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Suspected acute allergic reactions: analysis of admissions to the Emergency Department of the AOU Maggiore della Carità Hospital in Novara from 2003 to 2007

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Key words

Emergency Department, acute allergic reaction, anaphylaxis, medical admission, triage code

Summary

Objective of the Study: *The aim of our work is to ascertain the frequency and the impact of acute allergic reactions on the routine of a highly-specialized Emergency Department collecting information on the admission, the typology of symptoms and the degree of severity calculating the incidence and the outcomes of the events.* ***Materials and methods:*** *The study started the 1 July 2006 and the records of the Emergency Department of the Maggiore della Carità Hospital in Novara were consulted retrospectively in the period between the 1 January 2003 and the 31 December 2006, and prospectively up to the 31 December 2007, using keywords that could identify admission for suspected allergic reactions. Information relating to internal medicine and/or pediatric cases were examined, excluding all surgical and/or trauma cases. The number of admissions per year was considered broken down by clinical signs, triage assessment upon admission and discharge outcome.* ***Results:*** *Admissions to the Emergency Department during the period under consideration were 165,120 with 6,107 suspected cases of allergic reactions. The symptoms most frequently reported both in adults (A) and children (C ≤18 years old), were: hives 37%, asthma 20.65 (A)% and 27,4% (C); drug allergy 7.5% (A) and 6,1% (C). Reactions to Hymenoptera venom were less frequent, 4.7% (A) and 1.27% (C); the frequency of angioedema, conjunctivitis and rhinitis was between 1 and 4%. The incidence of food allergies (1.4%) and anaphylaxis (0.8%) was comparable for all ages. The triage assessment showed a significant percentage of "yellow" and "red" codes, with 362 cases (5.9%) and 71 cases (1.16%) respectively. A total of 151 patients was hospitalized, no one classified as "white" code. Death occurred in 7 cases: 4 "yellow" codes and 3 "red" codes, respectively. A more detailed specialistic evaluation was recommended in only 10% of the patients.* ***Conclusions:*** *Admissions to the Emergency Department for suspected allergic reaction are proportional to the number of overall admissions for internal medicine cases and do not appear to be related to the general increase of allergies in the population. This led us to focus our attention on how allergic diseases impact the work of an Emergency*

Department and how to describe the discharge diagnosis better. A significant number of descriptive diagnoses also turned out to be inaccurate and did not allow the syndrome to be identified properly. The analysis of this information aims to be a stimulus to improve the emergency clinical approach used for allergic diseases and to plan the adequate management of allergic patients after they have been treated in hospital.

