Demographic change and future sustainability of emergency departments: a pilot study for Liguria

I mutamenti demografici e la sostenibilità del pronto soccorso: un studio pilota per la Liguria

Paolo Cremonesi, Enrico di Bella, Lucia Leporatti, Luca Persico[1]

Abstract.
The progressive ageing of the population, together with increasing migration flows from non western countries are significantly changing the shape of the population pyramid in Italy. In this paper we estimate how these phenomena will impact on the future sustainability of Accident and Emergency Departments (AEDs) in Liguria, providing a forecasting of the total AED expenditure for the next decades (2012-2065). Results show that the increase in the number of foreign residents will be the most relevant determinant of the raise in AED accesses and expenditure, boosting expenditure and increasing the problems of overcrowding, waiting times and inappropriate use of AEDs.

Abstract
Il progressivo invecchiamento della popolazione, unito ai massicci flussi migratori dai paesi emergenti stanno notevolmente cambiando la forma della piramide demografica in Italia. Obiettivo di questo lavoro è quello di stimare l'impatto di questi fenomeni sulla sostenibilità del pronto soccorso, fornendo delle previsioni per la spesa in pronto soccorso per i prossimi decenni (2012-2065). I risultati mostrano che l'aumento della popolazione residente straniera determinerà il maggior incremento negli accessi e nella spesa in pronto soccorso, amplificando la spesa e aumentando i disagi dovuti al sovraffollamento, ai tempi di attesa e all'utilizzo improprio del PS.

Key words: demographic change, health care system sustainability, health care costs, inappropriate accesses.

Commento [M1]: L'abstract in italiano non corrisponde a quello in inglese e può essere migliorato

Commento [M2]: Meglio l'inglese. Non sono solo dai paesi emergenti

Formattato: Evidenziato

Formattato: Evidenziato

---

[1] Paolo Cremonesi, E.O. Galliera, Genoa, Italy; email: paolo.cremonesi@galliera.it
Enrico di Bella, University of Genoa; email: edibella@economia.unige.it
Lucia Leporatti, University of Genoa; email: lucia.leporatti@unige.it
Luca Persico, University of Genoa; email: persico@economia.unige.it

The authors would like to thank E.O. Ospedali Galliera and Municipality of Genoa for the precious cooperation in providing the data.

1. Introduction and Literacy Background

In western countries, the structure of the population is significantly changing. On one side the increase in life expectancy is leading to a progressive ageing of the population, while on the other side, as a consequence of increasing migration flows, the number of foreign people living and spending their old age in the host country is rising. This pattern is affecting the provision of several public services and, among them, the Accidents and Emergency Departments (AEDs), which should be adequately sized on the new needs [5]. In the last decades, the utilization of AED services has grown as, today, AEDs are used not only for acute emergency care but also to provide minimum services to indigent patients and, in general, to provide 24-hour accessible primary health care [7]. Unfortunately, this availability of health care services brought some patients to the improper use of AEDs for ordinary health care and, therefore, to an increase in the number of inappropriate accesses to AEDs. In order to properly manage emergency situations, patients that ask for assistance at AEDs are classified at acceptance according to their severity level which is syntetized by a color *triage coding* (white, green, yellow and red from the least to the most urgent level). Each triage code, in conjunction with the demographic characteristics of patients, can be considered a proxy for the assistance cost of each patient. Red and yellow codes are generally assumed to be more expensive than green and white codes, at least considering the time that the personnel (the main cost component for AEDs) dedicate to the patients [3]. But for general morbidity problems, older people tend to be classified as red triage code more often than younger, due to the fact that their overall health status is worse. On the other side, younger individuals accessing AED with red triage are often victims of accidents (e.g. traffic crashes) and they probably need more expensive medical investigations and assistance. It is thus evident that both demographic characteristics and triage code affect the cost of AED accesses. Therefore, the evolution of the structure of the population as a consequence to changes in the demographic pattern will significantly modify the composition of patients that will ask for emergency assistance and, consequently, the future AED expenditure. However, the increase in the number of services provided by AEDs in recent years, has not gone hand in hand with an increase in facilities and staff members. Thus, the issue of efficient management of AED departments has become particularly relevant with the explosion of the problems of over-crowding, high frequency and inappropriate use of AED.
The vast majority of previous researches on the future sustainability of AEDs focus the attention on ageing. Indeed, in western countries the improvement in living conditions and the progress in medicine brought to an increase in the number of people aged more than 65. It has been shown [8] that elderly people consume the largest part of resources devoted to AED in terms of absolute number of visits, length of staying and cost for each visit (time and resources). Older patients tend also to have higher levels of emergency (yellow or red triage code) and more serious medical conditions as they often have multiple comorbilities and a worse general health status. This means that, as the number of elderly people will rise due to the increase in life expectancy, the number of accesses and the associated cost will

