The burden of chronic disorders on hospital admissions prompts the need for new modalities of care:
A cross-sectional analysis in a tertiary hospital

C. HERNANDEZ 1, M. JANSA 1, M. VIDAL 1, M. NUÑEZ 1, M.J. BERTRAN 1, J. GARCIA-AYMERICH 2 and J. ROCA 1

From the 1 Integrated Care Unit, Respiratory, Endocrinology and Rheumatology Services and Preventive Medicine and Epidemiology Department (UASP), Hospital Clinic, CIBERES, IDIBAPS, University of Barcelona and 2 Centre for Research in Environmental Epidemiology (CREAL), IMIM, CIBERESP, Barcelona, Spain

Received 14 August 2008 and in revised form 8 December 2008

Summary

Background: Chronic disorders constitute a primary concern because of their burden on healthcare systems worldwide. Integrated care strategies enhancing the interface between tertiary care and primary care are pivotal to improve chronic care.

Aim: To assess the prevalence of chronic disorders on hospital discharges and their impact on unplanned admissions and mortality.

Design: Cross-sectional analysis of discharge information over 1 year (2004) in one University hospital.

Methods: Adoption of an operational definition of chronic disorder based on the WHO. Main outcome: co-morbid conditions, emergency room and hospital admissions, outpatient consultations and mortality.

Results: Fifty-eight percent of patients presented at least one chronic condition (19,192 patients, 53% males, 63±18 years) as primary (12,526 patients, 38%) or secondary diagnosis. The Charlson index was 2±3. Each chronic condition was associated with a 30% increase of having had an admission in the previous year. Up to 9% (1,656) of chronic patients showed multiple admissions in the previous year: two (917 patients, 55%), three (360, 22%) and four or beyond (379, 23%), being mostly unscheduled hospitalizations. The three most prevalent chronic disorders were cancer, cardiovascular diseases and chronic obstructive pulmonary disease (COPD). The rate of admissions was associated with co-morbidity (P<0.001) and mortality (P<0.001).

Conclusions: The study shows a high impact of cancer on planned hospitalizations whereas cardiovascular diseases and COPD generate a high percentage of unscheduled admissions. We conclude that integrated care services including patient-oriented guidelines are strongly needed to enhance both health and managerial outcomes.

Introduction

Ageing of the population together with changes in lifestyle is central factor to explain the increasing prevalence of chronic disorders, which is expected to continue over the next decades leading to further dysfunctions of healthcare systems worldwide.1-3 The urgent need for introducing substantial changes in delivery of care for chronic patients is widely accepted. The WHO has launched the Innovative Care for Chronic Conditions (ICCC) initiative4 formulating basic principles and strategies...
to enhance management of chronic patients. Although limited, published data exist evaluating the efficacy of the chronic care model, previous pilot experiences on integrated care programs have shown positive results.

It is well known that acute events associated to chronic disorders trigger unplanned, often avoidable, hospitalizations with a deleterious impact on patient quality of life, course of the disease and healthcare costs. The main hypothesis of the current investigation is that acute episodes associated with chronic conditions represent a high percentage of unplanned but preventable hospitalizations. Moreover, co-morbidities constitute a major factor of fragility to explain repeated hospital admissions in subsets of patients that concentrate a high use of healthcare resources. Our study aims at identifying the prevalence and types of chronic disorders determining hospital admissions in a highly specialized hospital over 1 year. We emphasize the analysis of associations of chronic conditions and their impact on unplanned admissions and in-hospital mortality. Particular attention is paid to frail patients with history of multiple admissions. The study was primarily designed to identify the key elements required for an extensive deployment and validation of integrated care programs to enhance interfacing with primary care and community services.

Material and method

Study group

We analysed all patients older than 14 years discharged over one full year, from 1 January to 31 December 2004, in a 850-bed highly specialized tertiary hospital located in the centre of Barcelona with a reference population of \( \sim 540,000 \) inhabitants. For each patient, information was obtained from the hospital discharge database, shared with the Health Department of Catalunya (CMBD) that includes age, sex, geographical location and diagnostic data following the International Classification of Diseases coding (ICD9-CM) and is monitored with high-quality standards. Primary and secondary diagnoses in each hospital discharge were clearly identified. The study was examined and approved by the Ethical Committee of the Hospital Clinic.