Foreword

The increased frequency of allergic diseases in the general population is shown in epidemiological studies conducted by the international scientific community.
In industrialized countries, about 20-25% of the population has respiratory tract symptoms and the incidence of these allergic syndromes in European countries (United Kingdom, Germany, Switzerland, Finland) ranges between 22 and 35% (1-3). The incidence in western countries appears higher in the 18-34 age group and in the 35-49 age group, with a reduction in the number of cases after 50 years of age (4).
The number of cases of asthma has changed over the years: from 10% estimated in the USA in the 90s to more than 15% in California alone (5,6).
Italian incidence of respiratory allergies shows a high heterogeneity: in a study conducted in Liguria, the estimated incidence of allergic rhinitis ranges between 1.54% in 1983 and 2.2% in 1995 (7); for asthma, the estimated incidence in Italy was about 3.3-5.5% in the 80s, while more recent figures show an incidence between 4% to 7% (8,9).
An Italian study on asthma (10) shows a 9.5% incidence of asthma in children aged 6 years old, and 10.4% in adolescents aged 13-14 years old. The incidence of rhinitis in children aged 6 is 9%, and in adolescents aged 13-14 is 17.2%, and for eczema it is 17% in children aged 6 and 12.8% in adolescents.
Although people who claim to suffer from food-related adverse events is approximately 20% of the population in Europe (11), the true incidence of food allergies is 2-4% of the adult population and approximately 5% of children (12,13). The frequency of allergic reactions to food additives does not exceed 0.5% of cases (12,13).
Epidemiological findings on reactions to drugs are still uncertain. However, only more rarely the reactions are unexpected and potentially severe (14,15). Unforeseeable reactions, whether allergic or pseudo allergic, account for no more than 5-10% of the total amount.
Allergic symptoms are mainly mild/moderate and are usually treated in specialist practices, rarely the severity of the symptoms requires intensive care (16,1,). Two syndromes are particularly dangerous: persistent severe asthma and anaphylaxis, since they can cause the patient's death in a few minutes (18-22).
Furthermore, after the acute phase has been treated, patients with the most severe symptoms, who have perhaps been treated in the Intensive Care Unit, are not always sufficiently made aware of the need to refer to specialist allergy centers for follow-up treatment (23,24).
On the other hand the American Academy of Allergy Asthma & Immunology recommends referring all patients to an allergist, especially children, for an in-depth diagnostic-therapeutic classification (25).
The aim of our work is to ascertain the frequency and resulting impact of acute allergic reactions on the routine of a highly-specialized Emergency Department collecting information on admission, typology of symptoms, the degree of severity, calculating the incidence and the outcomes of the events.
The analysis of this information aims to be a stimulus to improve the emergency clinical approach used for allergic diseases and to plan the adequate management of allergic patients after they have been treated in hospital.

Materials and methods

The study started at 1 July 2006 examines retrospectively the discharge records of the Emergency Department (E.D.) at the Azienda Ospedaliera - Universitaria "Maggiore della Carità" Hospital in Novara, (city of Piedmont Region in northern Italy), up to 31 December 2006 and prospectively up to 31 December 2007, using either single "keywords" or in various associations in the Emergency Department discharge diagnosis: allergy, food allergy, anaphylaxis, angioedema, asthma, conjunctivitis, dermatitis, dyspnea, edema, insect sting–induced dermatitis, rash, Hymenoptera, hypotension, rhinoconjunctivitis, hives, reaction, shock.
The records were examined for each single year and for the entire period, considering two age groups, adults (>18 years (A)) and children (≤ 18 years(C)).

The target population was the patients admitted to the Emergency Department where their diagnoses were coded using the ICD9CM.
Admission to the various rooms is established under the triage assessment made by the nursing staff (Tab. 1).
The diagnoses and triage code assigned to the patients were assessed and compared to diagnoses and triage code assigned at the discharge. The patients were subsequently classified into: ordinary discharges, voluntary discharges (leaving against the physician's advice), discharges with urgent follow-up treatment in clinics, discharges after having been kept temporarily under observation, hospitalization after a short period under observation at the E.D. and death.
Confidence interval for prevalence rate was computed by Wilson and Newcombe methods (36), a graphical display was performed using simple correspondence analysis to study and visualize the link between triage code and discharge patients categories (37).

