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Economic and social burden of drug intoxications in Morocco: prognostic analysis of 1,787 cases and development of a medico-economic model

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Abstract

Introduction: Drug intoxications lead to healthcare utilization and economic consequences that extend beyond hospital expenditure alone. In Morocco, national toxicovigilance data make it possible to identify profiles associated with prognosis and resource mobilization, but their economic burden remains poorly documented.

Objective: To identify the determinants of vital prognosis and length of hospital stay, then to develop a parameterized Moroccan model of the economic and social burden integrating direct costs, productivity losses, premature mortality, justice/social services, and quality of life.

Methods: Retrospective analytical study of 1,787 cases reported to the Poison Control and Pharmacovigilance Center of Morocco (CAPM) between 1980 and 2008. The epidemiological analysis focused on logistic regression of death, description of time to hospital discharge using Kaplan-Meier analysis, and the ROC curve of the prognostic model. A targeted literature synthesis, limited to PubMed and to publications from 2017–2024, searched for parameters on direct costs, resource utilization, productivity, premature mortality, justice/social services, and quality of life/QALY. The economic model follows a bottom-up approach based on the principle of quantity × Moroccan unit cost. It aims at a contemporary and parameterizable valuation, not a reconstruction of historical expenditures from 1980–2008.

Results: Sixteen deaths were observed (case fatality rate 0.90%). In the multivariable analysis on complete cases (n=1,493; 14 deaths), cannabis-based products were associated with lower odds of death than other substances (aOR=0.16; 95%CI 0.04–0.61; p=0.007). The apparent discrimination of the model was moderate (AUC=0.724; 95%CI bootstrap 0.595–0.841). Among the 51 cases with recorded length of hospital stay, the median was 2 days and the mean was 13.8 days, reflecting a strongly skewed distribution of resource consumption. The PubMed synthesis made it possible to structure a societal cost model distinguishing care, non-medical costs, productivity, premature mortality, justice/social services, and quality of life. As an illustration, applying a published Moroccan direct cost of 157 USD per episode corresponds to 280,559 USD for 1,787 episodes; this amount does not constitute a measure of expenditures actually incurred by the historical cohort.

Conclusion: Toxicovigilance data make it possible to identify clinical markers useful for resource stratification and for building a medico-economic model. The proposed framework

is transparent and updatable, but a complete national estimate will require prospective data on unit costs, professional activity, household expenditure, judicial events, and quality of life.

Keywords: drug intoxication; economic burden; cost of illness; societal costs; toxicovigilance; logistic regression; Morocco; PubMed.

Introduction

Psychoactive substance use constitutes a major public health issue. Beyond morbidity and mortality, its consequences include healthcare utilization, productivity losses, premature mortality, judicial costs, and impaired quality of life [1].

In Morocco, available studies show that substance use is embedded in family, school, and socioeconomic determinants, particularly among adolescents and high-risk populations [2-5]. This dimension justifies complementing the classical toxicological approach with an economic and social perspective.

The Poison Control and Pharmacovigilance Center of Morocco (CAPM) centralize intoxication notifications and constitutes a national toxicovigilance source [6,7]. An earlier analysis of the 1980–2008 data described 1,795 drug intoxications, dominated by Maajoune and cannabis [7]. The present work reanalyzes the cleaned database, prioritizing markers of prognosis and resource consumption, then links them to a contemporary economic synthesis.

The objective is not to reconstruct the expenditures incurred between 1980 and 2008, but to build, from the quantities observable in the database and from recently published economic parameters, a model allowing estimation of the current burden of such episodes in the Moroccan context.

The study thus aims to analyze the determinants of vital prognosis and length of hospitalization, to evaluate the discrimination of the prognostic model, and then to develop a parameterized model of the economic and social burden applicable to Morocco.

2. Materials and methods

2.1. Data Source and Study Population

This is a retrospective analytical study covering all cases of drug intoxication reported to CAPM over a 29-year period, from January 1, 1980 to December 31, 2008. The data come from CAPM's national toxicovigilance database, fed by spontaneous notifications from healthcare professionals and healthcare facilities (telephone response from the center, notification forms from hospitals and health centers). After cleaning and exclusion of duplicate or empty records, 1,787 usable cases were retained for analysis, an effective number very close to that reported by the original publication on the same database (1,795 cases) [7], the residual discrepancy being related to deduplication procedures.