Study design

We performed a cross-sectional analysis of all discharges during 2004 to evaluate the impact of chronic conditions on hospital admissions, analysing separately primary and secondary diagnoses.

For the purposes of the investigation, we adopted an operational definition of chronic disorder close to the one proposed by WHO that describes chronic condition as ‘health problems that require ongoing management over a period of years or decades including non-communicable diseases; persistent communicable diseases; certain mental disorders and ongoing impairments in structure’. Based on such a definition, we used all ICD9-CM categories considered in the hospital database alluded to above to generate an initial list of chronic conditions, which was checked against four international classifications. As part of this process, up to 2500 (ICD-9CM) diagnoses ranking among the 40 most prevalent Diagnosis Related Groups (DRGs) at the Hospital Clinic were considered for analysis. Up to 855 ICD-9CM items were adopted as chronic conditions and they were clustered in 129 categories classified by biological systems (see Supplementary material).

Data analysis

The patients with at least one chronic condition will be called herein ‘chronic patients’, we evaluated socio-demographic characteristics, number and severity of co-morbidities (Charlson index) and in-hospital mortality. We also assessed the use of hospital resources during the 12-month period previous to the first hospitalization during 2004: rate and length of hospitalizations, admissions in intensive care, emergency room consultations and number of outpatient visits. The impact of co-morbidity on the use of healthcare resources was analysed using a multivariate logistic regression model adjusted by sex and age. The source of hospital admission to identify planned vs. unplanned hospitalizations was identified, as well as the destination after discharge. In the study, unplanned admissions were those done through the Emergency Room while all other sources of hospitalization qualified as planned admissions.

We analysed the subset of chronic patients showing two or more hospital admissions during the 12-month period previous to the first admission during 2004 who will be called here in ‘frail patients’. Associations of chronic co-morbid conditions were assessed for the four most prevalent main diagnoses.

The database was coded to maintain confidentiality. Statistical analyses were done using SPSS v.11 (Inc, Chicago, IL, USA) and Stata, release 8.2 (StataCorp, 2005, College Station, TX, USA). For categorical variables, results were expressed as
Results
Characteristics of the study group
A total of 32,946 patients (42,475 discharges) were hospitalized during 2004. Fifty-eight percent of patients (19,192) and 62% of discharges (26,261) presented at least one chronic condition either as main or secondary diagnosis. In 38% of both patients (12,526) and discharges (15,975) a chronic disorder was the main reason for hospitalization.

The top 20 chronic conditions that were primary diagnoses for admission are ranked in Figure 1, left column, including their respective proportion on the total number of hospital discharges, expressed as percentage. The right column of Figure 1 ranks the most prevalent chronic disorders independently of whether the diagnosis was principal or secondary. It is of note that the first four main diagnoses were: cancer, ischemic heart disease, liver cirrhosis and chronic obstructive pulmonary disease (COPD), respectively.

The characteristics of the 19,192 patients (53% males) with at least one chronic condition, either as primary or secondary diagnosis, are displayed in Table 1. Distributions by sex, age and number of co-morbid conditions are shown in this table. Patients with chronic disorders presented higher length of hospitalization (9±11 days) than the average for all patients (6±10 days) (P<0.005). Similar figures for age and sex distributions and length of hospital stay were seen for the 12,526 patients in whom a chronic condition was the main diagnosis of hospital admission.

Impact of co-morbid conditions
Chronic patients presented a rather high co-morbidity score. Up to 71% of the patients (13,695) showed ≥2 co-morbid conditions. The Charlson index, based on the adjusted risk of 1-year mortality, was 2±3. The characteristics of the patients by number...
Table 1  Patient characteristics by sex, age quartiles and number of chronic co-morbid disorders