boost. However, age is not the unique demographic driver of health care demand. Some authors highlight the importance of gender differences in the use of AED: different studies show conflicting results but the majority of the researches demonstrate that women tend to use AED services more than men [5] due to the fact that they live longer and that during their reproductive age they need emergency services for childbirths [6]. It is thus evident that the decline in birth rates and the higher increase in life expectancy for women will impact on expected expenditure and accesses to AED. Lastly, ethnicity and nationality can have a role in use of AED services. Several authors [2] claim that immigrants tend to use more emergency services than native-born people due to the fact that they use AED as a source of primary care rather than a source of emergency services because they have no accesses to specialized visits or because they have a scarce knowledge about the healthcare system of the host country. If this is the case, as the number of help-seeking immigrants increases, the problem of inappropriate use of AED will become more serious in the future, changing the composition of patients by triage code.
In this work, generalizing the results obtained for one AED in Genoa and using the demographic projections of the population provided by the Italian Institute of Statistics (ISTAT), we estimate the future expenditure for AED for the period 2012-2065 in Liguria following a four steps approach: 1) we estimate an average cost for different categories of individuals split by demographic characteristics (i.e. age, gender, nationality) and triage code based on 2012 data relating one of the main AEDs in Genoa; 2) we estimate a probability of access to the AED for each of the aforesaid categories of individuals; 3) we project the costs and probabilities computed for 2012 to future years (2012-2065) using the residents forecasts provided by ISTAT to compute the expected number of accesses; 4) we estimate the corresponding future expenditure for the region.

2. Data and Methods

The datasets used for the analysis come from three different sources: the exhaustive AED registry of one of the main hospitals in Genoa (E.O. Ospedali Galliera[1]) which contains both medical and demographic information about the patients who accessed the AED in 2012 (49,969 accesses); the official regional AED fees which represent the standard cost associated to each visit or exams established by the Italian Ministry of Health (Law nr. 23/2013); residents forecasts (2012-2065) at regional level provided by ISTAT using a cohort component model (main scenario).
In order to obtain an estimation of the future expenditure for AED services we followed a widely used approach [4] dividing the analysis in four steps:

1) once standard costs, derived from the official regional AED fees, have been attributed to each patient, we computed the average costs of accessing the AED ($c_{g,a,n,tc}$) split by gender (g = males, females), 5 age groups (a = 15–24, 25–44, 45–64, 65–84, 85+), 2 nationality groups (n = Italian nationality, Foreign nationality) and 4 triage codes (tc = white, green, yellow, red) for a total of 80

[1] Note that the AED of E.O. Ospedali Galliera has a really small percentage of child patients because in Genoa there is an internationally relevant pediatric hospital, Ospedale Giannina Gaslini. Therefore the analyses herein discussed are all relative to adult patients.

average group costs.

2) we selected 14 urban areas of Genoa (from which 19,140 of the accesses came from) close enough to the Galliera AED and far enough from the other AEDs of the city to be defined as the catchment area of the AED and we estimated the access rates to the AED for each of the 80 categories of individuals as the ratio between the number of accesses per category of patients residing in the catchment area and the corresponding number of residents in the same area. As foreign people aged 85 or more split by gender and triage is composed by few cases we applied to this category the same access rates as Italian people: this is a conservative assumption as access rates for foreign are usually higher than the corresponding rates for Italian;