2.2. Variables Collected

For each case, the database records sociodemographic variables (age, sex, city, province, region, urban/rural setting), temporal variables (year, season, day of the week), toxicological variables (substance involved, product family and classification, route of exposure), circumstantial variables (main circumstance: accidental or intentional; subcategory: classic accident, drug abuse, suicidal, criminal, occupational), the location of the intoxication (home, public place, workplace, school), severity (severity grade according to the Poisoning Severity Score) [8], management, length of hospital stay, and outcome (favorable, death, sequelae).

2.3. Statistical Analysis

The statistical analysis focused on prognostic indicators and variables likely to influence resource consumption. Death (1) versus survival (0) was the primary criterion. Bivariate associations were studied using Pearson's χ^2 test or Fisher's exact test, then a parsimonious multivariable logistic regression estimated adjusted odds ratios (aOR) and their 95% CI. Given the small number of deaths, the model is considered exploratory. Its apparent discrimination was evaluated using the area under the ROC curve, with bootstrap 95% CI; no external validation was performed. For cases with recorded length of hospital stay, a Kaplan-Meier curve described time to discharge: discharge was the event and deaths were censored. This analysis is interpreted as a descriptive indicator of hospital retention and resource mobilization, not as an analysis of vital survival.

2.4. Targeted Economic Literature Synthesis in PubMed (2017–2024)

The economic synthesis used PubMed as the sole bibliographic source and was limited to publications from January 1, 2017 to December 31, 2024. Seven complementary queries targeted: (1) direct medical costs; (2) resource utilization — emergency care, hospitalization, intensive care, and length of stay; (3) productivity losses; (4) premature mortality; (5) justice, crime, and social services; (6) quality of life, utilities, and QALY; and (7) cost-of-illness type societal models. Results were merged and deduplicated by PMID, then

subjected to title/abstract screening and targeted quantitative extraction. This approach constitutes a targeted bibliographic synthesis and not an exhaustive systematic review. Studies were retained when they provided at least one monetary parameter or exploitable cost driver. Transferability to the Moroccan context was classified as A (directly usable Moroccan parameter), B (value adaptable after substitution of Moroccan prices or income), C (transferable method or architecture, non-transferable amount), or D (contextual information only). Foreign amounts were not mechanically converted into dirhams. The final model follows a bottom-up approach: each quantity of resources or events is multiplied by a documented Moroccan unit cost; unobserved components remain unquantified rather than being replaced by an arbitrary percentage.

2.5. Ethical Considerations

The data originate from CAPM's national toxicovigilance system and were analyzed in anonymized form. No nominative data were used.

3. Results

3.1. Epidemiological Data Focused on Prognosis and Resources

The cohort comprised 1,787 intoxications. Mean age was 21.7 ± 9.2 years, 83.2% of patients were male, and cannabis-based products predominated. Severity was mainly moderate (PSS 2: 59.7%), but 3.3% of cases were severe (PSS 3) and 0.9% very severe/fatal (PSS 4). Sixteen deaths were recorded, corresponding to an overall case fatality rate of 0.90%. These descriptive data are presented here solely as risk and cost stratification variables: severe forms, prolonged hospitalizations, and deaths are the main clinical drivers of the economic burden.

3.2. Logistic Regression of Vital Prognosis

After excluding unknown/unspecified outcomes and incomplete observations, the multivariable model covered 1,493 cases, including 14 deaths. In the adjusted analysis, cannabis-based products were associated with significantly lower odds of death than other substances (aOR=0.16; 95% CI 0.04–0.61; p=0.007). Age (aOR=1.04; 95% CI 0.99–1.09), male sex (aOR=0.49; 95% CI 0.15–1.60), and intentional circumstance (aOR=0.95; 95% CI 0.30–3.04) were not independently associated with death. Estimates remain exploratory given the small number of events.

Table 1. Factors associated with death: univariate and multivariable logistic regression.

