

MONITORING CAUSTIC INJURIES FROM EMERGENCY DEPARTMENT DATABASES USING AUTOMATIC KEYWORD RECOGNITION SOFTWARE

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SUMMARY. In Italy the European Union Injury Database reports the involvement of chemical products in 0.9% of home and leisure accidents. The Emergency Department registry on domestic accidents in Italy and the Poison Control Centres record that 90% of cases of exposure to toxic substances occur in the home. It is not rare for the effects of chemical agents to be observed in hospitals, with a high potential risk of damage - the rate of this cause of hospital admission is double the domestic injury average. The aim of this study was to monitor the effects of injuries caused by caustic agents in Italy using automatic free-text recognition in Emergency Department medical databases. We created a Stata software program to automatically identify caustic or corrosive injury cases using an agent-specific list of keywords. We focused attention on the procedure's sensitivity and specificity. Ten hospitals in six regions of Italy participated in the study. The program identified 112 cases of injury by caustic or corrosive agents. Checking the cases by quality controls (based on manual reading of ED reports), we assessed 99 cases as true positive, i.e. 88.4% of the patients were automatically recognized by the software as being affected by caustic substances (99% CI: 80.6%-96.2%), that is to say 0.59% (99% CI: 0.45%-0.76%) of the whole sample of home injuries, a value almost three times as high as that expected ($p < 0.0001$) from European codified information. False positives were 11.6% of the recognized cases (99% CI: 5.1%-21.5%). Our automatic procedure for caustic agent identification proved to have excellent product recognition capacity with an acceptable level of excess sensitivity. Contrary to our *a priori* hypothesis, the automatic recognition system provided a level of identification of agents possessing caustic effects that was significantly much greater than was predictable on the basis of the values from current codifications reported in the European Database.

Keywords: caustic injury, caustic burns, automatic recognition software, emergency department surveillance

Introduction

According to the Injury Database (IDB) sample of hospitals, in the member states of the European Union the effects of chemical substances are involved in about 1% of cases treated in a hospital Emergency Department (ED) after domestic and leisure-time accidents, 0.2% being caused by chemical corrosion.^{1,2} Similarly, in Italy, in the IDB sample, chemical products are involved in 0.9% of the accidents.³ The cases of corrosion in the Italian IDB are caused mainly by chemical products (60.1%), followed by pharmaceutical products (4.2%), food (3.8%), and personal hygiene articles (2.9%). In 2005 the Italian IDB reg-

istry recorded 34,324 cases of home and leisure accidents in nine hospitals all over the nation. A simplified ED registry on domestic accidents in Italy (Sistema Informativo Nazionale sugli Infortuni in Ambienti di Civile Abitazione - SINIACA) recorded in a single year 45,323 individual injuries (in 28 hospitals), 0.5% of which were caused by toxic substances.⁴ These last cases show a proportion of hospital admission of 15% of ED-treated cases, a figure more than double the average admission rates for all domestic injuries. In the same period the Italian National Institute of Health's toxic exposure surveillance system observed, with regard to some 52,000 cases, that approximately 90% of such accidents occurred in the home, 44%

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of which involving children aged 0-4 years.⁵ It is therefore not unusual for the effect of chemical agents determining potentially severe damage to be observed in hospitals.

Intrinsically, caustic substances have the potential to be the most dangerous of all chemical agents. The aim of our study was to monitor caustic or corrosive injuries in Italy using ED medical information system databases and to obtain information in real time by automatically reading the detailed reports provided in natural language by ED personnel.

Materials and methods

We created a Stata software program to automatically identify caustic or corrosive injury cases. We used a Stata 9.0 application (StataCorp LP, Lakeway Drive College Station, Texas, USA). The purpose of the procedure was to recognize caustic or corrosive agents free text using an agent-specific list of keywords contained in a dedicated dictionary. In order to assess the capacity of recognition of this expert system we focused attention on the procedure's sensitivity and specificity.

