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Vital Prognosis of Intoxicated Patients, Modeling by SVM, Evidence from Souss-Massa Daraa- Morocco

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Abstract

In Morocco, intoxication is a real public health problem with its frequency and severity. Between 1980 and 2007, over 77 000 cases are listed by the Moroccan Anti Poison Center (MAPC) as the highest number of deaths was observed in the Souss-Massa-Draa SMD area.

On the basis of a retrospective study, this is a database of all cases of intoxication recorded between 1992 and 2012 by the MAPC at the SMD level. We focus in this paper on the one hand, to study the epidemiology of intoxication, the evolution of health indicators, and to identify risk factors influencing the prognosis of intoxicated patients in SMD. On the other hand we adopt the classification approach by the SVM algorithm in order to classify the characteristics of two groups of patients evolution (Safe, Death) according to their vital prognosis. Both approaches are accomplished in order to provide the stakeholders of this sector, decision support tools that enable them to reduce the morbidity and mortality due to intoxication.

Keywords: Classification; Intoxication; Modeling; Risk factors; Forecasts; Safe-Death; Patient;

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1. Introduction

During the 1992-2012 study periods, 5792 intoxication cases were identified by the MAPC Moroccan Poison Center [14, 15, 16]. The province of Agadir has the highest number of cases of intoxication, with 43.5%. The average age of the victims was 23.0 (± 15.1) years with a sex ratio (M / F) of 0.9. Foods, drugs and gaseous products were, respectively, the first three types of most incriminated products. According to mortality, the highest number of deaths was recorded among addicts by industrial products, followed by animals and household products. Most intoxication was accidental, 75% and occurred at home in 79.1% of cases. The evolution of poisoned patients was favorable in 95.6% of cases, 4.4% of cases died (193 cases). The relative risk results show that, the cutaneous way, the criminal and suicidal circumstance, the type of isolated intoxication, the rural environment, the addicts coming from Agadir, the adults, the intoxicated by the industrial products and the animals are risk factors that are significantly associated with the progression of patients to death. The results of suicidal intoxication show that the number of the highest death was observed in poisoned by industrial products (53 deaths), followed by household products (15 deaths).

In addition, suicide attempts through the use of industrial products are 12 times more likely to progress to death compared to other addicts. The mortality and lethality rate of suicidal intoxications also decreased significantly between 1994 and 2012, with 55% and 44% of cases of death respectively being highly significant. The results show that SVM classification intoxicated by their vital prognosis was based on 16 parameters with a performance rate of 83%.

Between 1992 and 2012, 5792 cases of intoxication were collected, such as, the Toxic- vigilance system had collected 3958 cases and the Toxicological Information had recorded 1834 cases. This predominance can be explained by the fact that it is an old practice of the administrative staff of the medical delegations that has proved its worth.

According to our results, adults are more affected than other age groups. This is in line with the results of the literature [4, 5]. As shown in the bibliography, adults are often faced with deliberate intoxication for socio-economic reasons [4, 6, 7] However, several studies have indicated that adolescents are the most affected [17, 18]. In fact, there is a clear relationship between depression and attempted suicide during adolescence 8 and 9.

According to our results, the female sex is more affected than males (sex ratio = 0.2; $\chi2$ = 3.0). However, the highest case fatality rate was recorded in males (58%). The average age of the addicts was 26.5 (± 11.5) years. The extremes of age concern suicide attempts by the PPD were observed between 14 and 67 years. This is consistent with the results obtained by [5].

In most cases, the intoxication is orally, and for most studies, ingestion is done for the purpose of autolysis. In addition to its use for suicidal, criminal or even abortion, it is also used as a cure for pain by [17, 18], or against constipation but the use for autolytic purposes remains always predominant.

This study allowed us to draw first profile suicidal intoxication in the SMD area during the 20 years. Thus, the results [10] showed that the number of cases of suicidal intoxication and the case fatality rate in the study area are far from negligible. These data are important to consider in public health, especially in the area of environmental health and the field of occupational health. The majority of cases of suicidal intoxication are preventable, and in many cases, preventive measures are available. Detailed analyzes could possibly be carried out for each category of products, in order to better determine the epidemiological characteristics and the risk factors of each type of intoxication.

The approach used by [14, 15] gives a correlation structure, between the different variables using principal analysis comportment which generated principal axes, not too significant. Our approach by SVM based on optimization a model in order to have an objective decision making, and it is applied the first time in this type of study in Morocco. So the goal comes for minimizing the non-subjectivity of decision making that is often based on human experience.