Variable	Crude OR	95% CI	p	Adjusted OR	95% CI	p
Age (per year)	1.04	1.00–1.08	0.069	1.04	0.99–1.09	0.147
Male sex	0.57	0.18–1.77	0.329	0.49	0.15–1.60	0.236
Cannabis-based product (Maajoune/cannabis)	0.12	0.03–0.43	0.001	0.16	0.04–0.61	0.007
Intentional circumstance	1.50	0.50–4.50	0.468	0.95	0.30–3.04	0.931

Note: model adjusted on 1,493 complete cases, including 14 deaths; cautious interpretation given the rare events.

3.3. Time to Hospital Discharge: Kaplan-Meier Descriptive Analysis

Length of hospital stay was recorded for 51 cases. The median was 2 days and the mean was 13.8 days, reflecting a strongly skewed distribution with a few prolonged stays. The Kaplan-Meier curve shows a rapid decrease in the proportion of patients remaining hospitalized during the first days, followed by a prolonged tail. Because of the small number of recorded durations and the handling of deaths as censoring events, this analysis is strictly descriptive; it is used here as an indicator of resource consumption.

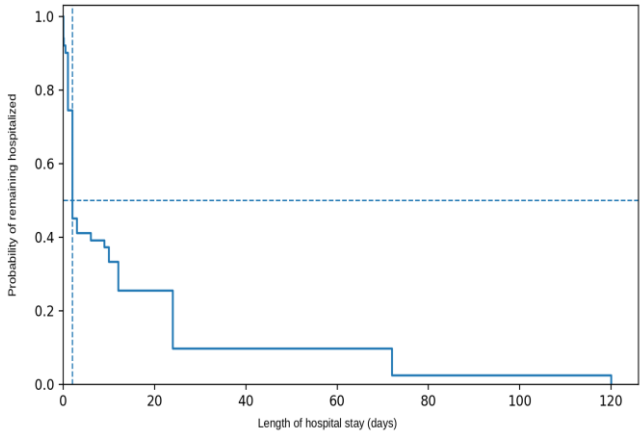

Figure 1. Kaplan-Meier curve of time to discharge among cases with recorded length of hospital stay (n=51).

3.4. Discriminant Performance of the Prognostic Model

The ROC curve of the multivariable model showed moderate apparent discrimination: AUC=0.724 (95% CI bootstrap 0.595–0.841), with a sensitivity of 64.3% and a specificity of 76.1% at the threshold maximizing the Youden index. Given the small number of deaths and the absence of external validation, these performances should be considered exploratory and not those of a validated clinical tool.

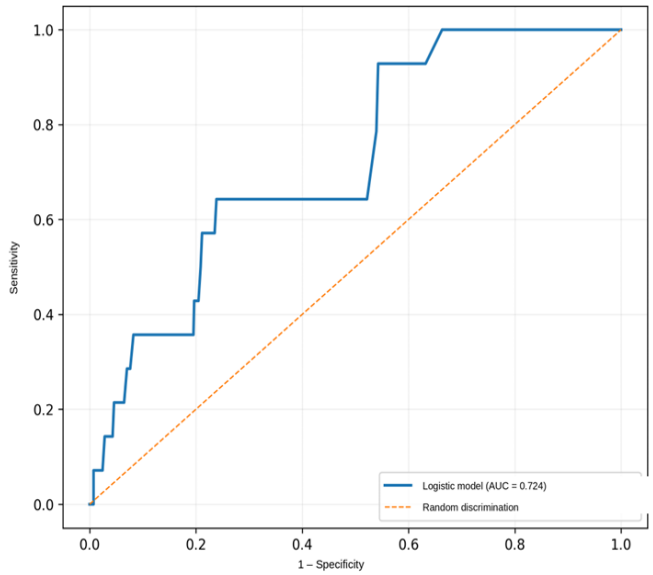

Figure 2. ROC curve of the multivariable model predicting death.

3.5. Economic Results of the PubMed 2017–2024 Screening

The targeted PubMed 2017–2024 synthesis identified quantitative studies covering the main components needed for the model: direct costs, hospitalization/intensive care, productivity, premature mortality, justice/social services, and QALY/utilities. Moroccan values are prioritized when available; foreign data mainly serve to define cost drivers and valuation methods [9-21].