Table 1 – Nurse triage codes

Red code is assigned to patients with critical vital functions that are immediately life-threatening or that could severely damage a vital organ.	**Yellow** code is assigned to patients whose vital functions are unstable, whose conditions could deteriorate quickly and are potentially life-threatening or could severely damage a vital organ within minutes or in the following hours. This includes moderate to severe asthma and generalized, ingravescent hives-angioedema.	**Green** code is assigned to patients whose vital functions are stable and where the risk to their lives or damage to their vital organs within 6-12 hours is minimal. This includes mild-moderate bronchial asthma and skin reactions such as atopic eczema and acute hives without any signs of evolution.	**White** code is assigned to patients whose vital functions are stable, who suffer from chronic or mild diseases, where the risk to their lives or damage to their vital organs within 24 hours is minimal. This includes allergic diseases such as mild to moderate sudden-onset oculorhinitis and sub-acute or recurring hives.
dyspnea: (at rest) with spO_2 < 90% (in non-COPD patient), RR > 30 /min or cyanosis **cardio-circulatory abnormalities**: sweating or paleness (with HR < 50 bpm and > 170 bpm, systolic BP < 80 mmHg and > 200 mmHg) **skin and mucosal abnormalities**: cutaneous marbling and cyanosis **other problems**: breathing with RR < 12 acts/min, diagnostic ECG for AMI or VT **negative for**: hemorrhage, pain, traumas, neurological and psychic disorders	**dyspnea**: (at rest) with gasping or wheezing, difficult (wheezy) breathing, sweating or paleness, spO_2 < 90 (COPD), asthmatic, ischemic heart disease, BP > 180/120 mmHg, suspected allergic reaction **cardio-circulatory abnormalities**: sweating or paleness (with HR > 50 and < 60 bpm, systolic BP > 80 and < 90 mmHg and > 180 and < 200 mmHg), no sweating or paleness upon arrival at the E.D (with HR < 50 bpm and > 170 bpm, systolic BP < 80 mmHg and > 200 mmHg) **skin and mucosal abnormalities**: lip/tongue edema from suspected allergy, **negative for**: hemorrhage, pain, traumas, neurological and psychic disorders, other problems	**cardio-circulatory abnormalities**: sweating or paleness (with HR > 60 and < 120 bpm, systolic BP > 90 and < 180 mmHg), no sweating or paleness upon arrival at the E.D. (with HR > 50 and < 60 bpm and > 120 and < 170 bpm, systolic BP > 80 and < 90 mmHg and > 180 < 200 mmHg) **skin and mucosal abnormalities**: bilateral edema of the limbs (main reason for admission to the ED), periorbital or facial edema **negative for**: dyspnea (at rest), hemorrhage, pain, traumas, neurological and psychic disorders, other problems	**Rhinitis**: from mild to moderate **skin and mucosal abnormalities**: hives in the sub-acute phase **negative for**: dyspnea, cardio-circulatory abnormalities, neurological and psychic disorders, hemorrhage, pain, traumas, other problems

Results

The medical admissions during the period considered were 165,120, the suspected allergic reactions were 6,107 (3.7%), for a potential population of approximately around 250,000 inhabitants (5.87% of 4,256,451 inhabitants in Piedmont).
The admissions by a single patient for the same condition was counted only once. On average, 8 persons per year were treated for the same symptoms by the Emergency Department two or more times.
Table 2 is a list of admissions to the Emergency Department per year for suspected allergies in the various age groups, totally 71,25% are adults and 28,75% are children.
The table 2 shows a high variation of the numbers of cases of allergic diseases in pediatric patients and a subsequently variation of the percentage. Moreover, the data show a lower number of cases in 2005 than in the other years in pediatric; a lower number of admission in 2007 both in adults and in pediatric patients, and we can also observe a lower number of cases in pediatric.
However in the four years period the impact of suspected allergy is around 4% of the total admissions at ED.
The most frequently recurring allergic syndromes for each age group are shown in table 3: Hives, Asthma, Insect sting-induced dermatitis, General Allergy and Drug Allergy represent the 77,7% of the total allergic disease in adults and 87.5% in children.
In particular among children the insect sting-induced dermatitis is 14% of the total diagnoses, against 6.81% in the adults: this difference is statistically significant. This high prevalence lies mainly in the diagnosis performed in 2005.
In table 3 we can observe two different clusters of allergies that show a difference rate (between adult and children) statistically significant: the first cluster includes Hives, Asthma and Insect sting-induced dermatitis and shows a high prevalence in children, the second cluster includes Hymenoptera allergy, Angioedema and Solar Dermatitis and shows a high prevalence in adults. Less frequent causes for urgent treatment were reactions to hymenoptera venom, angioedema, conjunctivitis and rhinitis.
To understand how suspect allergy is managed in Emergency Department we have compared discharge types (Normal, Urgent specialist follow-up, After short observation, Voluntary, Hospitalization and Death) to triage code assigned at patient admission.
During the four years of observation we considered 6107 cases: Normal discharge in 5053 cases (82.8%), urgent specialist follow up in 12.1%, Voluntary discharge after short observation ranged from 1.1% to 1.4%, Hospitalization after ED 2.4% and Death at the ED 0.15%. White code occurred in 60.3%, Green code 32.6%, Yellow code 5.9% and Red code 1.2%.
The simultaneous analysis of the triage codes and patients discharge categories displayed in figure 1 shows three clusters of discharge type "Normal Discharge", "Discharge after observation or voluntary or specialist" and "Death or Hospitalization". This analysis allows the characterization of the three clusters: the Normal discharge is characterized by white triage code, the second cluster is mainly characterized by Green and Yellow codes and the third is characterized by Red and Yellow codes.
The Normal discharged patients present the less severe

