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Value of Data Collected by Coroners and Medical Examiners as a Data Source for Toxicovigilance

LITERATURE REVIEW

Québec

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Direction de la santé environnementale et de la toxicologie

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1 Background

The coroner is a public officer (doctor, lawyer, or notary) appointed by the provincial government who reports to the Chief Coroner. The coroner systematically intervenes to determine the cause of death in a number of situations, including when a death occurs under violent (e.g., accident, suicide) or mysterious circumstances, when the death is the result of negligence, when the cause of death is unknown, or when the death occurs in a rehabilitation centre, penitentiary, detention centre, intensive supervision unit as defined in the Youth Protection Act, police station, daycare centre, or foster family, or in custody in a health facility, etc.[1] In Québec, nearly 10% of deaths are reported to Bureau du coroner du Québec (BCQ). Following the investigation, the coroner publishes his or her findings in a public report.

Although a coroner's report can take an average of 10 to 12 months to produce, information on the presumed causes and circumstances of the death are generally recorded in a database within 48 hours after the death is reported. Together with the results of the toxicological analyses that are frequently requested by coroners and are generally available within a few weeks, this information is a useful data source for quickly identifying threats to the public's health or emerging phenomena involving exposure to or consumption of chemicals.

1.1 Definitions of health vigilance and toxicovigilance

Health vigilance is defined by Ministère de la Santé et des Services sociaux (MSSS) as a continuous process of identifying and characterizing threats to population health through the collection, analysis, and interpretation of data on health determinants and effects. It enables MSSS to detect real or perceived health threats as early as possible and to alert public health authorities so they can respond appropriately (MSSS, 2014). Health vigilance differs from surveillance in that it involves an active process of identifying health threats.

The term toxicovigilance is used when health vigilance focuses on toxicants. Although MSSS does not have a definition of toxicovigilance, the World Health Organization (WHO) has defined it as an active process of identifying and evaluating toxic risks with the aim of reducing the incidence of poisonings by identifying new toxicological risks (WHO, n.d.).

For more information on the definitions of toxicovigilance and the differences between surveillance, toxicovigilance, and pharmacovigilance, the reader is encouraged to consult the publication by Vermette, Dubé, and Gosselin (2014).

[1] Bureau du coroner. (n.d.). Qu'est-ce qu'un coroner? Online: https://www.coroner.gouv.qc.ca/les-coroners/quest-ce-quun-coroner.html

1.2 Objectives of the literature review

The first objective of this literature review was to guide the development of appropriate toxicovigilance indicators for Québec by surveying toxicovigilance activities that use toxicological analysis data compiled by coroners and medical examiners on deceased persons. Given the absence of scientific literature on such toxicovigilance activities, the objective was revised in order to collect information on substances and populations targeted by similar surveillance activities, namely activities using toxicological analysis data compiled by coroners and medical examiners on deceased persons in Canada and around the world. This review also describes the main advantages and disadvantages of using data from ongoing coroners' and medical examiners' investigations for toxicovigilance purposes.

2 Methodology

2.1 White literature

Research strategy

The following databases were consulted using the OVID platform to survey the white literature:

- Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily, Ovid MEDLINE(R): 1946 to June 09, 2017
- Embase: 1974 to June 08, 2017
- Global Health: 1973 to June 1, 2017

The concepts of medicolegal context, vigilance, surveillance, and toxicology were selected. The keywords used for each of the concepts are presented in Table 1 below.

Table 1 Research results from June 9, 2017

#	Query	Results
1	((coroner* or coronial* or "medical examiner*" or medicolegal or "medico-legal" or forensic* or autops* or (death* adj3 (investigat* or sudden or suspicious or violent or unexplained or accident* or manner*)) or postmortem or "post-mortem").ti,ab. or "coroners and medical examiners"/ or autopsy/ or "cause of death"/ or coroner/ or "postmortem examinations"/)	671,165
2	((surveillance or toxicovigilance or "toxico-vigilance" or vigilance or indicator* or ((monitor* or detect*) adj3 (poisoning or mortality or "unexpected event*" or "unusual event*"))).ti,ab. or "public health surveillance"/ or Product surveillance, postmarketing/ or exp "postmarketing surveillance"/ or "surveillance"/)	1,139,740
3	((poison* or toxic* or substance* or chemical* or drug* or psychoactive* or opioid* or pesticide* or pollution* or hydrocarb* or "consumer product*" or exposure).ti,ab. or "forensic toxicology"/ or "hazardous substances"/ or exp drug/ or "chemicals and drugs"/ or exp "Environmental, industrial and domestic chemicals"/ or poisoning/ or "toxic substances"/)	10,895,426
4	1 AND 2 AND 3	3,839
5	Limit 4 to (English or French)	3,559

Some articles were also found and added by searching in the bibliographies of studies reporting other studies that met the selection criteria.