Table 2. PubMed 2017–2024 economic parameters most useful for building the Moroccan model.

Study/Country	Population/domain	Extracted quantitative parameter	Component	Method	Transf.	Use in the Moroccan model
Benabdellah et al., 2020 – Morocco	87 hospitalized poisoned children	127 USD direct medical + 30 USD direct non-medical = 157 USD/episode; stay 2.15 ± 1.87 days	Direct medical and non-medical	Prospective micro-costing	A	Moroccan anchor point; cautious extrapolation (pediatric population, heterogeneous toxicants)
Hofmarcher et al., 2024 – Sweden	Illicit drug use, year 2020	3.7 billion EUR; 355 EUR/inhabitant; 0.78% of GDP; ≈40% direct, ≈20% indirect, ≈40% intangible	Direct, indirect, social, intangible	Cost-of-illness, societal perspective	C	Model architecture; do not transfer amounts
Florence et al., 2021 – United States	OUD and fatal overdoses, 2017	1.02 trillion USD; majority of burden linked to reduced quality of life and value of life lost	Health, justice, productivity, QoL, mortality	Societal cost-of-illness; morbidity/mortality valuation	C	Justifies separating mortality and quality of life, and a societal perspective
Kirk et al., 2018 – Canada	277 ICU admissions for acute intoxication	Mean total cost 18,958 CAD/admission; opioids 12,967 CAD; median ICU stay 3 days	Hospitalization/ICU	Matched retrospective analysis, hospital costs	B/C	Provides an order of magnitude; confirms ICU stay as a major cost driver; replace unit prices with Moroccan costs
Meyer et al., 2019 – United States	193,614 opioid-related visits (32,713 hospital, 160,901 outpatient)	Hospitalization: 4,383 USD/visit, 4.35 days; outpatient: 533 USD/visit	Emergency/hospitalization/length of stay	Utilization data, adjusted models	B/C	Transferable resource parameters; unit costs not directly transferable
Thornton et al., 2024 – United States	57,413 working-age adults with painful conditions	Predicted lost workdays: opioids 13.06/yr; opioids+benzodiazepines 15.18/yr; benzodiazepines 5.75/yr	Productivity/absenteeism	MEPS; two-part model	B	Replaces an arbitrary percentage of direct costs with days lost × workday value in Morocco
Hall et al., 2024 – Australia	Heroin dependence, longitudinal follow-up	Mean societal cost 120,599 AUD/person/yr: health 10,055; productivity 63,158; crime 7,204; other 40,182; 2,703 life-years lost ≈ 213M AUD	Productivity/mortality/crime/health	Longitudinal cost-of-illness; VSLY for mortality	B/C	Useful for decomposing societal cost and separating productivity-mortality-crime

Chang et al., 2019 – Taiwan	Heroin users with/without opioid agonist treatment	Utility 0.23 higher under treatment; QALE 17.8 vs 9.2; QALE loss 18.2 vs 27.9; gain ≈ 9.7 QALY	QALY/utility/quality of life	EQ-5D + extrapolated survival	B/C	Justifies a separate quality-of-life block; may inform a future cost-utility analysis

Note: A = directly usable Moroccan parameter; B = adaptable value; C = transferable architecture/method; D = discussion only.

3.6. Direct Costs and Parameterized Moroccan Economic Model

The national anchor point is the Moroccan micro-costing published in 2020, which estimates the mean direct cost of a pediatric intoxication episode at 157 USD (127 USD medical + 30 USD non-medical). Its uniform application to the 1,787 episodes of the CAPM database gives 280,559 USD. This calculation is presented solely as a standardized illustration at contemporary unit cost: it measures neither the historical expenditures incurred between 1980 and 2008 nor a cost specifically observed for drug intoxications.

Table 3. Standardized illustration of direct cost based on a contemporary Moroccan unit cost.