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Age in quartiles</th>
<th>Number of chronic conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>P-value</td>
</tr>
<tr>
<td></td>
<td>n = 10144</td>
<td>n = 9045</td>
<td></td>
</tr>
<tr>
<td>Males (%)</td>
<td>61.8 (16.5)</td>
<td>64.0 (18.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of hospital resources during the 12 months previous to the first admission in 2004 and mortality</td>
<td>12.5 (17.2)</td>
<td>11.3 (15.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of each hospital stay (days)</td>
<td>8.8 (11.5)</td>
<td>8.7 (10.4)</td>
<td>0.242</td>
</tr>
<tr>
<td>In hospital mortality, n (%)</td>
<td>739 (57.6)</td>
<td>545 (42.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Use of hospital resources during previous 12 months</td>
<td>0</td>
<td>7783 (76.7)</td>
<td>7248 (80.1)</td>
</tr>
<tr>
<td>Number of hospital admissions, n (%)</td>
<td>1</td>
<td>1400 (13.8)</td>
<td>1102 (12.2)</td>
</tr>
<tr>
<td>&gt;1</td>
<td>961 (9.5)</td>
<td>695 (7.7)</td>
<td></td>
</tr>
<tr>
<td>Number of emergency room visits, n (%)</td>
<td>0</td>
<td>8848 (87.2)</td>
<td>7786 (86.1)</td>
</tr>
<tr>
<td>1</td>
<td>903 (8.9)</td>
<td>898 (9.9)</td>
<td></td>
</tr>
<tr>
<td>&gt;1</td>
<td>393 (3.9)</td>
<td>361 (4.0)</td>
<td></td>
</tr>
<tr>
<td>Number of disorders, n (%)</td>
<td>1</td>
<td>2577 (25.4)</td>
<td>2920 (32.3)</td>
</tr>
<tr>
<td>2</td>
<td>2058 (20.3)</td>
<td>1850 (20.5)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1683 (16.6)</td>
<td>1470 (16.3)</td>
<td></td>
</tr>
<tr>
<td>&gt;3</td>
<td>3826 (37.7)</td>
<td>2805 (31.0)</td>
<td></td>
</tr>
</tbody>
</table>

Results expressed as mean (± SD). The individual was used as the unit of analysis for all variables, with the exception of length of hospital stay, where the episode was the unit of analysis. Data contain three missing values in sex (n = 19 189) and 11 in age (n = 19 181).
of co-morbid conditions are depicted in Table 1 showing positive associations between number of co-morbidities and: age, sex (males), use of hospital resources during 2004 and in-hospital mortality rate ($P < 0.001$ each). Overall, in-hospital mortality for chronic patients was 7% (1284 patients, 58% men, 72±15 years).

The use of healthcare resources during the 12-month period previous to the first admission in 2004 is also displayed in Table 1, indicating a positive association between co-morbidities and hospital admissions ($P < 0.001$), emergency room visits ($P < 0.001$) and number of outpatient visits ($P < 0.001$). In a logistic regression, model adjusted for sex and age, each chronic condition was associated with a 30% increase of having had an admission in the previous 12 months. Similarly, the corresponding increase of having had an emergency room visit in the previous 12 months was of 19% for each chronic condition, after adjusting for sex and age.

**Patients with multiple admissions during the previous year**

Up to 1656 patients (9% of all chronic patients) showed $\geq 2$ hospitalizations within the 12-month period prior to the first admission in 2004, as displayed in Table 2. The rate of admissions was not associated with sex and age, but it showed a significant association with co-morbidity, either expressed as number of co-morbid conditions ($P < 0.001$) or Charlson index ($P = 0.008$). In a multivariate Poisson regression model, the number of chronic conditions was related to admissions independently of age, showing 3% increased risk of admission for each chronic condition. The rate of hospital admissions was also clearly associated with the mortality rate ($P < 0.001$) which was above the average observed in chronic patients in all instances.

The emergency room as entry point was significantly higher in patients with two and three admissions than in those with $\geq 4$ admissions in whom the rate of planned hospitalizations was higher ($P = 0.002$). While most of the patients with either COPD or cardiovascular disorders were admitted through the emergency room (97 and 80%, respectively), those with cancer and liver cirrhosis showed a rather low rate of emergency room admissions (26 and 24%, respectively). No differences among groups were observed in the average length of stay per hospitalization. The destination at discharge was mostly home (∼90%) and it did not show differences among groups. The six top main diagnoses in discharges of patients with multiple admissions were cancer (13% of discharges in this subset of 1,656 frail patients), cardiac disease

### Table 2  Characteristics of patients with multiple readmissions during the 12 month previous to the first admission in 2004

