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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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7. ¿En su trabajo intervienen pacientes o sujetos humanos?:
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19. datos clínicos y administrativos de manera retrospectiva no se solicitó
20. consentimiento informado a los participantes en el mismo. Los variables
21. recogidas mediante la revisión de las historias clínicas se trataron de
22. manera anonimizada y garantizada la confidencialidad de los datos. No se
23. recopilaron datos que pudiesen identificar a los pacientes implicados en
24. el estudio. Fue solicitada y aprobada la exención de consentimiento
25. informado al CEI del Hospital Universitario Germans Trias i Pujol.**

30. 3. ¿Su trabajo incluye un ensayo clínico?:
31. **No**

33. 4. ¿Todos los datos mostrados en las figuras y tablas incluidas en el manuscrito se
34. recogen en el apartado de resultados y las conclusiones?:
35. **Sí**

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

3 3
4 4 **Abstract**

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

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

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

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

1
2 25 interventions could redirect the avoided costs towards improving care support in
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4 26 residential settings.
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7 27 **Keywords:** ambulatory care sensitive conditions, hospitalisation, care home, aged
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31 **Abbreviations.** ACSC: Ambulatory care sensitive conditions; CH: Care homes; ED:
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33 Emergency department; EDA: Emergency department admissions; ACSC-EDA:
34 Emergency department admissions by ACSC; EMR: Electronic medical record; CCI:
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36 Charlson Comorbidity Index score; MAT-SET: Andorran model of triage-Sistema
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38 Español de Triaje
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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

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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 ≥ 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

1
2 72 costes. La disminución de estas patologías mediante la aplicación de intervenciones
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4 73 específicas podría redirigir los costes evitados hacia la mejora del apoyo asistencial en
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6 74 los entornos residenciales.
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9 75 **Palabras clave:** ambulatory care sensitive conditions, hospitalización, residencia,
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2 96 **Background**
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5 97 Up to 60% of care home (CH) residents may experience an emergency department
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7 98 admission (EDA) each year ¹, and a remarkable number of EDAs have been classified
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9 99 as potentially preventable or inappropriate. Furthermore, nearly 55% of EDAs among
10
11 CH residents may be for *ambulatory care-sensitive conditions* (ACSC) ², which have
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13 100 been defined as health conditions-diagnoses for which timely and effective ambulatory
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15 101 care could help to reduce the risk of hospitalisation, either by preventing the onset of an
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17 102 illness or condition, controlling an acute episodic illness or condition, or managing a
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19 103 chronic disease ³.
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23 104 Reducing avoidable admissions for ACSC has been a goal of policy makers,
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25 commissioners and service providers for many years, based not only on the provision of
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27 services in a resource-constrained healthcare system and the high avoidable costs, but
28
29 105 also because of the harmful outcomes of hospitalisation in frail older people ⁴. In fact,
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31 106 this population may suffer from advanced stage of disease, functional dependence or
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33 107 severe dementia ⁵ and, for them, hospitalisation may be more deleterious than beneficial
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36 108 ⁴ because of an increased risk of functional impairment ⁶, delirium ⁷, nosocomial
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38 109 infections ⁸ or mortality ².
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42 110 In Spain, a rate of up to 16.5% of ACSC-related hospitalisations has been documented
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44 in people over 65 years of age living in the community ⁹. However, there is a lack of
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46 data on the frequency of ACSC among CH residents, their characteristics and the costs
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48 associated with hospitalisation for ACSC in this population. Evaluation of these aspects
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50 could be useful in the development of cost-effective interventions that lead to a
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52 reduction of potentially avoidable hospitalisations and an improvement in the quality of
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54 care in the residential setting.
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7 121 **Aim**
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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.
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128 **Material and methods**
129 **Design**
130 The present study represents a secondary analysis of the *Caregency* study ¹⁰. 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 ^{11,12},
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

