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ORIGINAL ARTICLE

Emergency department visits in older people: pattern of use, contributing factors, geographical differences and outcomes

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Abstract
Aims To assess the pattern of use of Emergency Departments (EDs), factors contributing to the visits, geographical distribution and outcomes in people aged 65 years or more living in the Italian Lombardy Region in 2012.
Methods Based on an administrative database the study population was divided into groups according to the number of ED visits. A multinomial logistic regression model was performed to compare the characteristics of each group. The Getis–Ord's G statistic was used to evaluate the clusters of high and low visit prevalence odd ratios (OR) at district level. To estimate the severity of the disease leading to ED attendance, visits were stratified based on the level of emergency and outcome.
Results About 2 million older people were included in the analyses: 78 % had no ED visit, 15 % only 1, 7 % 2 or more. Male sex, age 85 years or more, high number of drugs, ED visits and hospital admissions in the previous year and the location of an ED within 10 km from the patient's place were all factors associated with a higher risk to have more ED visits. Clusters of high and low prevalence of visits were found for occasional users. Overall, 83 % of ED visit with a low emergency triage code at admission had as visit outcome discharge at home.
Conclusions In older people several variables were associated with an increased risk to have a high number of ED visits. Most of the visits were done for non-urgent problems and significant geographic differences were observed for occasional users.

Keywords Older people · Emergency departments · Triage code · Spatial autocorrelation · Outcomes

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Introduction

With the rapid growth of the oldest segment of the population, the management and integration of care delivery and costs represent an important issue for National Health Services (NHS). Among health care facilities, hospital Emergency Departments (EDs) provide a pivotal public service. Specifically, EDs are often used by older people as a first-line service for the management of any medical emergency, but also as a 24 h access line to acute and long-term healthcare services for primary medical care and social needs. Indeed, older people account for up to a quarter of all ED visits [1] and several studies in different

countries showed an increased trend of ED admissions in the last few decades by patients aged 65 years or more [2–6]. Compared with younger people, older people present with higher level of urgency, longer stay in the ED, higher rates of hospitalization, multiple ED visits and experience more adverse outcomes after discharge [7]. Older adults are often chronically ill and affected by multiple diseases; therefore they may need more frequently medical attention with the possible consequence of ED overload and inadequate delivery of care. The focus on ED use among older adults is a topic that deserves further scientific inquiry because some degree of ED use is inappropriate and could be potentially avoidable and preventable with the aim of improving coordination and integration of care delivery with an impact on the reduction of NHS costs.

Based on this background this study analyzed an administrative database to assess the pattern of use of EDs, the factors contributing to the ED visits and the visit outcomes in people aged 65 years or more living in the Lombardy Region (Northern Italy) in 2012. This study could be helpful to better understand the factors that bring older patients to use ED and what care process are provided to acutely ill older people. Furthermore, we previously found geographical differences in the prevalence of older people with chronic polypharmacy within the Lombardy region [8]. In another study we found that age and area of residence were the main determinants of increased drug prescribing [9]. So that we evaluated if similar differences would exist also in ED visits prevalence for older residents in the same region, to point out if exist the need to address targeted activities on the management of this complex population on the territory.

Methods

Organization of the Italian National Health Service (NHS)

The Italian NHS is organized into local health units (LHUs) which are in turn divided into health districts. In Lombardy, the largest Italian region, there are 15 LHUs divided in about 100 health districts. People seeking emergency care may refer free of charge to an ED all days and nights of the week or to their general practitioner (GP) during their visit hours. In Lombardy there are nearly 110 EDs in the hospitals of the region.

Data source

This study is part of a pharmacoepidemiological collaborative project on older people (aged 65 and older) living in Lombardy Region, the EPIFARM—Elderly Project (Progetto EPIdemiologia del FARMaco nell'Anziano). Lombardy Region has total population of nearly 10 million inhabitants which includes almost 2 million people aged 65 and older. The structure of the databases, routinely updated in the Region for administrative and reimbursement reasons, has been described in detail elsewhere [9].