<table>
<thead>
<tr>
<th></th>
<th>Number of admissions</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 $n=917$</td>
<td>3 $n=360$</td>
<td>$\geq 4$ $n=379$</td>
<td></td>
<td>$P$-value</td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>56.2</td>
<td>63.3</td>
<td>57.5</td>
<td></td>
<td>0.064</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>65.2 (16.2)</td>
<td>65.7 (16.0)</td>
<td>61.9 (15.6)</td>
<td></td>
<td>0.143</td>
<td></td>
</tr>
<tr>
<td>Number of chronic conditions</td>
<td>4.0 (2.9)</td>
<td>5.0 (3.4)</td>
<td>5.6 (3.9)</td>
<td></td>
<td>$&lt;0.001$</td>
<td></td>
</tr>
<tr>
<td>Charlson Index</td>
<td>3.2 (4.8)</td>
<td>4.0 (4.8)</td>
<td>3.8 (4.8)</td>
<td></td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Use of hospital resources and mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total hospital stay (days)</td>
<td>15.0 (17.8)</td>
<td>21.7 (24.1)</td>
<td>27.8 (30.6)</td>
<td></td>
<td>$&lt;0.001$</td>
<td></td>
</tr>
<tr>
<td>Length of each hospital stay (days)</td>
<td>9.0 (9.5)</td>
<td>9.3 (10.8)</td>
<td>8.6 (11.0)</td>
<td></td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Entry point, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency department</td>
<td>809 (53.0)</td>
<td>450 (53.4)</td>
<td>484 (46.6)</td>
<td></td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>Outpatient clinic</td>
<td>320 (21.0)</td>
<td>198 (23.5)</td>
<td>247 (23.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient list</td>
<td>386 (25.3)</td>
<td>184 (21.8)</td>
<td>287 (27.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>12 (0.80)</td>
<td>11 (1.3)</td>
<td>20 (1.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destination of discharge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>1356 (88.8)</td>
<td>744 (88.3)</td>
<td>931 (89.7)</td>
<td></td>
<td>0.599</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>171 (11.2)</td>
<td>99 (11.7)</td>
<td>107 (10.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In hospital mortality, n (%)</td>
<td>101 (11.0)</td>
<td>64 (17.8)</td>
<td>67 (17.7)</td>
<td></td>
<td>$&lt;0.001$</td>
<td></td>
</tr>
</tbody>
</table>

Results expressed as mean (±SD). The individual was used as the unit of analysis for all variables, with the exception of length of hospital stay, where the episode was the unit of analysis.
(8%), COPD (8%), liver cirrhosis (7%), systemic diseases (4%) and organ transplantation (3%).

**Associations of chronic disorders**

We analysed the distribution of co-morbid disorders associated with each of the four most prevalent main diagnoses during the first admission (Figure 1): cancer (9.7% of all discharges), cardiovascular diseases (8.2%), liver cirrhosis (2.2%) and COPD (1.9%). We observed similar associations of co-morbid conditions for each main diagnosis irrespective of the group of subjects examined: all 19192 patients with chronic conditions either as primary or secondary diagnosis (Table 1); the 12526 patients admitted because of a chronic condition as main diagnosis; or, the 1656 patients requiring multiple admissions over 1 year (Table 2).

Figure 2 displays by each of the four main primary diagnoses: cancer, heart disease, COPD and liver cirrhosis, the prevalence of the seven most frequent co-morbid conditions, expressed as percentages. It is of note that cardiovascular disorders and COPD were concomitant co-morbid conditions in a significant percentage of patients. Approximately 35% of episodes with COPD as main diagnosis showed chronic heart disease as secondary diagnosis and 25% of patients with cardiovascular disorders as main diagnosis presented COPD as secondary diagnosis. Moreover, these two conditions shared a similar pattern of co-morbid disorders. In patients with cardiovascular disorders, the most prevalent co-morbid conditions were: arterial hypertension (40% of episodes), diabetes (24%), COPD (21%) and renal failure (9%). In COPD patients: heart disease (38%), arterial hypertension (27%), diabetes (16%) and cancer (10%) were the most frequent associated chronic conditions. In contrast, patients with liver cirrhosis showed a completely different pattern of associated disorders including: cancer (16%), diabetes (8%), arterial hypertension (7%), anaemia (6%) and renal failure (4%). Finally, in patients with cancer: arterial hypertension (15%), liver cirrhosis (13%), diabetes (8%), COPD (7%) and anaemia (6%) were the most prevalent associated conditions.