1
2 144 selected within each hospital for further review and data collection. This ensured that
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4 145 data from all seasonal periods per hospital were examined. Using a data collection
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6 146 sheet, a trained team of medical or nursing professionals from each participating
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8 147 hospital collected the study variables by reviewing the participants' electronic medical
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10 record (EMR) and collecting data from the Minimum Basic Emergency Department
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12 148 Data Set (CMBD-UR)¹³.
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19 151 **Measures**
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21 152 **Baseline characteristics of the residents involved in the EDA**
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24 153 Sociodemographic characteristics of the EDA were collected. Functional status was
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26 154 assessed using the standardised Barthel Index score (range 0-100) in the previous three
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28 155 months, if available in the EMR ¹⁴. A lower score indicates greater dependence. Further,
29
30 156 the following Barthel Index categories were also used: non-dependence (Barthel index
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32 157 ≥ 95), mild (61-95), moderate (41-60) or severe dependence (≤ 40) ¹⁵. If the Barthel
33
34 158 Index score was not available, the researchers' extracted information on the "level of
35
36 159 dependence" (independent, mild, moderate or severe dependence) as indicated in the
37
38 160 resident's EMR, if available. Subsequently, a new variable was created to define the
39
40 161 "compiled level of dependence" of the resident, combining the categories of the Barthel
41
42 162 Index with those of the variable "level of dependence", being the four resulting
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44 163 categories: non-dependence, mild, moderate or severe dependence. Cognitive status in
45
46 164 the previous 3 months was assessed according to the information obtained from the
47
48 165 EMR for this period. Thus, we gathered information on whether the resident had
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50 166 cognitive impairment and whether the resident had a diagnosis of dementia, **in which**
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52 167 **case researchers were asked to specify the severity of dementia. In order to obtain**
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2 168 **a wide picture of the study sample, severity of dementia was determined according**
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4 169 **to the information available in the EMR (i.e. mild, moderate or severe dementia),**
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6 170 **and no validated grading systems or psychometric tests were necessary, as this**
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8 171 **would have probably led to a big amount of missing values for this variable.**
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12 172 Multimorbidity was evaluated using the Charlson Comorbidity Index (CCI) score, with
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14 173 higher scores indicating greater 10-year mortality risk ¹⁶.
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17 174 The MAT-SET (Andorran model of triage-Sistema Español de Triaje) scale was used to
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19 175 assess the emergency level (triage) of the resident on arrival at the ED with the triage
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21 176 categories provided by the scale (I-V) ¹⁷.
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24 177 Concerning the destination after ED discharge, the return to the CH, admission to
25
26 178 another hospital or intermediate care wards and “mortality during EDA” were
27
28 179 identified. Information on the type of acute hospital admission ward (internal medicine,
29
30 180 acute geriatrics, traumatology, emergency short-stay, general surgery, pneumology and
31
32 181 other wards) and the type of intermediate care wards (subacute care, post-acute care,
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34 182 palliative care, long-stay medical, psychogeriatric) was gathered. Regarding mortality,
35
36 183 we collected data on “mortality during EDA” and “mortality 30 days after ED
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38 184 discharge”. “Short-term mortality” was considered for those cases that presented with
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40 185 either “mortality during EDA” or “mortality 30 days after ED discharge”.
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48 187 **Ambulatory care sensitive conditions**
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51 188 Among the main diagnoses, ACSCs were identified using the list of 16 ACSCs for CHs
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53 189 proposed by Walsh *et al.* This list was selected by a panel of experts with clinical and
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55 190 health services research experience in the field of long-term care, by assessing
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57 191 appropriate diagnoses for this population group ¹⁸. For the present study, respiratory
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1 192 infections were included in the chronic obstructive disease/asthma group. In this way,
2 193 EDAs with a main diagnostic corresponding to an ACSC (ACSC-EDA) and EDAs with
3 194 a main diagnostic unrelated to an ACSC (non-ACSC-EDA) were identified.
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7 196 **Costs estimation related to the ACSC-EDAs**

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9 197 The costs related to each ACSC-EDA, which included both the costs generated by the
10 198 ED admission *per se* and, where applicable, the subsequent costs of admission to other
11 199 acute hospital or intermediate care wards, and hospitalisation at home, were calculated
12 200 in euros (€). The unit rate and payment method established by the *Departament de Salut*
13 201 *de la Generalitat de Cataluña*, adjusted to the year 2017, were used to measure costs¹⁹.
14
15 202 The costs generated by EDA, other acute hospital wards or sub-acute care wards were
16 203 generated by "discharge", while the costs generated by admission to the remaining
17 204 intermediate care wards were determined according to the "days of stay" in these wards.
18
19 205 As the number of "days of stay" in intermediate care wards was not available, a unit
20 206 price was established according to the maximum stay recommended for each of these
21 207 wards by the *Departament de Salut de la Generalitat de Catalunya*²⁰. Supplementary
22
23 208 Table 1 (Appendix A) shows the unit costs associated with each unit of admission
24 209 (adjusted to 2,017).
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28 211 **Statistical Analyses**