In particular, five databases were analyzed for the purpose of this study:

1. Patient demographic database that contains data on older patient such as the unique personal identifier code, sex, date of birth, local health unit (LHU) and city of residence, death, any institutionalization and the reference GP;
2. Emergency department database, where each visit record contains the date, time, triage code, how patients reached the ED and outcomes;
3. General practitioner database that collects name, LHU and city in which the GP works;
4. Drug prescription database that collects prescriptions dispensed by retail pharmacies in the Region and reimbursed by the NHS;
5. Hospital discharge database that contains the date of hospital admission and the diagnosis at hospital discharge.

Al data were managed according to the current Italian law on privacy and were analyzed using an anonymous subject code.

Population selection

Overall, 2,030,345 community-dwelling subjects aged 65 years or more in charge to GPs were living in the Lombardy Region between 1 January and 31 December 2012. Data from 2 places, Campione d'Italia (552, 0.03 %) and Cremona LHU (76,973, 3.8 %) were excluded because data were missing. To avoid outliers in prevalence rates, we also excluded from the analysis 81.003 (3.9 %) subjects cared by GPs with less than 100 patients in his/her practice. A final population of 1,949,020 older patients (96 %) living in Lombardy Region from 1 January and 31 December 2012 was included in the analysis.

Pattern of use, contributing factors and outcomes of ED visits

To evaluate the pattern and frequency of use of EDs, the selected population was divided into four groups according to the number of their visits to the ED during 2012: no visit (group 0), one visit (group 1), two or three (group 2), four or more (group 3). This classification was done to differentiate between occasional and frequent users of ED. Months of the year, days of the week and hours of the day

in which patients made the ED visit were also examined in relation to the groups mentioned above. Physician suggestion or patient decision for the ED visit were also analyzed.

To assess any factor contributing to ED visits, the following variables were taken into account in each group: classes of age (65–74, 75–84, 85+ years old); sex; LHUs (Bergamo, Brescia, Como, Lecco, Lodi, Mantova, Milano, Milano 1, Milano 2, Monza e Brianza, Pavia, Sondrio, Varese, Vallecamonica); total number of patients and the percentage of older patients in charge to one GP (as proxy of the GP workload) divided into low, medium and high according to quartiles of the distribution; number of drugs, number of ED visits and hospital admissions in the year before (used as proxy of health status and pattern of healthcare utilization) and the location of an ED within a distance of 10 km from the patient's place of residence.

Factors that may contribute to ED visits were chosen based on the results of previous studies [10].

ED visits were stratified according to the level of emergency at the triage (white and green triage codes = low emergency; yellow and red triage codes = high emergency), and visit outcomes grouped as discharge to home (including discharge to home, decline the ED admission before the medical visit, decline the ED admission during the ED stay), hospital admission (hospital admission, transfer to other facility of care, ambulatory referral) or others (dead in ED, refused hospital admission). This information can be helpful in evaluating the use of ED for non-urgent reasons (that could have been managed by the GP).

ED visits of people dead upon arrival at the ED and missing triage codes were excluded ($n = 364$). The triage is an operative scale of the level of emergency using a color code: white, non-urgent (cases and situations that should be managed in the frame of primary care); green, minor emergency (deferrable); yellow, urgent but with no immediate life threatening conditions; red, non-deferrable emergency (life threatening situations). The code is assigned by professional nurses according to nation-wide criteria [11].

