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Allergy alerts in electronic health records for hospitalized patients

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ABSTRACT

Background: Electronic health records (EHRs) are used to register important health-related information, such as allergic conditions, and contribute to the safety and quality of medical care.
Objectives: To evaluate the use of allergy alert entries in EHRs and to establish the allergy profile of hospitalized patients.
Methods: Allergy data recorded in EHRs were analyzed in a cross-sectional, observational, descriptive study of patients admitted to the hospital from January 1 through June 30, 2011.
Results: A total of 15,534 patients were admitted to the hospital during the study period. The rate of inclusion of allergy information in the EHRs was 64.4%. In 2,106 patients an alert was activated to declare an allergy, intolerance, or any other type of adverse reaction. Drugs were the most common responsible agent (74.4%), followed by foods (12.6%) and materials (4.8%). Entries for drug allergy or intolerance were more common in females (64.8%) than males, with a significant statistical difference ($P < .01$), and increased proportionally with age. Entries for food allergy or intolerance were also more common in females (58.0%) than males ($P < .01$), but this trend was reversed in the 0- to 15-year-old age group. By contrast, the entries for food allergy or intolerance decreased proportionally with age. In 7,907 cases the EHRs revealed that patients were free of allergies, intolerances, or any other type of adverse reactions.
Conclusion: Drug allergy was the most frequently reported allergic condition, followed by foods and materials. Allergy alerts vary depending on age and sex. The proper use of a system for allergy alerts included in EHRs provides valuable information about hospitalized patients, contributing to the improvement of clinical practice.

Introduction

Allergic conditions are reported with increasing frequency in clinical practice.[1–5] Allergic reactions occurring during hospitalization may be prevented if data about allergy are known and properly recorded. The development of new information and communication technologies contributes to the safety of patients and quality of medical care.[6,7] Electronic health records (EHRs) provide the opportunity to register important health-related information, such as allergic conditions. Well-designed and easy-to-use applications should be provided to record this type of information, which is essential to prevent medical errors in clinical practice.[8–10]

Most reports regarding allergic conditions in the hospital setting refer to drug allergies. However, other conditions, such as food, latex, or other allergies and intolerances, have special relevance for hospitalized patients. Although in hospitals physicians and other health care professionals are trained to ask about drug and latex allergy, other allergies are frequently ignored. In addition, patients with complex medical conditions, such as coeliac disease, deafness, or chronic renal diseases, frequently have multiple drug or food restrictions, all appearing in EHRs as allergies. Moreover, the confusion between allergy and other types of adverse reactions is common.[11] This confusion brings additional difficulties in the estimation of the frequency and patterns of allergy in hospitalized patients. The aims of this study were to evaluate the use of allergy alerts in EHRs and to describe the frequency and patterns of allergic conditions in hospitalized patients.

Methods

We performed a cross-sectional, observational, descriptive study of patients admitted to the hospital from January 1 through June 30, 2011. Data were obtained from a new EHR program. The application allows registration of allergic status. Declaration of allergy, intolerance, or adverse reaction activates an alert before the use of any drug, food, or material (eg, latex, antiseptics, and

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bandages) during hospitalization. An absence of alert activation bars limitations. Allergy information was provided by patients and/or from preexisting medical records. This information was entered into the EHRs by the attending physicians.

Entries were classified according to the type of registration: absence or presence of allergy, intolerance, or adverse reaction; the responsible agent; and the patient's demographic data. Allergy or intolerance was activated in case of suspicion or after a well-established diagnosis. An adverse reaction was introduced in case of any abnormal reaction not suggestive of being a clear allergic reaction (such as penicillin or milk allergy) or an intolerance (such as in the case of lactose malabsorption or drug-induced dyskinesias). Allergies and intolerances were analyzed together because in many cases both concepts were used indistinctly (as in the case of nonsteroidal anti-inflammatory drugs and lactose intolerance).

The statistical analysis was performed using the R software package by the R Development Core Team.[12] The equality of distributions between the sexes was assessed with the Kolmogorov-Smirnov test, with $P < .05$ considered statistically significant. The median age of patients was assessed using the Mann-Whitney nonparametric test, and the cases of allergy by age for each group (by sex and type of allergy) were analyzed using gamma regression models.

Results

During the study period the total number of hospital admissions was 15,534, of which 54.7% were in females. The mean (SD) patient age was 43.8 (27.0) years (range, 0–103 years). Children (<15 years old) accounted for 21.2% of the sample.