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30 212 EDA characteristics were described using mean and standard deviation (SD) for
31 213 continuous variables and absolute numbers and percentages for discrete variables. T-
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33 214 test for normal variables and non-parametric Mann-Whitney U test were used for group
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35 215 comparisons (ACSC-EDA vs. non-ACSC-EDA) of continuous variables, while Fisher's
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2 216 exact test was used for categorical variables. All tests were two-sided at the 5% level of
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4 217 significance (p = 0.05).
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7 218 The costs associated with ACSC-EDA were analysed. To calculate the average cost of
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9 219 an admission to an ED, hospital or intermediate care unit, the total number of
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11 220 admissions to these units and the total cost generated by these admissions were taken
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13 221 into account.
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16 222 Following Walsh *et al.*¹⁸, a sensitivity analysis was performed to estimate the
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18 223 admissions and cost savings that could be achieved assuming a 20%, 40% and 60%
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21 224 reduction in ACSC-EDAs.
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24 225 All analyses were performed using IBM SPSS Statistics version 25 (IBM Corporation,
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26 Chicago, IL).
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31 228 **Results**
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34 229 A total of 12,580 EDAs of older adults living in CH were identified. Of these, a final
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36 230 sample of 2,444 EDAs was obtained after random sampling, corresponding to 1,982
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38 231 older residents.
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41 232 The characteristics of CH residents involved in EDAs and comparison between ACSC
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43 233 and non-ACSC EDAs are shown in Table 1. In brief, the global EDA were
44
45 234 predominantly of women (67.7%), with a mean age of 85.9 years (SD 7.2), and a
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47 235 median (1st quartile-3rd quartile) of CCI of 3 (2-4). A wide proportion were
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49 236 functionally impaired (44.3% showed a severe compiled degree of functional
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51 237 dependence) and with cognitive impairment (78% of EDA). Among them, 56.6%
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53 238 suffered from advanced dementia.
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2 239 There were no statistically significant differences between the two groups studied
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4 240 (ACSC and non-ACSC EDA) in terms of sociodemographic characteristics,
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6 241 multimorbidity, and functional and cognitive status.
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11 243 *[Please include Table 1 around here]*
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17 245 The characteristics and outcomes of the EDA, as well as the outcomes according to the
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19 246 presence of ACSC as main diagnosis are shown in Table 2.
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22 247 The majority of residents were discharged to CH (52.6%), with 44% experiencing
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24 248 hospitalisation (either in acute, intermediate care wards or hospital at home).
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27 249 Differences in admission units were found between non-ACSC-EDA and ACSC-EDA.
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30 250 Finally, higher short-term mortality was observed in non-ACSC-EDA vs. ACSC-EDA
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32 251 (17.9% vs. 14%; p=0.009).
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38 253 *[Please include Table 2 around here]*
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44 255 The frequency of each ACSC and the top 10 non-ACSC diagnoses, as well as the
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46 256 frequency of admission to other acute or intermediate care wards for each diagnose are
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48 257 described in Table 3.
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53 259 *[Please include Table 3 around here]*
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58 261 Table 4 displays the detailed costs related to ACSC by unit of admission and the
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60 262 average cost per EDA admitted to an ED, acute or intermediate care units.
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2 263 The overall costs of ACSC-EDAs was €1,948,997.30 with an average cost per EDA of
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4 264 €1,408.24.
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7 265 Table 5 provides the results of the sensitivity analysis. Based on these analyses, between
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9 266 400 and 1200 admissions per year and between €390,000 and €1,170,000 in costs could
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11 267 be avoided by achieving these percentage reductions in ACSC-EDA.
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16 269 *[Please include Table 4 around here]*
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21 271 *[Please include Table 5 around here]*
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273 **Discussion** 28