Statistical analysis

The Cochran-Armitage test for trend was employed to evaluate the relationship between variables and the increasing number of ED visits. The same test was used to compare the visit outcomes with the emergency level (triage codes) of ED visits. The GP's workload was assessed by means of two variables: the number of overall patients in charge and the percentage of older patients in charge to GPs. Both the variables were then categorized on the basis of the quartiles of their distribution. For the number of overall patients in charge to GPs the categorization was low (100–1159), medium (1160–1551) and high (>1551). For the percentage of older patients in charge of GP the categorization was low (<19.4 %), medium (19.4–27.5 %) and high (>27.5 %). A multinomial logistic regression model with stepwise selection and level of significance $\alpha = 0.05$ was performed to compare the characteristics of each group (1–3) versus group 0 (no ED visit in 2012) to evaluate the variables associated with ED visits. Using a multinomial regression model we could adjust for all the variables considered associated with ED visits (listed in Table 1), rather than adjusting only for few variables (e.g., sex and age groups) that could be done by the standardization of the ED raw prevalence rates. The data were analyzed using SAS 9.2 [12].

Spatial autocorrelation and clusters analysis

For each group and overall we estimated the ED visit prevalence odd ratios (OR) at health district level by logistic regression models. Variables included were sex, classes of age, health district of residence, number of overall patients in charge and percentage of older patients in charge to a GP, presence of an ED within 10 km from the patient's place of residence. The model was estimated using the stepwise selection and a significance level $\alpha = 0.05$. The estimated ORs were then standardized and the z-scores obtained were graphically represented with the choropleth map. To verify the model of geographical distribution, the Moran's I index of spatial autocorrelation [13] was used, which evaluates whether or not the areas with similar values of ORs are clustered, scattered or distributed randomly in the territory. The clusters of high and low ORs at $\alpha = 0.05$ significance level were obtained using the Getis–Ord's G statistics [13]. To define spatial contiguity we used the fixed distance band method: each health district was analyzed within the context of those neighboring within a specified critical distance. We used 36 km as fixed distance band because this was the minimal distance to have at least one neighbor for each health district in Lombardy. The cartographic representations and spatial analyses were made using ArcMap 10.1 [14].

Results

Pattern of use

Among the 1,949,020 older patients living in the Lombardy Region from 1 January and 31 December 2012 included in the analyses 1,529,601 (78 %) had no ED visit (group 0), 288,984 (15 %) had 1 visit (group 1), 111,411 (6 %) 2–3 visits (group 2) and 19,024 (1 %) had 4 or more visits

Table 1 Patients characteristics (overall and by groups)