Table 1. Distribution of intoxication according to the 16 regions of Morocco (1980-2007)

Area	Effective	Percentage %
Souss Massa Darâa	4764	6,2
Gharb-Chrarda-Béni Hssen	1981	2,6
Taza-Al Hoceima-Taounate	1805	2,3
Fes-Boulemane	2089	2,7
Doukala-Abda	3774	4,9
Guelmim-Es Semara	1637	2,1
Chaouia-Ouardigha	3243	4,2
Meknes-Tafilalt	6009	7,8
Rabat Salé-Zemmmour- Zaer	7384	6,9
Tadla- Azilal	8037	10,4
Tangier-Tétouan	6537	8,5
The eastern	7022	9,1
Marakhech-Tensift-Al Haouz	7818	10,1
Grand Casablanca	13516	17,5
Laayoune-Boujdour-Sakia El Hamra	1492	1,9
Oued ed Dahab-Laguira	17	0,0

23 % : Food　　　　　18% : Medication　　　　　13% : The gaseous product

Fig. 1. Distribution of cases of intoxication according to the type of toxic product in SMD area

Table 2. The case fatality rate due to intoxication according to the regions of Morocco

Area/ Period	Safe	Death	Specific lethality %
Total of all Moroccan regions (1980-2007)	51049	1203	2,4
SMD (1980-2008)	3360	186	5,4
Tadla-Azilal (1980-2008)	5579	91	1,6
Marrakech-Tensift-Alhaouz (1980-2008)	3442	65	1,8
Eastern (2007-2011)	1483	25	1,7
Fes-Boulemane (2007-2011)	1357	25	1,8
Tangier-Tetouan (1980-2008)	4136	67	1,6

Table 3: The evolution of patients and risk factors according to the environment, the regions of Morocco
S.L : specific lethality ; RR relative risk; HS : highly significant; VS : very significant; NS : not significant

Area	Urban			Rural			RR
	Safe	Deaths	L.S%	Safe	Death	L.S%	

SMD	1478	23	1,5	941	29	3,9	2,64 (HS)
Tangier-Tetouan	2013	31	0,01	455	9	0,01	1,2(NS)
Tadla-Azilal	1930	31	6	1366	14	16,3	3,13 (HS)
Marrakech-Tensift-Alhaouz	2175	34	7,7	636	10	8,2	1,7 (NS)
The eastern	3444	36	0,99	326	9	2,55	2,33 (TS)

In the following we study the prognostic problem by SVM approach [2, 3].

Nomenclature

SVM   Support vector Machine
MAPC   Moroccan Anti Poison Center
SMD   Sous Massa-Daraa

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2. The model

Currently, the latest trend in statistics is machine learning; with the goal is an identification of classes to which objects belong from certain descriptive parameters.
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.   It is indeed to extract a general rule from the observed data. The generated procedure should correctly classify sample examples and have good predictive power to properly classify new descriptions.
The methods used for classification are many, as: The Support Vector Machine SVM, the Neural Networks…. These methods have proved their effectiveness in many areas of applications, such as: image processing, medical diagnostics the categorization.
Under subjection, some parameters may be unnecessary who can skew the system, thus leading to decisions with high risk.
The goal is to generate a classification based on the conditions of patient's: Wait or not to wait for medical intervention or medical emergency.

3. Data processing

The database used it was from MAPC about intoxications in SMD area during   1992 and 2012, which   is composed of 5792 intoxicated patients which heavily contaminated by various toxic products

3.1. Variables and parameters studied

We are interested to the variables relate to following characteristics:
- Spacio-temporal: year, month, season, province…
- Patients: gender, age…
- Toxic: product or family of products…
- Intoxication: pathway of contamination, circumstance, circumstance, way of exposure…
  Clinical signs: symptomatology, number of signs, treatment.

3.2. The problem

In Our database we have recorded the tens of parameters that pose a problem for classification. In this regard, the question is: the classification of patients cured and deceased patients is it based on a single parameter or more?

- One parameter: gender ; age ; province ; pathway ; circumstance ; ….
- Tow parameters: gender + age ; gender + pathway; gender + province ; ….
- Three : gender + age + pathway ; gender+province+ way of exposure ; …
- and so on. …. (see the figure below)
  The criteria are based on formula (1):

$$\sum_{i=1}^{N_{Total}} 1_{\text{if(Model Decision}_i = \text{Reality}_i)} \Big/ N_{Total} \qquad (1)$$

Where N_{Total} is the total number of database records used to make the Back test, and the sum of these coefficients, divided by the total number of tests represents the process performance index.