Table 2 - Admission to the ED for year

Year	Adult			95% CI		Pediatric			95% CI		Total			95% CI	
	a	n	%	LL	UL	a	n	%	LL	UL	a	n	%	LL	UL
2003	832	22657	3.67%	3.43%	3.92%	481	7173	6.71%	6.13%	7.28%	1313	29830	4.40%	4.17%	4.63%
2004	767	25398	3.02%	2.81%	3.23%	580	10212	5.68%	5.23%	6.13%	1347	35610	3.78%	3.58%	3.98%
2005	724	27505	2.63%	2.44%	2.82%	274	11541	2.37%	2.10%	2.65%	998	39046	2.56%	2.40%	2.71%
2006	869	28310	3.07%	2.87%	3.27%	629	12994	4.84%	4.47%	5.21%	1498	41304	3.63%	3.45%	3.81%
2007	904	18961	4.77%	4.46%	5.07%	47	369	12.74%	9.34%	16.14%	951	19330	4.92%	4.61%	5.22%
Total	4096	122831	3.33%	3.23%	3.44%	2011	42289	4.76%	4.55%	4.96%	6107	165120	3.70%	3.61%	3.79%

(a): suspected allergic diseases
(n): number of emergency admissions
(%) percentage is compute on total admission per emergency (Medical or Pediatric respectively) and year of study
CI: Confidence Interval; LL: Lower confidence Limit, UL: Upper confidence Limit

Table 3 - Allergic syndromes 2003-2007

	Adults	%	rate x 1000	LL	UL	Children	%	rate x 1000	LL	UL	Delta	LL	UL	sign
Hives	1384	33.79%	11.27	10.69	11.87	712	35.41%	16.84	15.65	18.11	-5.57	-6.96	-4.24	*
Asthma	883	21.56%	7.19	6.73	7.68	547	27.20%	12.93	11.90	14.06	-5.75	-6.96	-4.60	*
Entomodermatosis	279	6.81%	2.27	2.02	2.55	288	14.32%	6.81	6.07	7.64	-4.54	-5.41	-3.75	*
General allergy	330	8.06%	2.69	2.41	2.99	92	4.57%	2.18	1.77	2.67	0.51	-0.05	1.02	
Drug allergy	305	7.45%	2.48	2.22	2.78	120	5.97%	2.84	2.37	3.39	-0.35	-0.97	0.19	
Conjunctivitis	160	3.91%	1.30	1.12	1.52	64	3.18%	1.51	1.19	1.93	-0.21	-0.67	0.18	
Hymenopter allergy	171	4.17%	1.39	1.20	1.62	25	1.24%	0.59	0.40	0.87	0.80	0.46	1.10	*
Angioedema	196	4.79%	1.60	1.39	1.84	45	2.24%	1.06	0.80	1.42	0.53	0.12	0.89	*
Dermatitis (CD +eczema)	193	4.71%	1.57	1.36	1.81	60	2.98%	1.42	1.10	1.83	0.15	-0.30	0.55	
Food allergy	62	1.51%	0.50	0.39	0.65	24	1.19%	0.57	0.38	0.84	-0.06	-0.36	0.17	
Rhinoconjunctivitis	70	1.71%	0.57	0.45	0.72	18	0.90%	0.43	0.27	0.67	0.14	-0.13	0.36	
Shock	31	0.76%	0.25	0.18	0.36	16	0.80%	0.38	0.23	0.61	-0.13	-0.37	0.05	
Solar dermatitis	32	0.78%	0.26	0.18	0.37	0	0.00%	0.00	0.00	0.09	0.26	0.14	0.37	*
Total	4096					2011								
Total: Admission 2003-2007	122831					42289								