Variables		Group 0 *N* (%) 1,529,601 (78)	Group 1 *N* (%) 288,984 (15)	Group 2 *N* (%) 111,411 (6)	Group 3 *N* (%) 19,024 (1)	Overall *N* (%) 1,949,020 (100)	*p* value
Classes of age (years)	65–74	840,310 (54)	132,295 (46)	45,425 (41)	7051 (37)	1,025,081 (53)	<0.0001
	75–84	522,768 (34)	112,241 (39)	46,175 (41)	8298 (44)	689,482 (35)	<0.0001
	85+	166,523 (11)	44,448 (15)	19,811 (18)	3675 (19)	234,457 (12)	<0.0001
Sex	Females	882,981 (58)	164,287 (57)	61,440 (55)	9576 (50)	1,118,284 (57)	<0.0001
	Males	646,620 (42)	124,697 (43)	49,971 (45)	9448 (50)	830,736 (43)	
LHU	Bergamo	155,567 (10)	30,685 (11)	11,785 (11)	1830 (10)	199,867 (10)	<0.0001
	Brescia	164,120 (11)	35,577 (12)	14,964 (13)	2465 (13)	217,126 (11)	<0.0001
	Como	94,143 (6)	17,254 (6)	6548 (6)	1163 (6)	119,108 (6)	<0.0001
	Lecco	57,224 (4)	8976 (3)	2732 (2)	299 (2)	69,231 (4)	<0.0001
	Lodi	35,067 (2)	6810 (2)	2715 (2)	509 (3)	45,101 (2)	<0.0001
	Mantova	69,757 (5)	12,770 (4)	4839 (4)	733 (4)	88,099 (5)	<0.0001
	Milano	299,198 (20)	52,801 (18)	19,828 (18)	3640 (19)	375,467 (19)	<0.0001
	Milano 1	143,922 (9)	28,372 (10)	11,233 (10)	2129 (11)	185,656 (10)	<0.0001
	Milano 2	91,307 (6)	16,643 (6)	6465 (6)	1204 (6)	115,619 (6)	0.0057
	Monza e Brianza	136,184 (9)	23,900 (8)	8450 (8)	1336 (7)	169,870 (9)	<0.0001
	Pavia	95,370 (6)	18,438 (6)	6560 (6)	1078 (6)	121,446 (6)	0.0016
	Sondrio	27,778 (2)	6171 (2)	2517 (2)	382 (2)	36,858 (2)	<0.0001
	Varese	144,686 (9)	27,326 (9)	11,496 (10)	2042 (10)	185,550 (10)	<0.0001
	Vallecamonica	15,268 (1)	3261 (1)	1279 (1)	214 (1)	20,022 (1)	<0.0001
Level of workload of GP (number of patients in charge)	low (100–1159)	223,872 (15)	42,534 (15)	16,562 (15)	2916 (15)	285,884 (15)	0.0016
	Medium (1160–1551)	863,568 (56)	162,963 (56)	62,695 (56)	10,675 (56)	1,099,901 (56)	0.1217
	high (>1551)	442,161 (29)	83,487 (29)	32,154 (29)	5433 (29)	563,235 (29)	0.4379
Level of workload of GP (% of elderly patients in charge)	low (<19.4 %)	234,887 (15)	46,360 (16)	18,632 (17)	3277 (17)	303,156 (16)	<0.0001
	Medium (19.4–27.5 %)	789,666 (52)	149,231 (52)	58,045 (52)	9778 (51)	1,006,720 (52)	0.0581
	High (>27.5 %)	505,048 (33)	93,393 (32)	34,734 (31)	5969 (31)	639,144 (33)	<0.0001
N of drugs taken in 2011	0	244,625 (16)	29,002 (10)	8490 (7)	1056 (6)	283,173 (15)	<0.0001
	1	128,527 (8)	16,431 (6)	4695 (4)	525 (3)	150,178 (8)	<0.0001
	2–4	472,984 (31)	74,240 (26)	23,437 (21)	2831 (14)	573,492 (29)	<0.0001
	5+	683,465 (45)	169,311 (59)	74,789 (67)	14,612 (77)	942,177 (48)	<0.0001
N of ED visits in 2011	0	1,346,228 (88)	227,387 (79)	77,883 (70)	10,052 (53)	1,661,550 (85)	<0.0001
	1	141,490 (9)	42,878 (15)	20,678 (19)	4044 (21)	209,090 (11)	<0.0001
	2–3	38,533 (3)	16,502 (6)	10,663 (10)	3296 (17)	68,994 (4)	<0.0001
	4+	3350 (−)	2217 (1)	2187 (2)	1632 (9)	9386 (−)	<0.0001
N of hospital admissions in 2011	0	1,331,577 (87)	232,329 (80)	83,024 (75)	11,805 (62)	1,658,735 (85)	<0.0001
	1	136,336 (9)	36,715 (13)	17,182 (15)	3747 (20)	193,980 (10)	<0.0001
	2–3	54,330 (4)	17,072 (6)	9231 (8)	2606 (14)	83,239 (4)	<0.0001
	4+	7358 (−)	2868 (1)	1974 (2)	866 (5)	13,066 (1)	<0.0001
ED within 10 km from patient's place of residence		1407,954 (92)	266,409 (92)	103,004 (92)	17,724 (93)	1,795,091 (92)	<0.0001

Group 0 patients with none ED visit in 2012, *Group 1* patients with one ED visit in 2012, *Group 2* patients with 2 or 3 ED visits in 2012, *Group 3* patients with 4 or more ED visits in 2012, *LHU* local health unit, *GP* general practitioner, *ED* emergency department