Component	Unit cost (USD/case)	N	Estimated total cost (USD)	Share of direct cost
Direct medical costs	127	1,787	226,949	80.9%
Direct non-medical costs	30	1,787	53,610	19.1%
Total direct costs	**157**	**1,787**	**280,559**	**100%**

Note: illustration at contemporary reference price based on 157 USD/episode. It does not constitute an estimate of the historical expenditures of the CAPM cohort.

The main model abandons the proportional 25/50/100% scenarios. It is now based on a bottom-up logic: for each component, an observed or estimated quantity is multiplied by a documented Moroccan unit cost. Undocumented components remain unquantified until a national parameter becomes available.

Table 4. Parameterized Moroccan economic model: quantities, unit costs, and formulas.

Component	Quantity/driver	Moroccan unit cost	Calculation formula	Status in the cohort
Emergency care	N_emerg = number of cases using emergency care	CU_emerg = mean cost of an emergency visit (MAD or USD, Moroccan source 2017–2024)	C_emerg = N_emerg × CU_emerg	Quantity to be extracted/validated in the CAPM database; unit cost to be documented
Conventional hospitalization	ΣD_hosp = total hospitalization days; mean observed duration = 13.8 days in the recorded subset	CU_hosp = Moroccan cost per hospitalization day	C_hosp = ΣD_hosp × CU_hosp	Duration partially observed; unit cost to be documented
Intensive care/resuscitation	ΣD_ICU = total ICU days	CU_ICU = Moroccan cost per ICU day	C_ICU = ΣD_ICU × CU_ICU	ICU use/duration to verify in database; unit cost to be documented
Examinations, treatments, monitoring	N_exam/treat = volumes of resources consumed	CU_exam/treat = Moroccan unit tariffs/costs	C_exam/treat = Σ(Q_i × CU_i)	Not exhaustively detailed in the database
Direct non-medical costs	N × transport/travel and other household expenses	CU_nonmed = mean Moroccan cost per episode	C_nonmed = N_concerned × CU_nonmed	Not observed; external Moroccan parameter required
Morbidity-related productivity	N_active × D_lost; literature: 13.06 days/yr opioids, 15.18 days/yr opioids+benzodiazepines	V_day = economic value of a workday in Morocco	C_prod = N_active × D_lost × V_day	Occupational status/lost days not observed; to be parameterized
Premature mortality	16 deaths; YLL_i = expected life expectancy − age at death	V_annual = annual income/productivity or life-year value per retained Moroccan method	C_mort = Σ(YLL_i × V_annual)	Deaths observed; age at death to be exploited; valuation to be documented
Justice/crime	N_arrests, N_convictions, D_incarceration, offenses	Moroccan police/justice/detention unit costs	C_justice = Σ(Q_j × CU_j)	Not documented in CAPM database; external module or future collection
Social services	Use of social services, support, housing, reintegration	Corresponding Moroccan unit costs	C_social = Σ(Q_s × CU_s)	Not documented in the database
Quality of life/QALY	ΔQALY or utility loss; international literature as methodological framework	Monetary value/QALY, Moroccan only if defensible national method exists	B_QoL = ΔQALY × value/QALY (secondary analysis)	Not estimated in the main analysis
Total societal cost	Sum of validated monetary components	—	C_societal = C_emerg + C_hosp + C_ICU + C_exam/treat + C_nonmed + C_prod + C_mort + C_justice + C_social	Main formula of the model

Note: Societal cost is defined as the sum of direct medical, direct non-medical, productivity, premature mortality, justice, and social services costs. The psychological/QALY burden is kept in a separate block to avoid unjustified monetization.

4. Discussion

4.1. From Prognostic Markers to Cost Drivers

In this study, descriptive epidemiology mainly serves to define the groups likely to mobilize the most resources. Logistic regression suggests a different risk of death depending on the toxicological profile, while the AUC of 0.724 reflects moderate apparent discrimination. The analysis of time to discharge highlights the heterogeneity of length of stay. These results thus link prognosis, duration of care, and resource consumption, but must remain exploratory given the small number of deaths and incomplete hospitalization data.