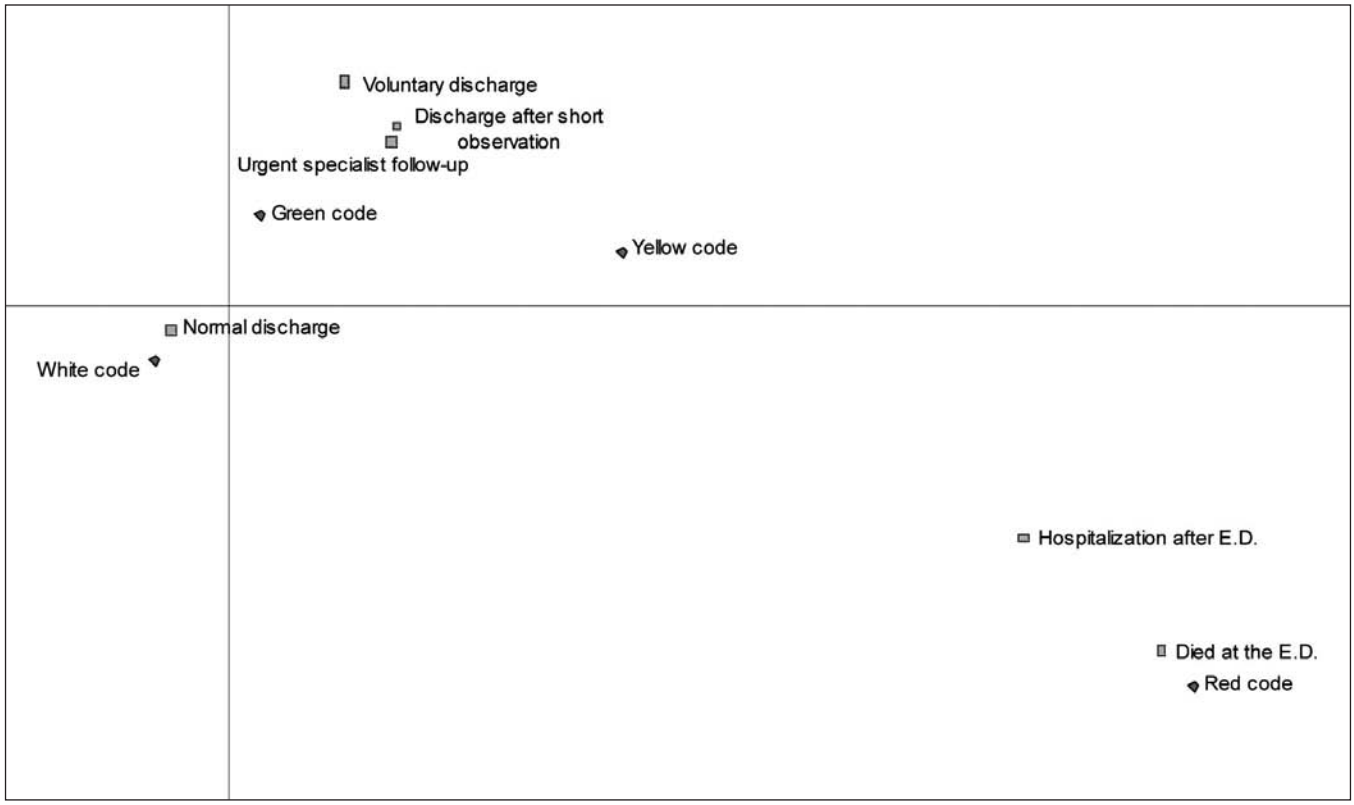
(%): percentage is computed using as denominator total allergies; (rate x 1000): is computed using as denominator total admission 2003-2007; (CD) : contact dermatitis; (rd): rate difference between Adult and Children; (95% CI): 95% Confidence Interval; (LL): Low confidence Limit: (UL): Upper confidence Limit: (Sign.): rd statistical significant at 5% level