(group 3). Patients' characteristics are summarized in Table 1. Patients with 4 or more visits were older, more frequently males, taking a higher number of drugs and more ED visits and hospital admissions in the year before, compared with the patients groups with none of few ED visits (all $p < 0{,}0001$). Table 2 reports the ED raw

Table 2 Emergency departments (ED) raw prevalence rates per 1000 older residents for all the 15 Local Health Units (LHUs) according to groups

LHU	Group 1	Group 2	Group 3	Overall
Bergamo	153.5	59.0	9.2	221.6
Brescia	163.9	68.9	11.4	244.1
Como	144.9	55.0	9.8	209.6
Lecco	129.7	39.5	4.3	173.4
Lodi	151.0	60.2	11.3	222.5
Mantova	145.0	54.9	8.3	208.2
Milano	140.6	52.8	9.7	203.1
Milano 1	152.8	60.5	11.5	224.8
Milano 2	143.9	55.9	10.4	210.3
Monza e Brianza	140.7	49.7	7.9	198.3
Pavia	151.8	54.0	8.9	214.7
Sondrio	167.4	68.3	10.4	246.1
Varese	147.3	62.0	11.0	220.2
Vallecamonica	162.9	63.9	10.7	237.4
Overall	148.3	57.2	9.8	215.2

prevalence rates per 1000 older residents for all the 15 Local Health Units (LHUs) according to groups. Overall, 634.898 ED visits were analyzed (45.5 % made by patients belonging to group 1, 39.4 % by those of group 2, 15.1 % by those of group 3). Most of them (76 %) were labeled with a low emergency triage codes (white or green), 67 % were self referral patient ED visits, that decreased by groups (68 % in group 1; 66 % in group 2; 64 % in group 3). In each group, there was a higher prevalence of ED visits in the month of December (9.4 %), with the exception of group 3 that showed an increase during the month of August (9.4 %). Monday (16.3 %) was the day of the week with the highest number of admissions in all groups and the highest number of admissions being registered between 8 am and 2 pm (47 %).

Factors contributing to the ED visits

Compared with group 0 (no ED visit), multinomial logistic regression (Table 3) showed that males were at higher risk to have at least one ED visit and this risk increased among the groups. The same trend was evident related to the classes of age with the oldest old (85+) people doubling their risk of having 4 or more ED visits in the study year. Lecco LHU inhabitants were at lower risk to have at least one ED visit in all groups. Comparing to the Lecco LHU inhabitants, those living in the Sondrio LHU were at higher risk in group 1 (OR 1.35, 95 % CI 1.30–1.40) and 2 (OR 1.66, 95 % CI 1.57–1.76), those living in the Varese LHU (OR 2.25, 95 % CI 1.99–2.54) in the group 3. In all groups, patients in charge to a GP with low level of workload were at higher risk to have at least one ED visit. An increasing number of drugs (OR 2.34, 95 % CI 2.19–2.50), ED visits (OR 30.66, 95 % CI 28.66–32.80) and hospital admissions (OR 2.93, 95 % CI 2.71–3.18) in the previous year were the variables mainly associated with a higher risk to have 4 or more ED visits in 2012. The ED located within 10 km from patient's place of residence was found associated to an increased probability to have an ED visit in the proportion of 8, 13 and 17 % in the three groups, respectively.