29 274 The present study found that, in a sample of 2444 EDA in 5 university hospitals in
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31 275 Catalonia (Spain) of CH residents, more than half of the EDA (56.6%) had ACSC as a
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33 276 main diagnosis. Globally, EDA were predominantly women, with a mean age of 85.9
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35 277 years, high multimorbidity and high levels of functional and cognitive impairment.
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37 278 EDA presenting with ACSC did not differ from those without ACSC in these
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39 279 characteristics. Furthermore, about 44% of all EDA required hospital admission, with
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41 280 similar proportions among ACSC and non-ACSC EDA. Short-term mortality was
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43 281 slightly higher in the group without ACSC, which could be explained by a tendency
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45 282 towards a higher severity level at triage in this group. The most frequent ACSC
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47 283 identified in our study were falls/trauma, chronic obstructive pulmonary disease/asthma,
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49 284 urinary tract infection and congestive heart failure.
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52 285 Previous international studies have reported varying proportions of ACSC-EDA (often
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54 286 named as ACSC hospitalisations) among CH residents, with ACSC-EDAs ranging from
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1 287 19% to 43% ²¹⁻²³. The different populations studied and the ACSC lists used could
2 288 explain these variations. For example, Walsh *et al.* ¹⁸, using an ACSC list similar to the
3 289 one used in the present study, reported ACSC-related hospitalisation frequency of 39%
4 290 but their study population included not only CH residents but also people receiving
5 291 community-based services. Conversely, Ouslander *et al.* ²⁴, documented higher ACSC
6 292 hospitalisation rates (67%) than those observed in our study.
7 293
8 294 With regard to the ACSC identified, international research has also identified chronic
9 295 obstructive pulmonary disease/asthma, urinary tract infection, falls/trauma and
10 296 congestive heart failure, among the top ACSCs ^{18,25,26}.
11 297
12 298 In terms of costs, the present study found that the average cost per ACSC-EDA was
13 299 1,408.24 € (including the costs of ED and admission to hospital or intermediate care
14 300 wards after ED discharge), resulting in an overall cost for all ACSC EDA of around 2
15 301 million €. Our sensitivity analysis suggested that the cost savings could have ranged
16 302 from 390,000 to 1,170,000 €. Thus, the research team considered that at least this
17 303 amount of money could have been invested in interventions to prevent ACSC-related
18 304 EDA.
19 305
20 306 Reducing ACSC-related admissions in CH has been an important goal in different
21 307 healthcare systems for years ²⁷⁻²⁹, and several interventions have been reported that
22 308 could help achieving this aim.
23 309
24 310 Young *et al.* ³⁰, identified four factors that were significantly associated with reduced
25 311 ACSC admissions among CH residents: effective communication between nursing staff
26 312 and physicians regarding the resident's condition, physicians being able to treat
27 313 residents within the CH and transferring them to hospital as a last resort, providing
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1 310 better training and support for nursing staff and aides regarding end-of-life care, and
2 311 facilitating access to complementary test results.
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4 312 Some interventions based on the management of certain commonly referred conditions
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6 313 (often classified as ACSC) have been suggested. Loeb *et al.*³¹ compared the use of a
7 314 clinical care pathway with usual care for CH residents who developed symptoms of
8 315 pneumonia and other lower respiratory tract infections in 22 nursing homes in Ontario,
9
10 316 Canada. Their results showed a reduction in the rate of hospital admissions, resulting in
11 317 substantial cost savings.
12
13 318 Other research studies have more widely focussed on reducing potentially 'avoidable' or
14 319 'preventable' hospital admissions among CH residents. In fact, several definitions of this
15 320 concept have been used³², including ACSCs but also aspects other than ACSCs such as
16 321 the priorities and wishes of the CH residents' and the availability of resources in CHs,
17 322 among others³³.
18
19 323 Selected multifactorial interventions including, among other activities, regular visits by
20 324 general practitioners or geriatricians, additional training for care centre staff or the
21 325 improvement of relationships between care providers have shown positive results in
22 326 reducing potentially preventable hospitalisations³⁴⁻³⁸. Recently, Carter *et al.*³⁹ found
23 327 promising evidence for the effectiveness and cost-effectiveness of a nurse led, early
24 328 intervention program in preventing unnecessary hospital admissions in CH.
25