3) we estimated the number of adult accesses ($A^*_{g,a,n,tc,t}$) for each year (t) between 2012 and 2065 multiplying the access rates derived in step 2 by the number of adult residents in Liguria for the next 50 years ($Y^*_{g,a,n,t}$) per each group of individuals using the ISTAT forecasts;

4) finally, we estimated the future AED expenditure split by group ($E^*_{g,a,n,tc,t}$) multiplying the average per capita cost computed in step one ($c_{g,a,n,tc}$) by the estimated number of patients in each group in future years ($A^*_{g,a,n,tc,t}$):

$$E^*_{g,a,n,tc,t} = c_{g,a,n,tc} * A^*_{g,a,n,tc,t} \quad (1)$$

The estimated expenditure is thus computed using values fixed to the base year (2012). The projections of future health care expenditure are based on restrictive assumptions, previously introduced by [1]: the consumption for emergency services remain constant over time within each age, gender and nationality group, so that the future demand for health care services only depends on population size of each category while all the other factors (e.g. incidence of sickness and injury, consumption pattern among groups) remain constant. In addition, the average per capita expenditure within each group is assumed to be constant over time, and thus to be independent of the technological and medical progress.

4. Results and discussion

To correctly interpret the results, it is necessary to preliminary analyze the population forecasts by ISTAT following the main scenario. Due to a contraction in birth rates, the total number of residents in Liguria will decrease by 6.89% over 50 years and people aged more than 65 and having foreign nationality will increase respectively by 12.71% and 209.67% (Table 1). Results show that, due to changes in the demographic pattern, overall, the number of accesses and the total expenditure will increase respectively by 26% and 35%, suggesting that, the increase in the number of accesses is higher for more expensive individuals (e.g. older people). From Table 1 it is evident that population ageing and migration flows are the most relevant determinants of the increase in the number of accesses. Indeed, if we look at Italian people, the only group of patients for which expenditure will increase is the oldest one (people aged more then 85), with an increase of 101%, while for the other

categories accesses and total expenditure will decrease due to a contraction in the population. Conversely, if we look at the contribution of migration flows it is clear that patients of all age categories will increase. The Italian/foreign nationalities composition is given in Figure 1: the AED estimated cost for residents with foreign nationality will pass from the 9.5% in 2012 up to the 35.5% in 2065.

Heath care managers and policy makers are probably interested in how this increase will impact on the distribution of accesses by triage code: indeed, inappropriate use of AED is the cause of several economic (increase in expenditure) and logistic (overcrowding, congestion, waiting time) problems. Table 2 shows the evolution of accesses by triage code *ceteris paribus* between 2012 and 2065: according to our estimation, due to the demographic pattern, the number of inappropriate accesses to AED (white triage code) will increase by 37.5%. This will amplify the problem of efficient management of AEDs [7]: to avoid overcrowding and worsening in the quality of the services offered, AEDs facilities should be adapted to this pattern. In addition, congestion and waiting times should be addressed properly as they can become particularly serious problems with dramatic outcomes for vulnerable patients (such as elderly people). However, from Table 2 we can see that the increase in accesses is much higher for more urgent medical conditions (red triage code) (+66%) due to the progressive ageing of the population.

Table 1: Residents (Res), Accesses (Acc) and AED Expenditure (Exp) in years 2012 and 2065 per group of individuals.

		Age	15–24	25–44	45–64	65–84	85+	Tot
NATIONALITY	ITALIAN	Res 2012	114,010	337,403	436,557	364,719	67,308	1,319,997
		Res 2065	93,208	213,407	269,318	266,547	134,495	976,975
		%Var	-18%	-37%	-38%	-27%	100%	-26%
		Acc 12	15,746	43,878	48,845	66,574	29,206	204,249
		Acc 65	12,870	27,788	30,112	48,885	59,084	178,740
		%Var	-18%	-37%	-38%	-27%	102%	-12%
		Exp 12	1,048,221	2,803,937	4,022,307	7,607,787	4,013,475	19,495,727
		Exp 65	856,301	1,773,844	2,479,044	5,590,998	8,064,371	18,764,558
		%Var	-18%	-37%	-38%	-27%	101%	-4%
	FOREIGN	Res 12	17,807	59,629	28,393	4,540	311	110,680
		Res 65	44,505	110,428	96,450	70,164	21,193	342,740
		%Var	150%	85%	240%	1445%	6714%	210%
		Acc 12	4,149	16,075	6,670	2,920	136.3579	29,952
		Acc 65	10,265	29,532	23,037	45,396	9,292	117,522
		%Var	147%	84%	245%	1454%	6714%	292%
		Exp 12	240,796	979,913	488,889	319,912	18,401	2,047,911
		Exp 65	597,526	1,804,924	1,680,967	4,973,756	1,253,902	10,311,075
		%Var	148%	84%	244%	1455%	6714%	403%