The rate of allergy information included in the EHRs was 64.4% (Fig 1). In most cases, an absence of allergy or intolerance was indicated (74.7%), whereas in 2,050 patients the EHRs indicated the presence of allergy or intolerance to one or more agents. In 56 cases, another type of adverse reaction (0.5%) was registered.

In total 2,660 alerts for allergy or intolerance were analyzed, with 1,980 entries for drug allergy or intolerance (74.4%), 336 for food allergy or intolerance (12.6%), and 129 for allergy or intolerance to materials (4.8%). Table 1 lists the type of alerts and the responsible agents.

The demographic characteristics of patients differed, depending on the type of alert. The median age of patients with drug allergy or intolerance was 60 years, whereas patients with food allergy or intolerance had a mean age of 29.5 years ($P < .001$). Drug and food allergy or intolerance was more frequent in females (63.5% and 57.9%, respectively).

In some cases, the EHRs included more than one alert, and the number of alert activations per patient was different, depending on the type of alert. There were 1,980 alerts for drug allergy or intolerance in 1,594 patients (1.24 entries per patient), whereas in case of food allergy or intolerance there were 336 alerts in 252 patients (1.33 entries per patient) and 129 alerts for allergy or intolerance to materials in 119 patients (1.08 entries per patient). One hundred thirteen patients had 3 or more alerts, with a mean (SD) of 3.8 (2.7) alerts per patient. Forty patients fulfilled the diagnosis of multiple drug intolerance syndrome, with a mean (SD) of 3.52 (1.09) (range, 3–9) events per patient.

The analysis of the frequency of the alerts by sex and age showed that drug allergy or intolerance was more frequent in females (64.8%) compared with males ($P < .01$), and the frequency increased proportionally with age (Fig 2). Alerts for food allergy or intolerance were also more common in females (58.0%) compared with males ($P < .01$), but in children (0–15 years old) the rate was reversed (44.1% in girls and 55.9% in boys). Food allergy or intolerance entries decreased proportionally with age (Fig 2).

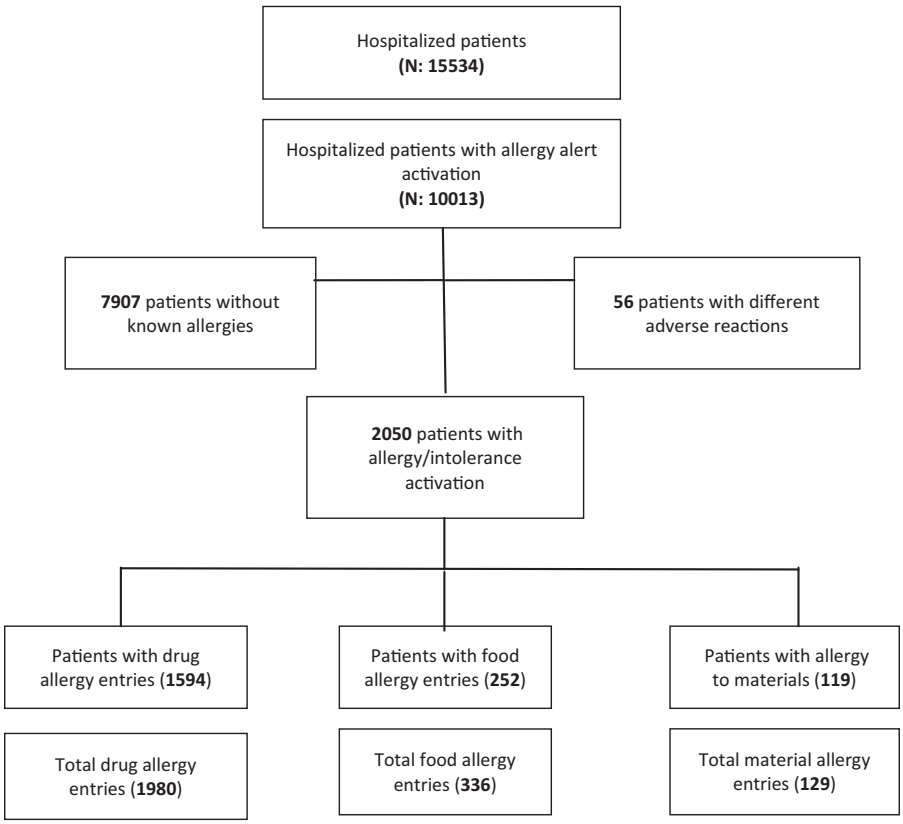

Fig. 1. Study population and stratification, depending on the types of allergy alerts.