26 329 Finally, some studies have analysed the effects of interventions aimed at reducing
27 330 hospital admissions among CH residents in general. Graverholt *et al.* performed a
28 331 systematic review on this topic and concluded that, although the quality of the evidence
29 332 is low, several interventions may have an effect on reducing hospital admissions in this
30 333 population⁴⁰. Conversely, Kane *et al.*⁴¹, in a randomised controlled trial using the
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1 334 INTERACT training and implementation support, which included tools that help CH
2 335 staff identify and evaluate acute changes in CH resident condition and document
3 336 communication between physicians, care paths to avoid hospitalization when safe and
4 337 feasible, advanced care planning and quality improvement tools, found no benefits in
5 338 rates of hospitalisation or ED visits among CH residents.
6
7 339 To the best of our knowledge, the present study is the first one providing national data
8 340 for Spain on the frequency of EDAs related to ACSCs in a large sample of CH
9 341 residents, as well as the characteristics of the CH residents involved in these EDAs,
10 342 their requirements for admission to acute or intermediate care wards, the specific ACSC
11 343 involved, and the associated costs. The results of this study could be used for the
12 344 development and implementation of interventions aimed at preventing potentially
13 345 avoidable hospitalisations among frail older adults living at CH.
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15 346 Other strengths of the present study are its multicentre design, and the long time-period
16 347 covered, which favoured the understanding of the economic impact of EDA throughout
17 348 a one-year period.
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19 349 This study has limitations. The retrospective study design is prone to measurement
20 350 errors and missing data. However, data were carefully obtained from each participant's
21 351 medical record by a group of trained researchers who were medical or nursing
22 352 professionals from each participating hospital. **Due to a relevant number of missing**
23 353 **values for the Barthel Index, the level of dependence of the participants was**
24 354 **measured using a non-validated instrument in many cases, which could have led to**
25 355 **an over or infra-estimation of this variable. Furthermore, due to a lack of data, an**
26 356 **estimation was done for the days of admission to intermediate care, which may**
27 357 **have led to an over or infra-estimation of the costs. Finally, potentially avoidable**
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2 358 hospital admissions were measured by identifying only ACSCs, and no data could be
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4 359 collected on other aspects of appropriateness, such as care preferences or priorities of
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6 360 participants and their caregivers, or on secondary diagnoses.
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12 362 **Conclusions**
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15 363 The present study found that EDA due to ACSC are frequent among CH residents,
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17 364 being falls/trauma, chronic obstructive pulmonary disease/asthma, urinary tract
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19 365 infection and congestive heart failure the most frequently identified ACSCs. The cost
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21 366 savings associated with reducing EDA due to ACSC could be invested in the
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23 367 implementation of interventions aimed at preventing potentially avoidable
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26 368 hospitalisations in this population. The results of this study may provide a basis for the
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28 369 development of cost-effective interventions with this aim.
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35 371 **Appendix A.**
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37 372 Supplementary Table 1. Unit costs related to each unit of admission (adjusted to 2017)
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42 374 **Appendix B.**
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45 375 Group authorship
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2 381 **References**
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2 549 **Table 1. Characteristics of the CH residents involved in EDA (n=2,444) and**
3 550 **comparison between ACSC-EDA and non-ACSC-EDA**
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Variables	ACSC-EDA (n,%) (1384, 56.6)	Non-ACSC-EDA (n,%) (1060, 43.4)	p	Overall EDAs (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 <u>0-37</u>)*, 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)
<i>Missing values, n</i>	81	86		167
Dementia, n (%) **	741 (59.7)	563 (60.3)	0.791	1,304 (59.9)
<i>Missing values, 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)
<i>Missing values, n</i>	75	73		148
Barthel Index for activities of daily living (range 0- <u>100</u>)*, median (Q1-Q3)	40 (10-70)	45 (15-70)	0.132	40 (15-70)
<i>Missing values, 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)
<i>Missing values, 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)