Table 4: As example: the preference in this case is about 71,5%

Real results	Model Output	Attribution
Death	Death	1
Death	Safe	0
Death	Death	1
Safe	Safe	1
Death	Death	1
Death	Safe	0
Death	Death	1

The processing system chooses P parameters among N parameters as input (C_N^P possibilities) and it is assesses for each possibility the performance. In fact, our data base has been spread over two, a part of the learning (Back test), the other to testing where we have tested all possibilities in the system   which keeps the characteristics that giving the best performance. Our model use *P* variables in Back test database with a following criteria:

- 1 is attributed to the result given by the model when it is similar to reality
- 0 otherwise.

3.3. Simulation and Results

The SVM approach gives a combination or the parameters that give a classification of patients (safe, death) With an overall performance rate Figure 1 above presents the results of simulation. The classification of intoxicated patients (safe, death) , is based only on 16 parameters that were collected and stored in a historical of 5792 patients. We note that the performance of classification reaches its maximum for the 16 parameters, thus the others skew the classification. So the results of the simulation are identical with 10/12.

The model can detect the evolution of patients with performance equal to 83,3% of cases.
Thereafter, if we have new cases of intoxicated patients, decision making for medical or medical emergency intervention is based only on these 16 parameters.

Table 5: The 16 parameters that give the maximum performance of the classification

Parameters	
Province	Agadir ; Ouarzazate ; Tiznit ; ….
Month	January February ; March
Year	1992 ;………………………………………………..
Season	Summer ; spring;………………………………..
Age	………………………………………………………

Age-intox	New born ; infant; …………………..
Gender	Female ; Male
Toxic product	………………………………………………………….
Product family	Medication; food ; …………………..
pathway	Cutaneous; oral…
Exposition	Single; repeated ………………………………..
Number of SC	1 ; 2 ; 3 ; ………………………………………………
Symptomatic treatment	Yes or No
treatment evacuator	Yes or No
Gastric lavage	Yes or No
Gradation	Level 0 ; Level 1 ; ……………………………….

So the results of the simulation are identical with 10/12. The model can detect the evolution of patients with performance equal to 83,3% of cases.
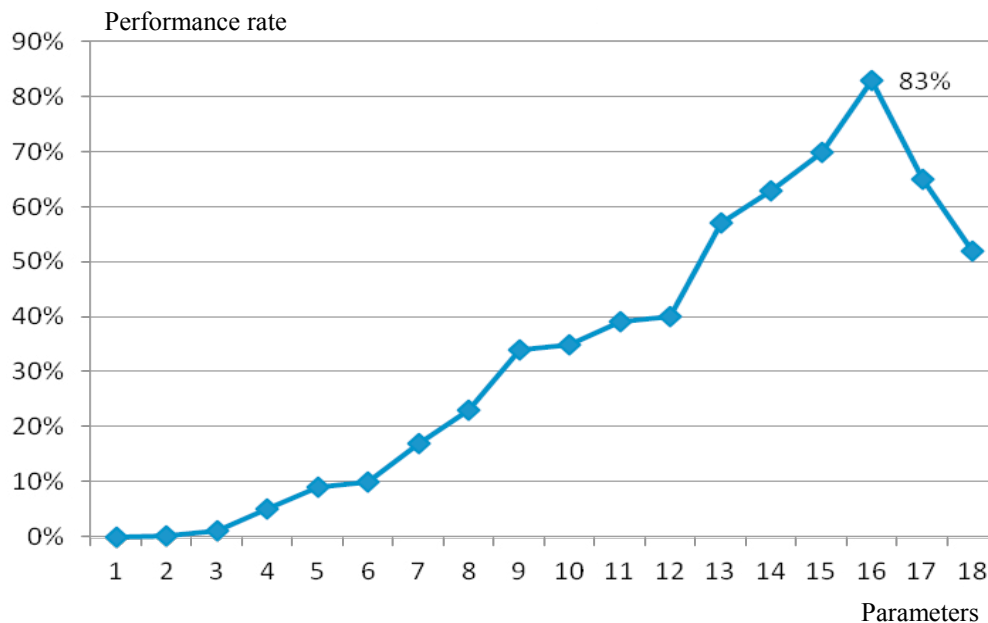

Fig. 2. Distribution of parameters according to their performance rates

4. Conclusion and discussion

In this paper, we presented the application SVM approach, we have given a classification of the evolution of the patients (safe, death) based only on these 16 parameters. This classification method is based on finding a hyper plane that separates the data sets as much as possible. This method is applicable for two-class classification tasks, but there are extensions for classification Multi classes.