codes: 3602 "white" codes, 1361 "green" codes, 90 "yellow" codes and no "red" codes.
The Voluntary discharges against the physician's opinion present mainly mild severe codes (2 white codes, 58 Green codes and 11 Yellow codes and no Red codes).
The Discharges with referral to a specialist practice present mainly mild severe codes: 79 White codes, 482 green codes, 163 Yellow codes and 13 Red codes.
The Discharges after a short period of observation present no White codes, 73 Green codes, 11 Yellow codes and 4 Red codes.
The Hospitalization after ED presents 0 White codes, 17 Green Codes, 83 Yellow codes 51 Red codes. Death at the ED were 0 White code, 0 Green codes, 4 Yellow codes and 3 Red codes. Four adults died at the E.D for anaphylaxis, 2 "yellow" codes and 2 "red" codes.
Exacerbated bronchial asthma led to the death of 2 people, 1 adult and 1 child, while the death of one child, who was a "yellow" code at the admission as insect sting-induced dermatitis, was probably a case of anaphylaxis from a hymenopter sting.
These data endorse a little evidence on the appropriate management of the suspected allergic diseases at the ED.

Discussion

The impact of the cases of suspected allergy represents an amount not so indifferent on the total amount of the admissions at the E. D.
The number of admissions to the Emergency Department for suspected allergic diseases varied between 2.6% and 4.9% (media 3.7%) of the total during the years considered.
Therefore no higher incidence of acute onset of "allergic reactions" was reported, despite the increase in allergic diseases among the general population (4,7,10).
This could be the result of the role of prevention, and the diagnostic and therapeutic work performed by the Regional Hospital Network for Allergic Diseases, a computerized and well-established network in the territory (24).
The data of the E.D. are important really for their role of access to the sanitary services. In addition, the nature - not so serious - of the cases let them get away from the epidemiological monitoring, even in the presence of an informative web/network of allergology.
In fact less then 20% of the patients examined and treated at the E.D. (542 cases) were given a written referral for

Figure 1 – Simple Correspondence Analysis performs a simultaneous plot of the triage codes and patients discharge categories. The quality of representation is 99%, the graph shows three clusters of patient discharge, "Normal Discharge", "Discharge after observation or voluntary or specialist" and "Death or Hospitalization". The first cluster is characterized by white triage code, the second cluster is mainly characterized by green and yellow codes and the last is characterized by red and yellow codes



specialist allergy assessment after being discharged. Only a small number of the patients, 172 patients, corresponding to about a third of those sent to a specialist, were registered in the database of the Piedmont Regional Hospital Network for Allergic Diseases by the specialist services at the Maggiore Hospital in Novara. Of these 34 were "yellow codes" and 3 were "red codes". During the period considered the most frequently recurring diagnoses for all the groups of patients were hives (34.3%) and asthma (23.4%), respectively; the great majority were mild cases. The number of "food allergy" cases is consistent: 2-3% of real, non-pollen related food allergies reported in the general population (12,13,27).