Results

We checked the validity of the system by direct man-

ual quality control on free-text description for the selected cases and for all those codified as being due to the effects of chemical/thermic agents or poisoning. Ten hospitals in six regions participated in the study. The program identified 112 cases of injury by caustic or corrosive agents. Checking the cases by quality controls (based on manual reading of ED reports), we assessed 99 cases as true positive, i.e. 88.4% of the patients were automatically recognized by the software as being affected by caustic substances (99% CI: 80.6%-96.2%), that is to say 0.59% (99% CI: 0.45%-0.76%) of the whole sample of home injuries, a value almost three times as high as that expected ($p < 0.0001$) from European codified information. False positives accounted for 11.6% of the recognized cases (99% CI: 5.1%-21.5%).

Discussion and conclusion

Our automatic procedure of caustic agent identification proved to possess excellent agent recognition capacity, with an acceptable level of excess sensitivity. Contrary to our *a priori* hypothesis, automatic recognition provided a level of identification of agents possessing caustic effects that was significantly much greater than was predictable on the basis of the values from current codifications reported in the European Database.

MONITORAGE DES BLESSURES CAUSTIQUES ENREGISTRÉES DANS LES BASES DE DONNÉES DES SERVICES D'URGENCE MOYENNANT L'EMPLOI D'UN LOGICIEL AUTOMATIQUE POUR LA RECONNAISSANCE AUTOMATIQUE DES MOTS-CLÉS. RÉSUMÉ. En Italie, selon la Base de Données des blessures de l'Union Européenne, les produits chimiques sont impliqués dans 0,9% des accidents qui se produisent à la maison ou pendant les activités du temps libre. En outre, selon le registre italien des Services d'urgences pour ce qui concerne les accidents domestiques, y inclus les accidents enregistrés chez les Centres de Contrôle des Poisons, 90% des expositions toxiques surviennent à la maison. Dans les hôpitaux on peut observer avec une certaine fréquence les effets des agents chimiques, avec un risque potentiel élevé de graves dommages - la fréquence de cette cause de l'hospitalisation est deux fois celle des blessures causées par les autres accidents domestiques. Nous nous proposons dans cette étude d'examiner les effets des blessures causées par les agents caustiques en Italie en utilisant la reconnaissance automatique des textes libres dans les bases de données médicales des Services d'urgence. Nous avons créé un logiciel informatique Stata pour identifier automatiquement, avec l'aide d'une liste de mots-clés spécifiques pour ce type d'agent, tous les cas de blessures causées par les substances caustiques ou corrosives. Nous avons focalisé l'attention sur la sensibilité et la spécificité de la procédure. L'étude s'est déroulée dans dix hôpitaux dans six régions de l'Italie. Le programme a identifié 112 cas de blessures causées par des agents caustiques ou corrosifs. Les contrôles de qualité que nous avons effectués (basés sur la lecture manuelle des relations des Services d'Urgence) ont indiqué 99 cas comme de véritables cas positifs, ce qui signifie que 88,4% des patients ont été reconnus automatiquement par le programme logiciel comme atteints de substances caustiques (99% IC: 80,6%-96,2%), c'est-à-dire 0,59% (99% IC: 0,45 à 0,76%) de l'échantillon total de blessures domestiques, une valeur presque trois fois supérieure à la valeur attendue ($p < 0,000$) par rapport à l'information européenne codifiée. Les faux positifs ont constitué 11,6% des cas reconnus (99% IC: 5,1%-21,5%). Notre procédure automatique pour l'identification des agents caustiques a démontré une excellente capacité de reconnaissance des produits, avec un niveau acceptable de sensibilité excessive. Contrairement à notre hypothèse *a priori*, le système de reconnaissance automatique a fourni un niveau d'identification des agents susceptibles d'infliger des effets caustiques qui était significativement supérieur au niveau prévisible sur la base des valeurs contenues dans les codifications actuelles indiquées dans la Base de données Européenne.

Mots-clés: blessure caustique, brûlures caustiques, logiciel de reconnaissance automatique, surveillance des services d'urgence

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