Geographical differences at health district level

The prevalence rate of ED visits in the 76 health districts of the Lombardy Region included in the study varied from a minimum of 14.4 % to a maximum of 26.6 %, with a mean of 22.1 % and a standard deviation of 2.7. Overall, the Moran's I Index was equal to 0.16 (z-score = 3.52; $p = 0.0004$), meaning that there is a significant spatial autocorrelation, and that it may be possible to find spatial clusters. The value of the Moran's I Index was not very high, but the z test confirmed that significant spatial clusters were indeed present. Figure S1 shows a large cluster of health districts with low values of ED visits that correspond to the LHUs of Milano, Monza e Brianza, Lecco and some nearby areas. There is also a large cluster of health districts with high values of ED visits represented by the almost entire LHU of Brescia. A significant spatial autocorrelation and clusters were found also for group 1 ($I = 0.18$; z-score = 3.81; $p = 0.0001$) and 2 ($I = 0.16$; z-score = 3.93; $p = 0.0007$). Both groups 1 and 2 showed a similar distribution of spatial clusters (Figure S1). No significant spatial autocorrelation were found for the group 3 ($I = 0.08$; z-score = 1.83; $p = 0.0668$) (Figure S1).

Visit outcomes

Overall 21 % of patients with at least one ED visit in 2012 were subsequently admitted to the hospital. Most patients were discharged to home from the ED (74 %). Grouping by classes of age, 16 % of people aged 65–74 years old, 22 % of those aged 75–84 and 30 % of those aged 85 or older were hospitalized. When the ED visits were stratified by level of emergency, nearly 83 % of patients with a low emergency triage code and 51 % with a high emergency triage code were discharged to home (Table 4).

Discussion

Our study showed that among people 65 years or older, subgroups of ED users could be identified. Most of the cases (78 %) reported no use of ED during the year, 15 % were occasional users (only once a year), the remaining 6 % referred to the ED 2 or 3 times and 1 % 4 or more

Table 3 Results of multinomial logistic regression

		Group 1 vs 0		Group 2 vs 0		Group 3 vs 0	
		OR	IC 95 %	OR	IC 95 %	OR	IC 95 %
Sex	Females	1.00		1.00		1.00	
	Males	1.07	1.07–1.08	1.16	1.15–1.18	1.38	1.34–1.42
Classes of age (years)	65–74	1.00		1.00		1.00	
	75–84	1.21	1.20–1.22	1.36	1.34–1.38	1.44	1.39–1.49
	85+	1.49	1.47–1.51	1.80	1.77–1.83	1.98	1.90–2.06
LHU	Bergamo	1.16	1.13–1.19	1.32	1.26–1.38	1.46	1.29–1.65
	Brescia	1.27	1.24–1.30	1.60	1.53–1.66	1.91	1.70–2.16
	Como	1.10	1.07–1.13	1.26	1.20–1.32	1.63	1.43–1.85
	Lecco	1.00		1.00		1.00	
	Lodi	1.18	1.14–1.22	1.43	1.36–1.52	2.07	1.79–2.39
	Mantova	1.13	1.09–1.16	1.35	1.28–1.42	1.68	1.47–1.93
	Milano	1.06	1.04–1.09	1.24	1.19–1.29	1.74	1.55–1.97
	Milano 1	1.18	1.15–1.21	1.41	1.35–1.48	2.01	1.77–2.27
	Milano 2	1.10	1.07–1.13	1.30	1.24–1.36	1.81	1.59–2.06
	Monza Brianza	1.04	1.01–1.07	1.11	1.06–1.16	1.30	1.14–1.47
	Pavia	1.18	1.14–1.21	1.30	1.24–1.36	1.63	1.43–1.86
	Sondrio	1.35	1.30–1.40	1.66	1.57–1.76	1.80	1.54–2.10
	Varese	1.17	1.14–1.20	1.56	1.49–1.63	2.25	1.99–2.54
	Vallecamonica	1.25	1.20–1.31	1.45	1.35–1.55	1.69	1.42–2.03
Level of workload of GP (number of patients in charge)	Low	1.03	1.01–1.04	1.05	1.03–1.07	1.09	1.04–1.14
	Medium	1.01	1.00–1.02	1.01	1.00–1.03	1.03	0.99–1.06
	High	1.00		1.00		1.00	
Level of workload of GP (% of elderly patients in charge)	Low	1.06	1.04–1.07	1.14	1.11–1.16	1.19	1.13–1.24
	Medium	1.01	1.00–1.02	1.06	1.04–1.07	1.05	1.02–1.09
	High	1.00		1.00		1.00	
Number of drugs taken in 2011	0	1.00		1.00		1.00	
	1	1.01	0.99–1.03	0.94	0.91–0.98	0.80	0.72–0.89
	2–4	1.19	1.17–1.21	1.19	1.16–1.22	1.03	0.96–1.11
	5+	1.66	1.64–1.69	2.09	2.04–2.14	2.34	2.19–2.50
No. of ED visits in 2011	0	1.00		1.00		1.00	
	1	1.51	1.49–1.53	1.94	1.91–1.98	2.69	2.59–2.80
	2–3	1.96	1.93–2.00	3.23	3.15–3.31	6.62	6.34–6.92
	4+	2.82	2.67–2.98	6.71	6.35–7.10	30.66	28.66–32.80
No. of hospital admissions in 2011	0	1.00		1.00		1.00	
	1	1.17	1.15–1.18	1.26	1.24–1.29	1.46	1.40–1.52
	2–3	1.23	1.21–1.26	1.42	1.38–1.45	1.81	1.72–1.90
	4+	1.39	1.33–1.46	1.85	1.76–1.95	2.93	2.71–3.18
ED within 10 km from patient's place of residence	Yes	1.08	1.06–1.10	1.13	1.10–1.16	1.17	1.10–1.24
	No	1.00		1.00		1.00	