Table 1
Types of allergy alert activation and causative agents

Allergy and intolerance	No. (%) of alerts
Drugs	1,980 (74.4)
Antibiotics	869 (43.9)
β-Lactams	606 (69.7)
Quinolones	62 (7.1)
Sulfonamides	56 (6.4)
Macrolides	35 (4.0)
Aminoglycosides	32 (3.7)
Tetracyclines	20 (2.3)
Other antibiotics	58 (6.7)
NSAIDs	605 (30.6)
Pyrazolones	262 (43.3)
Salicylates	165 (27.3)
Acetaminophen	33 (5.5)
Propionic acid derivatives	57 (9.4)
Acrylacetic acid derivatives	29 (4.8)
Oxicams	6 (1.0)
Coxibs	3 (0.5)
Fenamates	1 (0.2)
NSAIDs (as a group)	49 (8.1)
Opiates	65 (3.3)
Radio contrast media	63 (3.2)
Iodinated compounds	39 (2.0)
Antiemetics	35 (1.8)
Corticosteroids	25 (1.3)
Muscle relaxants	24 (1.3)
Antithrombotics	19 (1.0)
Anxiolytics	16 (0.8)
Antiepileptic drugs	15 (0.8)
Anesthetics	14 (0.7)
Calcium blockers	14 (0.7)
Antihistamines	10 (0.5)
Vitamins	11 (0.5)
ACE inhibitors	8 (0.4)
Mucolytics	8 (0.4)
Other	140 (7.1)
Foods	336 (12.6)
Milk	100 (29.8)
Fruits	75 (22.3)
Nuts	37 (11.0)
Shellfish	32 (9.5)
Cereals	20 (6.0)
Egg	19 (5.6)
Fish	18 (5.4)
Legumes	11 (3.3)
Other	24 (7.1)
Materials	129 (4.8)
Latex	55 (42.6)
Bandages	35 (27.1)
Metals	24 (18.6)
Silicone	2 (1.6)
Other	13 (10.1)
Other allergies	215 (8.1)
Pollen	66 (30.7)
Mite	66 (30.7)
Epithelia	22(10.2)
Alternaria	11 (5.1)
Insects	9 (4.2)
Pharmaceutical excipients	3 (1.4)
Other	38 (17.7)
No allergy	7,907 (74.7)
Adverse reaction	56 (0.5)
Total	10,623

Abbreviations: ACE, angiotensin-converting enzyme; NSAIDs, nonsteroidal anti-inflammatory drugs.

Discussion

Our study found a prevalence of allergy or intolerance of 13.2% in a population of hospitalized patients in a tertiary care hospital. Data obtained through the analysis of allergy or intolerance alerts from EHRs revealed different patterns, depending on the type of entry. In addition, we found age and sex variations in the frequency of alert activations.

In Spain the overall prevalence of allergy (including food, drug, venom, contact, and respiratory) has been estimated at 15% to 20% of the general population,[5] with a mean (SD) age of 24.8 (17.8) years. Drug allergy was reported in 14.7% of consultations at allergy clinics[13] and food allergy in 7.4%, with the latter peaking during the first 5 years of life and decreasing with age.[14]

The present study has been performed in a population of hospitalized patients; thus, its results cannot be extrapolated to the general population. Moreover, in the hospital setting, drug, latex, and food allergy are frequently recorded, whereas allergy to airborne allergens is occasionally registered.

There are few reports about the prevalence of drug allergy in hospitalized patients.[15,16] Most studies performed in the hospital setting refer to the incidence of new adverse reactions during hospitalization or drug adverse reactions as a reason for emergency department visits or hospital admissions. A meta-analysis from a hospitalized US population[17] found a prevalence of drug adverse reactions of 15.1%. In a French study drug allergy caused 6.5% of the emergency consultations and 6.1% of hospital admissions.[18]

We found drugs as the main cause for allergy or intolerance alert activation (15.9% of hospital admissions with allergy information included in the EHRs and 10.3% of patients). The most frequently reported groups were antibiotics and anti-inflammatory drugs. These two groups are the most common cause of drug-induced allergic reactions in the general population.[13,19–22] Among antibiotics, β-lactams were the most common agents (69.7%) and included immediate and nonimmediate hypersensitivity reactions. These results agree with those of other authors.[23] Commonly used antibiotics, such as quinolones, macrolides, or sulfonamides, were less frequently reported.