In the subset of patients with multiple admissions for chronic disorders (Table 2), it is of note that the main diagnosis was such in ~60% of admissions whereas in the remaining 40% of episodes one of the co-morbid conditions was the main cause of hospitalization.

**Discussion**

**Main results**

It is well accepted that chronic non-communicable diseases represent ~80% of the burden on healthcare systems in developed countries playing an exceedingly dominant role on both mortality and disabilities. Moreover, communicable diseases such as HIV/AIDS and hepatitis have progressively evolved to chronic conditions such that they may also benefit from an integrated care approach.
In this scenario, the high impact of chronic disorders on tertiary care admissions constitutes a reasonable finding. In the study, chronic disorders were the primary cause of discharge in 38% of all patients older than 14 years of age, during 2004. Moreover, the distribution of the top chronic disorders either as main or secondary diagnoses (Figure 1), included the four priorities of the ICC initiative, namely: cancer, cardiovascular diseases, COPD and diabetes.

The results of the study clearly highlight the impact of co-morbidities on mortality, some of them sharing common risk factors such as tobacco, and use of resources which points out an imperative need for evolving from the current disease-oriented approach toward a patient-focused perspective to properly cope with the co-morbidity challenge.

To our understanding, we have identified two main target groups of patients in whom specific actions must be undertaken to raise efficiencies in the interface between hospital and primary care practice.

First, we should take into consideration chronic patients responsible for unplanned admissions, irrespective of the number of re-admissions over 1-year period. Cardiopulmonary disorders and COPD constitute highest priority for action because of several reasons. The two disease conditions show high degree of association both as main diagnoses and associated co-morbidities22–25 (Figure 2). Moreover, the analysis of the literature shows an unacceptable high rate of unplanned re-admissions (above 30% within 2 months after discharge) in chronic patients with cardiac and respiratory disorders which indicate a potential for improving efficacy of care.

We acknowledge marked differences among healthcare systems in the rate of hospital admissions through emergency room due to acute events of chronic cardiovascular and respiratory disorders. For example, in Barcelona ~70% of all severely exacerbated COPD patients are admitted through emergency rooms, but this figure falls to ~30% on average in the United Kingdom. In contrast, the rates of early relapses in these two chronic disorders show high similarity among countries.9,26,27

A second high-priority group for action is those subjects requiring multiple hospitalizations over 1 year (9% of all chronic patients hospitalized) (Table 2). They were often admitted (in ~40% of episodes) because of one the secondary diagnoses, reinforcing the need for patient-oriented programs to prevent hospitalizations. The number of admissions showed a significant association with the entry point. Cardiovascular disorders and COPD generated the highest percentage of unplanned hospitalizations (80 and 97%, respectively) due to episodes of exacerbation, whereas emergency room admissions only represented a rather small percentage in both cancer (26%) and liver cirrhosis (24%). It is noteworthy that, COPD changed from being the fourth cause of admission (1.9% of admissions) in the whole study group of 32,946 patients (Figure 1) to the third position (7% of admissions) in this subset of patients with multiple admissions, indicating that this disorder must be considered a target condition for preventive actions. Overall, we believe that the results of the current study are of paramount importance for the design of innovative services aiming at preventing unplanned hospitalizations.

Patients with cancer were the group with the highest rate of admission as primary diagnosis (9.7%) as shown in Figure 1. Moreover, in the subset of frail patients (Table 2) those with cancer as primary diagnosis showed a high rate of planned hospitalizations. It is our understanding that the hospitalization rate in this study group can be significantly reduced with an integrated care strategy which may also enhance other clinical outcomes, including health related quality of life.

**Challenges for an extensive deployment of innovative integrated care services**

Disease-specific randomized controlled trials undertaken in patients with chronic heart failure,28,29 COPD,9,30 diabetes,31,32 and other conditions33,34 have consistently shown the potential of home-based integrated care to enhance clinical outcomes while generating cost-containment at system level.28,35

A common problem in all these pilots studies is that disease-specific trials have shown high-internal validity, but a questionable external validity because of an elevated rate of exclusions.9 It must be taken into account that ~60% of exclusions are generally due to severe co-morbid conditions that can be potentially managed through transversal programs addressed to frail patients with multiple severe chronic disorders. The second most important exclusion factor, often present in frail patients, is lack of appropriate community resources which reinforces the need for bridging healthcare and community services providing social support.