Our data show a probable under-estimation of the number of cases of anaphylaxis registered in Emergency Department while the number of deaths is higher than that expected by the various epidemiological studies (34,35). It is therefore presumed that some cases of anaphylaxis have not reached the hospital and that some sudden deaths in the territory have been attributed to other causes.

On the other hand 2 cases of anaphylaxis in 2007 were classified as "green code", one discharged as "voluntary discharge" and the other as "normal discharge".

An important fact is that "triage" screening by the nursing staff is not focused on coding allergic reactions, but because of staff awareness, an appropriate evaluation of severity was made in most of the cases treated.

The more severe cases were always properly coded: subjects who were "yellow" and "red" code required intensive care, either temporarily or during normal hospitalization. A total of 83/362 "yellow codes" and 51/71 "red codes" were hospitalized.

This is confirmed by the outcomes: most of "white code" and "green code" admissions were discharged after treatment (97,8% of the "white" code admissions and 68,3% of the "green" code admissions). However, the number of subjects who were referred to a specialist practice is too small compared to the need for making a proper diagno-

sis, which is vital to prevent subsequent relapses. In fact, the "white" code category had numerous diagnoses that deserved further investigation. Bronchial asthma is a chronic disease and even when assessed as being mild its evolution should not be overlooked (28). In the same way, hives tend to return and/or persist over time: cases of acute hives are often an expression of sensitivity to some allergen that can be avoided while exacerbated/chronic hives subjects, if not adequately treated, return several times to the E.D. for observation. Adverse reactions to drugs lead to a "label" being placed on the patient that influences the patient's behavior, the subsequent work of physicians and other health workers while the evolution of hymenoptera sting symptoms is not readily foreseeable without further investigations.

In the same way, a more detailed description of the diagnosis would be advisable in order to avoid the use of very general terms which could invalidate the collection of the epidemiological data needed to improve emergency hospital services.

In fact, by generically using the definitions "allergic reaction" or "insect sting-induced dermatitis" or "dermatitis" for a number of diagnoses which account for 18.5% of all admissions is impossible to understand really the overall impact of allergies on the work of an E.D. and, as a result, to quantify the resources that are required to deal with specific matters.

This information shows the need to improve the emergency clinical approach to allergic diseases and to plan the subsequent management of patients based on a medium and long term diagnosis/therapy. Especially for cases of anaphylaxis, it is essential to provide proper information on prevention and on how to deal with anaphylaxis and self-injectable epinephrine outside the hospital (28-30).

This can also be a source of useful information on how to improve the overall response to the health needs of allergic subjects, for example by comparing the data with that of other similar facilities in other areas, in order to determine how the presence of specialist centers can prevent/reduce suspected allergic acute events (11).

It would also be useful to create a greater sense of awareness among health workers when addressing patients to the appropriate specialists for the diagnosed disease, after receiving emergency treatment (26).

The epidemiological analysis of these cases is important because there is a link with the exposition of the environmental type.

The "acceptance" of the allergic subject allows the related cause – effect of the allergen/symptoms to be clarified and the set of information tools and therapies that can prevent and/or treat exacerbation to be prepared (25,32).

Dedicated it tools can now be used to print automatically information materials and guidelines for patients, by automatically linking the various print functions, keywords in the descriptive diagnosis and triage severity.

Emergency diagnosis and treatment can be performed by planning a standard in-house procedure to create more awareness of, and to train medical and non-medical staff.

The goal is to obtain a consistent diagnostic-therapeutic response by defining both the times and methods for hospital observation and by suggesting appropriate treatment at home and with priority access to specialist allergy centers.

It is just as important to provide users with information that is clear, logical and consistent with real clinical needs: often different departments of the same hospital give contradictory information.

The Emergency Department is currently a "brochure" that presents the hospital, and using the information on its activity to confirm that the system is working efficiently and to suggest further improvements is essential in guaranteeing that resources are put to the best scientific and clinical use.

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