Commento [M3]: Mettere anno per esteso altrimenti non si capisce nulla

The last column of Table 2 shows how the ratio between the expenditure for more severe medical condition (yellow + red triage) and less severe medical condition (white + green triage) will evolve: this ratio can be considered a good indicator of rate of appropriate use of AED. The ratio increases over time (from 0.95 in 2012 to 1.13 in 2065) meaning that the weight of inappropriate use of AED will, at least nominally, decrease in the future.

Figure 1: Expenditure by nationality group in selected years in the interval 2012-2065 (values in thousands of euros).

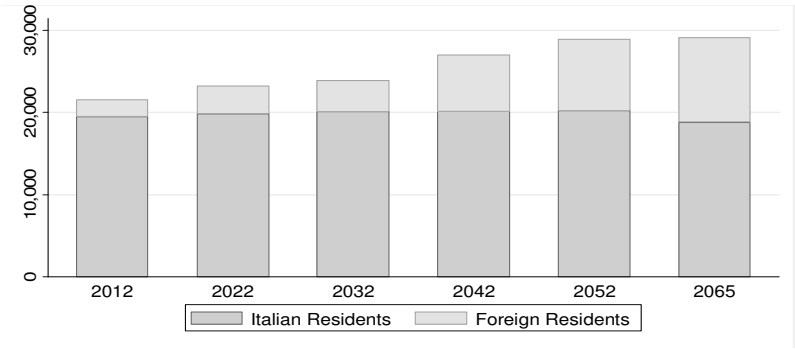

Table 2: Number of accesses by triage code and percentage of the total number of accesses

Year	White	Green	Yellow	Red	$\frac{Exp\ (Y+R)}{Exp\ (W+G)}$
2012	14,854 (6%)	148,361 (63%)	62,875 (27%)	8.110 (3%)	0.95
2065	20,425 (7%)	175,035 (59%)	87,349 (30%)	13,453 (5%)	1.13
%Var (12-65)	37.50%	17.98%	38.92%	65.89%	

We are aware that this study has some limitations (first of all the extension of the results of step 2 to the whole regional adult population) but future research will be focused on collecting AEDs accesses data from the other hospitals of the city or, possibly, of the whole region to (partly) overtake the problem of the catchment area.

References

1. Abel-Smith B., Titmuss R.: The Cost of the National Health Service in England and Wales. Cambridge: Cambridge University Press (1956).
2. Cots, F., Castells, X., García, O., Riu, M., Felipe, A., & Vall, O: Impact of immigration on the cost of emergency visits in Barcelona (Spain). BMC Health Services Research, 7:9. (2007).
3. di Bella E., Montefiori M., Cremonesi P.: Cost analysis of emergency department, Journal
4. of Preventive Medicine and Hygene , 51:157-163 (2010)
5. Gray A. (2005) Population Ageing and Healthcare Expenditure. Ageing Horizons (2):15-20.
6. LaCalle E.J., Rabin E.J., Genes N.G.: High Frequency Users of Emergency Department Car, J Emerg Med 44 (6) (2013).
7. Macintyre S., Hunt K., Sweeting H.: Gender differences in health: are things really as simple as they seem? Soc Sci Med 42:617-24 (1996).
8. Moskop J. C., Sklar D. P.,Geiderman J.M., Schears R.M., Bookman K.J.: Emergency Department Crowding, Part 1: Concept, Causes, and Moral Consequences. Ann Emerg Med 121(4): 718-730 (2008).
9. Samaras N., Chevalley T., Samaras D., Gold G.: Older Patients in the Emergency Department: A Review, American College of Emergency Physicians (2010).