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

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

12 * Underlined scores are most favourable.

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

16 *** Residents without registered Barthel index.

18 **** Combination of the categories of the Barthel Index and “level of dependence” variables: compiled-non-dependence
19 (Barthel index ≥ 95 or “non-dependence”), compiled-mild (Barthel index 61-95 or “mild”), compiled-moderate (Barthel
20 index 41-60 or “moderate”), or compiled-severe (Barthel index ≤ 40 or “severe”) dependence.

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2 569 **Table 2. Characteristics and outcome of CH residents during their stay in the ED**
3 570 **and comparison between ACSC-EDA and non-ACSC-EDA, including**
4 571 **hospitalisations**
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Variables	ACSC-EDA (n, %) (1384, 56.6)	Non-ACSC-EDA (n, %) (1060, 43.4)	p	Overall EDA (n, %) (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)
<i>Missing values, 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)
<i>Missing values, n</i>	3	8		11
Intermediate Care Ward after EDA, n (%)	211 (15.2)	79 (7.5)	<0.001	290 (11.8)

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

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

25 * Deceased in ED are excluded

26 ** Admissions to hospital at home are included

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

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

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2 584 **Table 3. Frequency of ACSCs and top 10 non-ACSC, and frequency of admission**
3 585 **of EDA to hospital or intermediate care wards (n=2,444)**
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Main diagnoses	Frequency of EDA n (%)**	Frequency of EDA with admission to other hospital or intermediate care wards * n (%)***
ACSC		
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	-	-
Non-ACSC	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)

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

16 Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions

17 * Admissions to hospital at home are included

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

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

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

Unit of Admission	ACSC n (€)
Emergency Department Ward (n (€))	1,384 (144,835.60)
Hospital Ward after EDA*''''(n (€))	405 (1,426,319.89)
Medical Wards **	378 (1,298,180.52)
Surgery Wards ***	11 (73,189.93)
Intermediate Care Ward after EDA (n (€))	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)
Overall Cost (including admission to the ED and other hospital or intermediate care wards)	1,384 (1,948,997.30)
Average cost per EDA (including admission to the ED and hospital or intermediate care wards)	1,384 (1,408.24)

32 Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions; ED, Emergency Department; EDA, Emergency Department
33 Admission

34 * *Includes hospital at home*

35 ** *Medical wards include: cardiology, digestology, endocrinology, internal medicine, geriatrics, pneumology, neurology,
36 oncology, psychiatry, nephrology, emergency short stay unit and intensive care unit.*

37 *** *Surgery wards include: traumatology, urology, general surgery, vascular surgery and neurosurgery.*

38 **** The cost is calculated on the basis of the number of days of admission according to the maximum stay recommended
39 for each of these wards by the Departament de Salut de la Generalitat de Catalunya²⁰

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2 610 **Table 5. Results of sensitivity analysis on the estimated reduction in the frequency**
3 **611 and cost of ACSC based on assumptions about the proportion of avoidable**
4 **612 admissions to ED, other hospital and intermediate care wards that could be**
5 **613 prevented.**
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10 11 Category	12	13 Frequency of ACSCs, 14 costs and 15 admissions/savings assumptions
16 Overall admissions for ACSCs (n)		1,384
17		
18 Overall costs for ACSC (€)*		1,948,997.30
19		
20 Average cost per ACSC EDA (€)		1,408.24
21		
22 Assumption 1: 20% of admissions defined as ACSC from an outpatient point of view are		
23 avoided. *		
24 Ambulatory Care-Sensitive Conditions prevented (n)		277
25 Estimated cost savings for Ambulatory Care-Sensitive Conditions prevented (€)		390,081.11
26		
27 Assumption 2: 40% of admissions defined as ACSC from an outpatient point of view are		
28 avoided. *		
29 Ambulatory Care-Sensitive Conditions prevented(n)		553
30 Estimated cost savings for Ambulatory Care-Sensitive Conditions prevented (€)		778,753.98
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32 Assumption 3: 60% of admissions defined as ACSC from an outpatient point of view are		
33 avoided. *		
34 Ambulatory Care-Sensitive Conditions prevented (n)		830
35 Estimated cost savings for Ambulatory Care-Sensitive Conditions prevented (€)		1,168,835.09
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37 Abbreviations: ACSC, Ambulatory Care-Sensitive Conditions

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39 * 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 (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

* *Cost per discharge*

** *Cost per stay (days of admission)*