This study allowed drawing up and for the first time the epidemiology of intoxication in SMD area, between 1992 and 2012. Thus the results show that the number of cases of intoxications and the mortality rate in this region are far from being negligible.

 In perspective, the future studies can address the subject in term of expand the modeling and data processing, on a database of all regions of Morocco including Big Data, explore the characteristic of patients by other new methods of statistic or machine learning in order to increase the weight variables and of selecting the best model. In other hand it is preferable to put a mobile application that could help the interveners in public health to treat the cases of intoxication, especially in rural areas, and in real time to minimize the risk of mortality.

Acknowledgements

References

[1] Hinde, Hami, Abdelmajid Soulaymani, Lahcen Ouammi, and Rachida S. Bencheikh. (2011) "Atractylis gummifera L. intoxication. Data of the poison control center and pharmacovigilance of Morocco" *Bulletin of the Exotic Pathology Society*, **104 (1)** :53-57

[2] Campbell, Colin and Yiming Yiming. (2011) "Learning with Support Vector Machines, Synthesis lecture on articial intelligance machine learring" *Morgan & Claypool publishers*

[3] Bernhard Schölkopf and Alexander J. Smola. (2002) "Learning with Kernels, Support Vector Machines, Regularization, Optimization, and Beyond" *The MIT Press*

[4] Frédérik, Staikowsky, Florence Theil and Sébastien Candella. (2005) "Évolution des médicaments utilisés dans les intoxications médicamenteuses volontaires examinées aux urgences" *Presse Med* **6** :34-842

[5] Nabila, Attazagharti, Abdelmajid Soulaymani, Lahcen Ouammi, Rachida S. Bencheikh. (2009) "Intoxications médicamenteuses et facteurs de risque influençant l'évolution des patients" *Antropo* **9** 19-33

[6] De Miguel-Bouzas JC, Castro-Tubío E, Bermejo-Barrera AM, Fernández-Gómez P, Estévez-Núñez JC and Tabernero-Duque MJ. (2012) "Epidemiological study of acute intoxication cases treated at a Galician hospital between 2005 and 2008" *Adicciones* : **24(3)** :239-46

[7] Robin, Cremer and Mathieu M. Nolf. (2004) "Epidémiologie des intoxications de l'enfant" *Archives de pédiatrie*, **11(6)**:677-679

[8] Gispert Maria, Wheeler Kirk. (1998) "Suicides de l'adolescent scolarisé, Une étude épidémiologique chez les jeunes scolarisés (12–20 ans) " *Ann Psychiatr* **(13)** :16-23

[9] Safaa, El Khaddam, Abdelmajid Soulaymani, and Rachida S. Beincheikh. (2013) " Epidemiologic profile of the suicidal intoxication in the TadlaAzilal region" *Journal Of Pharmacy* **3(7)** : 13-19

[10] Siham Mahir. (2014) "Facteurs de risque, Prévisions et modélisation des intoxications dans la région de Souss-Massa-Drâa" *Phd thesis, Ibn Tofail* university

[11] Bernhard E. Boser, Bernhard E. Boser, Vladimir N. Vapnik. (1992) "A Training Algorithm for Optimal Margin Classifiers" [archive] In *Fifth Annual Workshop on Computational Learning Theory, Pittsburgh, ACM*, :44-152

[12] Vladimir, N. Vapnik. (1995) "The nature of statistical learning theory" USA, New York, *Springer Verlag*,

[13] Antoine, Villa, Frédéric Baud, and Bruno Megarbane. (2007) "Intoxications aigues les plus fréquentes" *Medical Encyclopedia* **25 (30)** :A-10

[14] Siham, Mahir, Abdelmajid Soulaymani and Hinde Hami. (2014) "La Mortalité prématurée due aux intoxications dans la région de Souss-Massa-Draa" *European journal of scientific research* **25 (2)** :228-236

[15] Siham, Mahir, Abdelmajid Soulaymani and Hinde Hami. (2013) "Suicides par intoxications dans la région de Souss-Massa-Draa" *Santé publique*, **25** :343-350

[16] Siham, Mahir, Abdelmajid Soulaymani and Rachida S. Bencheikh. (2014) "Les Caractéristiques épidemiologiques des intoxications dans la région de Souss-Massa-Draa au Maroc" *Research fr* **(1)** 619

[17] Marie, F.Le Heuzey and Pascale Isnard. (1995) "Enfants et adolescents suicidants" *Archive pédiatrique* **2(2)** :130-135

[18] Marie, Choquet and Verginie. Granboulane. (2003) "Jeunes suicidants à l'hôpital" *Le Carnet Psy* **8(85)**