There is a need to move the focus from the current interest in advanced chronic conditions toward the development of preventive integrated care strategies addressed to early stages of chronic diseases or even to citizens with an increased risk of developing chronic disorders. Ultimate aims should include enhancement of efficiencies of management aspects
and positive modulation of the prognosis of chronic disorders. To face all these challenges, increasing attention is being paid to the need for deep organizational changes of health systems\textsuperscript{36–38} from a provider-centred perspective to a patient-focused approach.\textsuperscript{39} In the new scenario, a major issue will be the extensive introduction of information and communication technologies (ICT) as enabling tools to facilitate new ways of accessibility of citizens to the system, to effectively promote information sharing among professionals across the system and between citizens and both formal and informal care givers. Altogether these changes should have a marked positive impact on standardization of procedures.

**Strengths and weaknesses of the research**

The study provides pivotal information to enhance articulation between the dual functions of the study Centre. In other words, its role as a high-technology hospital should be properly matched with the activities as a secondary care institution currently involved in the deployment of integrative care strategies. We understand that this issue is increasingly becoming a common challenge for most University hospitals.

We acknowledge, however, limitations inherent to methodological aspects of the study such as its retrospective nature and the fact that analyses are based on administrative information. The external validity of the current investigation seems not to be a problem as far as the figures are consistent with the prevalence of principal and secondary diagnoses reported in the literature. The most prevalent primary diagnoses were: cancer, cardiovascular disorders and chronic respiratory diseases. Likewise, diabetes and arterial hypertensive disease emerged as the most frequent secondary diagnosis.

The unusually high impact of conditions like liver cirrhosis seems to be related with specific strengths of the institution. This fact, however, does not compromise the overall of the main conclusions.

**Conclusions**

While acknowledging the central role of primary care in chronic care management, the current study raises the strategic need for a proper interface between hospital care and primary care. We learnt that co-morbidity plays a major role on unplanned admissions and it constitutes a limiting factor for the deployment of disease-specific programs. The design of patient-oriented guidelines across chronic conditions that are often clustered is strongly needed to develop well-standardized preventive programs.

Chronic cardiovascular disorders and COPD should be taken into account together in these transversal programs since they seem to play a major role triggering unplanned hospitalizations. The study suggests that there is potential to reduce planned admissions in cancer, but further detailed analyses are needed. Last but not least, since \textasciitilde{}90\% of the patients with multiple admissions were discharged directly at home, it is reasonable to speculate that modalities of transitional care combining home-based services with the supporting role of convalescence canter can enhance recovery while reducing re-admission rates.

**Supplementary data**

Supplementary data are available at QJMED online.

**Acknowledgements**

The authors thank the following members of the Hospital Clinic: Luisa Gonzalez (former Nurse Director), Dr Antoni Trilla, Preventive Medicine and Epidemiology Department. Evaluation, Support and Prevention Unit (UASP); Dr Raimundo Lozano and Dr Artur Conesa (Information Systems), Dr Alfons Lopez-Soto (Geriatric Unit. Internal Medicine Service); Dr Enric Esmatjes and Dr Ignacio Conget. Endocrinology and Nutrition (ICMDiM) for their logistic support. We are also grateful Lourdes Lozano and Ascension Pelaez for their continuous assistance. Ignasi Serra from the CREAL provided statistical support and Georgia Narsavage from West Virginia University. School of Nursing (USA) generated useful suggestions for the manuscript. We also acknowledge the continuous support of Dra Conxa Castell, Health Promotion Service. Department of Health. Public Health Division. Department of Health, Catalonia, Spain. Our special thanks to Francisco Pozo. Rafael Bengoa and Josep M Antó for the useful comments on the manuscript.

**Funding**

Beca intramural, IDIBAPS. Hospital Clinic; Fondo de Investigaciones Sanitarias FIS PI060591; Marato TV3 042010; and Linkcare eTEN 517435. The research was not sponsored by commercial companies.

*Conflict of interest:* None declared.
References