OR odds ratio, *IC* intervals of confidence, *LHU* local health unit, *GP* general practitioner, *ED* emergency department

times. People who accessed to ED more than 4 times during the observation period accounted for about one-sixth of the total burden of ED care, corresponding to about 96,000 ED visits out of a total of 634.898. Although multiple ED admissions represented a small percentage of the total, however they should result in the most demanding proportion of ED care in terms of numerical overload as well as quality of assistance. In fact, older people with multiple chronic diseases and ED admissions may require specific geriatric competency not necessarily present in the ED setting [15]. Our study also showed that male sex, age ≥75 years, high number of ED hospital

Table 4 Outcomes in elderly patients with at least one ED admission in 2012 (overall and by groups) according to triage codes

Group	Outcome*	Triage codes			
		White/green		Yellow/red	
		N	%	*N*	%
1	Discharge to home	186,880	84.7	34,912	51.2
	Hospital admission	32,282	14.6	32,382	47.5
	Others	1,565	0.7	897	1.3
	Overall	220,727	100	68,191	100
2	Discharge to home	156,617	82.4	29,981	49.9
	Hospital admission	31,740	16.7	29,157	48.5
	Others	1,655	0.9	926	1.5
	Overall	190,012	100	60,064	100
3	Discharge to home	58,323	81.4	12,368	51.0
	Hospital admission	12,769	17.8	11,536	47.6
	Others	592	0.8	334	1.4
	Overall	71,684	100	24,238	100
Overall	Discharge to home	401,820	83.3	77,261	50.7
	Hospital admission	76,791	15.9	73,075	47.9
	Others	3812	0.8	2139	1.4
	Overall	482,423	100	152,475	100

*"Discharge to home" included patients who have been discharged to home, declined the ED admission before the medical visit, declined the ED admission during the stay; "Hospital admission" included patients who have been hospitalized, moved to other facility of care, or had an ambulatory admission; "Others" included patients who died in ED or refused the hospital admission

364 ED records with missing data or black triage codes were excluded

admissions and drugs taken in the year before were all factors associated with an increased risk to have a higher number of ED visits. People with four or more ED visits in 2011 had a 30-fold higher risk (OR 30.66, 95 % CI 28.66–32.80) to have the same number of ED visit in the subsequent study year. Our data confirm what has been previously shown in the literature, i.e., that the main variables predicting hospital readmissions are increasing age, male gender, previous hospital admissions and poor health conditions (high comorbidity, high number of drugs) [16–20].