Drug allergy alerts were more common in women at all age intervals and increased progressively with age. A recent large study performed in a general population from the United States found that the overall incidence of self-reported antibiotic allergy was 15.3%. Women had higher rates of antibiotic allergy in every decade

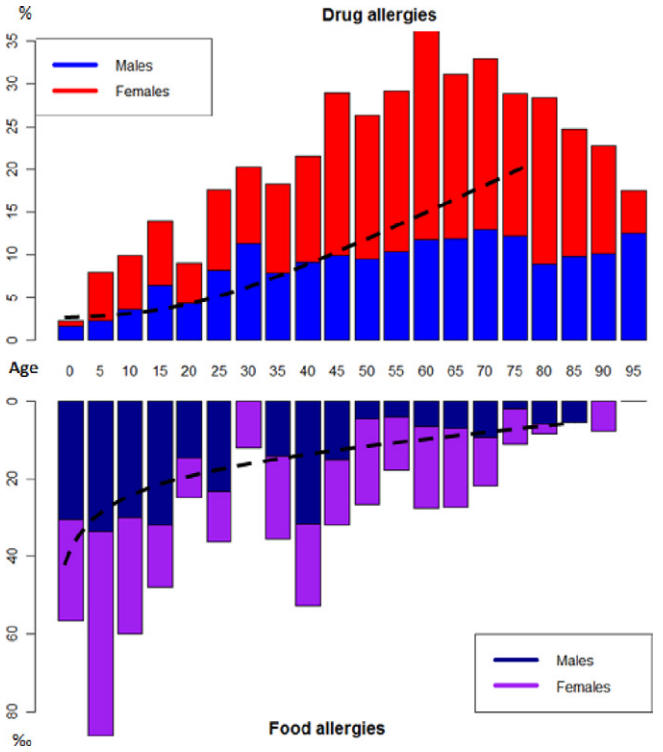

Fig. 2. Frequency of allergy and intolerance alert entries, depending on age and sex.

of life but the first decade, and increasing age had a significant correlation with antibiotic allergy prevalence.[19] This finding has been confirmed in a multicenter survey[20] performed in several Mediterranean countries. The authors hypothesized that the increased exposure to drugs and increasing age in addition to the differences in prescription patterns are responsible for this trend.

Multiple drug intolerance syndrome has been defined by the presence of 3 or more unrelated drug class allergies. Our results revealed a prevalence of 2.0% for this condition, similar to recent published data.[20,24]

Observational studies performed in the general population estimate a food allergy prevalence of 3.2% in France, 3.7% in Germany, and 7.6% in Spain,[14,25,26] and the rates seem to be increasing.[1,2,4] To our knowledge, there are no data regarding the prevalence of food allergy or intolerance in hospitalized patients.

In our study the overall frequency of food allergy was 2.5%, with higher rates in children (6.0%) and decreasing progressively with age. Milk and dairy products, fruits, and nuts were the main recorded causes. These data agree with previous observational studies in the general population.[14,27,28]

Patients considered as nonallergic were identified in the EHRs (7,907 patients, 51.5% of admissions). This information is important because it provides freedom in drug prescription, dietary orders, and the use of medical materials (eg, prosthesis, latex, and bandages) or diagnostic procedures. This issue is remarkably important in the emergency department or the operating room.

A possible limitation of this study is that the source of the allergic information in most cases is based on the information given by the patient and probably not always confirmed by a specialist. In addition, concepts of allergy, intolerance, or adverse reaction were not always properly used. Regarding the overall prevalence of allergy or intolerance in our study, it is worth noting that patients, when admitted to the hospital, are more frequently asked about drug than food allergy or intolerance. Consequently, we expect an overestimation of drug allergy or intolerance and an underestimation of food allergy, especially in adults. In any case, to prevent adverse events and improve safety in the hospital setting, alerts should always be activated in case of suspicion,[29] even if the information has not been confirmed.

The present study has demonstrated that the allergy alert is an underused resource (64.8%). The most likely reason is a lack of knowledge regarding drug, food, and material allergies. The analysis of the circumstances leading to the underuse of the allergy alert resource could provide important clues to generalize the inclusion of allergic information in the EHR.

The use of allergy alerts included in the EHRs allows for gathering and providing information about the prevalence of allergic conditions in hospitalized patients. Drugs are the agents more frequently reported followed by foods and materials. The type of allergy alert varies, depending on age and sex. The proper use of a complete and thorough system for allergy alerts provides important information about the hospitalized patient and contributes to the improvement of daily clinical practice.

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