63 €           |
| Intermediate Care Ward after EDA                    |                      |
| Subacute care *                                     | 1,741.02             |
| Post-acute Care**                                   | 89.59                |
| Long-stay medical**                                 | 59.69                |
| Abbreviations: EDA, Emergency Department Admissions |                      |
| * <i>Cost per discharge</i>                         |                      |
| ** <i>Cost per stay (days of admission)</i>         |                      |