There is a great debate concerning the appropriateness of ED use. One indicator of inappropriate use is represented by the level of emergency of the medical condition in ED [21]. In our study most ED visits were not urgent (76 %), a value that is slightly higher compared with another study previously conducted in Italy in older patients [22] that identified as not urgent only the ED visits labeled with white triage code. Furthermore, we found that a high percentage of overall ED visits were for self-referral by patients, as pointed out also in other studies. This finding may suggest that older people rely on the ED capability to provide a ready answer to their medical needs, in terms of diagnostic and therapeutic interventions and specialist consultations in all likelihood even for those conditions that could be managed in outpatients services. In 2007 the Italian Ministry of Health developed an algorithm to define an ED visit as inappropriate [21]. The ED visit could be defined as inappropriate if patients with low emergency triage code (green or white) at ED admission were discharged to home or left the ED before or during medical examination [21]. In our study 74 % of older patients admitted to ED were discharged to home, and only 21 % were hospitalized. As expected, the rate of hospitalization increased with advancing age (22 % for those aged 75–84 and 30 % for those aged 85 or older) and level of emergency (yellow and red triage codes—47.9 %).

Previous studies have analyzed geographical differences in ED use by older adults in North Carolina [23] and spatial patterns of epilepsy-related ED visit in California [24], but none compared the ED visit of older people at district level using spatial analysis. In our analyses, spatial autocorrelation in the distribution of prevalence of ED visits has been shown for those people with only 1 ED visit (group 1) and for those with 2–3 ED visits (group 2) in the year. Overall and in the two aforementioned groups, a large cluster of high prevalence of ED visits emerged in almost the entire LHU of Brescia and a cluster of low prevalence in the LHUs of Milano, Monza e Brianza, Lecco and some nearby areas. This distribution doesn't seem to be explained by the health status or by demographic characteristics of the older living in these areas, neither by GPs workload or the presence of ED next to patient's place of residence. In fact we corrected the model for sex, classes of age, health district of residence, the GPs workload and location of the ED within 10 km from the patient's place of residence and performed the analyses stratifying by the three groups. Perhaps the differences in ED visits' prevalence could be explained by different patients' attitude for occasional use of ED or could be the result of differences in primary health care system in the territory. In our previous study [8] on geographical distribution of older people with chronic polypharmacy, we found similar results: clusters of low prevalence rates were found in the north-west part of the region, while high prevalence rates were more common in the eastern area. In the same work geographical differences could only partly explained by the distribution of the epidemiology of diseases and patients' health, confirming a possible different attitude of GP on prescribing and managing this complex population. So that, taking together, the results of our studies could make emerge both a different attitude of older patients for the use of ED and consumption of drugs, but also a different attitude of GP for the managing of older patients on the territory.

Some limitations of this analysis must be highlighted. First, the administrative database of the region does not

collect data on clinical variables. However, the number of hospitalizations and of prescribed drugs was considered as a proxy of multimorbidity [25]. Second, the study is limited to the observation of a single Italian region and our results cannot be generalized. Certainly further studies should be performed to investigate whether geographical differences exist in the distribution and prevalence of ED visits among different regions.

In conclusions, older patients present many variables associated with an increased risk of ED multiple visits. The majority of the ED visits were done for medical conditions evaluated as not urgent and significant geographic differences in ED visits prevalence were observed for occasional users. As the number of older people along with their request for ED care continues to grow, targeted interventions to appropriately manage older patients with multimorbidity in ED are badly needed. An ED tailored to meet the complex needs of older people providing professional staff educated to the medical needs of the aging population would result in better quality of care, improvement of ED organization and cost reduction for NHS. Further research to analyze appropriate use of ED in this population should be done.

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Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Statement of human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study formal consent is not required.

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