4.2. Direct Medical Costs: From Cost per Episode to Cost per Resource

Direct cost is currently the best-documented component in Morocco. The Moroccan micro-costing provides a national benchmark, but its uniform application masks the heterogeneity of severity and resource consumption. The model developed therefore favors decomposition into emergency visits, hospitalization days, ICU days, examinations, and treatments. This approach is consistent with the international studies from the screening, in which level of care and length of stay are major cost determinants [9,14,15].

4.3. Indirect Costs: Productivity and Premature Mortality

Indirect costs should not be calculated as a fixed fraction of medical expenditure. The 2017–2024 literature emphasizes the importance of lost workdays, disability, and premature mortality. The Moroccan model therefore distinguishes C_productivity = N_active × days lost × value of a workday and C_mortality = Σ(life-years lost × retained annual economic value). This separation improves transparency and limits the risk of double counting [16,17].

4.4. Justice, Social Services, and Psychological Burden

A strictly hospital-based perspective underestimates the societal burden. The screening studies show that criminal justice, crime, social services, social exclusion, and family burden can represent significant expenditure items. In the proposed model, these costs are represented by quantifiable events — arrests, convictions, days of incarceration, and use of social services — to which Moroccan unit costs can be applied. The psychological burden and quality of life are treated separately; they are not monetized in the main analysis due to the lack of psychometric measures and utilities collected in the CAPM database [10-12,18-21].

4.5. Detailed Architecture of the Moroccan Economic Model

The final model is a bottom-up cost-of-illness model with a societal perspective. It distinguishes: (1) direct medical costs = emergency care + hospitalization + intensive care + examinations/treatments; (2) direct non-medical costs = transport and household expenses; (3) indirect morbidity costs = lost activity days × daily value; (4) premature mortality = life-years lost × annual economic value; (5) justice and social services = quantities of events × unit costs; and (6) quality of life/QALY as a secondary analysis. The main societal cost is C_total = C_direct medical + C_direct non-medical + C_productivity + C_mortality + C_justice + C_social. Each parameter must be accompanied by its source, its monetary year, and a sensitivity analysis [11,12,17,21].

PSS severity further allows operational stratification: C = N(PSS0-1) ×C_mild + N(PSS2) ×C_moderate + N(PSS3) ×C_severe + N(PSS4) ×C_fatal. This formulation directly links prognostic analysis to costs: PSS3-4 forms, prolonged stays, and deaths receive distinct resource and economic loss parameters, which is more defensible than a single average cost applied to all cases.

4.6. Strengths, Limitations, and Implications

The main strength is the combination of a national toxicovigilance database with an economic synthesis targeted exclusively in PubMed for the 2017–2024 period. This narrative and cost-of-illness synthesis approach follows a methodology similar to other IMRAD-format economic and narrative reviews previously conducted by our group in the Moroccan context. This choice improves reproducibility but does not claim the exhaustiveness of a multi-database systematic review. Other limitations are possible underreporting, the low frequency of deaths, the absence of external validation of the prognostic model, the scarcity of recorded hospitalization durations, and the lack of individual data on income, employment, household expenditure, justice, and quality of life. In addition, contemporary unit costs cannot be interpreted as the expenditures actually incurred between 1980 and 2008. The model must therefore be understood as a current, parameterizable valuation framework, not as a historical reconstruction.

5. Conclusion

This study transforms a national toxicovigilance series into a medico-economic analytical framework: clinical data are focused on death, length of hospital stay, and prognostic discrimination, then linked to the main cost drivers. The PubMed 2017–2024 synthesis makes it possible to structure a societal model distinguishing care, non-medical costs, productivity, premature mortality, justice/social services, and quality of life.

The Moroccan unit cost of 157 USD per episode constitutes an illustrative anchor point, but its extrapolation to the cohort should not be interpreted as an observed historical expenditure. Validation of the model will require prospective collection of Moroccan unit costs and missing socioeconomic variables. Subject to this reservation, the proposed framework can support future estimation of the national economic burden and guide the prioritization of data to be integrated into the toxicovigilance system.

Declarations

Consent to participate: not applicable (anonymized surveillance data).

Funding: no specific funding was received for this work.

Conflicts of interest: the authors declare no conflict of interest.

Data availability: database owned by the Poison Control and Pharmacovigilance Center of Morocco (CAPM); available upon reasoned request to the institution.

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