Selection criteria and selection of articles

The relevant articles that were selected covered vigilance or surveillance with respect to deaths by poisoning involving chemicals, and the analyses were performed based on data from medicolegal databases, coroners' records, death certificates, and other death-related databases.

The references were imported into the *EndNote* reference management software program to remove duplicates. The methodology used to remove duplicates was taken from Bramer et al (2016).

The references were then imported into the Zotero reference management software program, where they were successively selected based on 1) title, 2) abstract, and 3) full text.

The selected articles are presented in Appendix 1.

2.2 Grey literature

Research strategy

The grey literature was surveyed using Google (the first 10 pages of results), *Google Scholar* (excluding scientific articles), and *Carrot* as well as the databases *Open Grey*, *New York Academy's Grey Literature Report*, *McMaster University's Health System Evidence*, and the *Public Health Data Bank*. A number of web pages from various government agencies and public health agencies were also manually surveyed using several keywords.

The concepts of medicolegal context and surveillance were selected. The following keywords were used, alone or in combination, depending on the webpages and databases: "coroner," "medicolegal," "forensic," "poisoning," "*toxicovigilance*," "vigilance," "*surveillance*," "drug," and "toxicology."

2.3 Selection criteria and selection of articles

The relevant documents covered vigilance or surveillance with respect to poisonings involving chemicals and were based on data from medicolegal databases, coroners' records, death certificates, or other death-related databases. No documents from the grey literature were selected.

3 Reviewed literature

Following evaluation of the full texts, a total of 62 articles on surveillance activities examining toxicological analysis data collected by coroners or medical examiners and extracted from investigation reports or death certificates were selected. The selected articles present regional or national surveys and poisoning surveillance activities for which there is a delay of several months to several years between the events (e.g., death, poisoning) and the data analysis. In addition, most methods report manual extraction of data on recovered substances and circumstances of death, while computerized and automated extraction is desirable in the case of toxicovigilance, to minimize delays.

The selected articles are summarized in Appendix 1, by country. Briefly, the studies included were comprised of 2 studies from Canada (Toronto and Halifax), 25 from the United States, 1 from France, 18 from Australia and New Zealand, and 16 from other countries. The studies were also assigned a relevance rating (details in Appendix 1). It should be noted that most studies were rated "not relevant" or "not very relevant," while only 13 were rated "relevant."

3.1 Substances investigated or detected in the studies

Table 2 lists the substances that were investigated, detected, or reported in the 62 selected articles. Substances are listed by class (drugs—including drugs based on their potential for misuse, e.g., opioids—medications, or other) and effect (e.g., depressants, disruptors, antipsychotics, etc.). It should be noted that all the substances presented in Table 2 are not necessarily found in Québec and not all are included in toxicological analyses conducted by laboratories at the request of the BCQ.

3.2 Populations or circumstances of death targeted in the studies

Although most of the studies focused on all direct or indirect poisonings in the general population, some of the articles targeted specific populations or circumstances of death. The targeted age groups include 15–64 years old (n = 2), adolescents (10–19 years old; n = 1), and 13 years old and over (n = 1). The targeted populations include the homeless (n = 1), health professionals (n = 1), prisoners (n = 1), and people who were sexually abused as children (n = 1).

With regard to circumstances of death that have been the subject of special investigations, of particular interest are suicides (all age groups (n = 3) as well as in children under 18 (n = 2)), deaths by road accidents (all age groups (n = 3), as well as in 18–24-year-olds (n = 1)), deaths by poisoning caused indirectly by hurricanes (e.g., carbon monoxide poisoning; n = 1), and deaths due to agranulocytosis, convulsions, cardiac electrical conduction disorder, pulmonary embolism, and suicide among former or current clozapine users (n = 1).

Table 2 Substances investigated, detected, or reported in the selected reviewed

Class	Category	Substance		
Drugs	Depressants	▪ Alprazolam ▪ Bromazepam ▪ Buprenorphine ▪ Butalbital ▪ Chlordiazepoxide ▪ Clonazepam ▪ Codeine ▪ Diazepam ▪ Estazolam ▪ Ethanol ▪ Phenazepam ▪ Fentanyl ▪ Flunitrazepam ▪ Flurazepam	▪ GHB (gamma-hydroxybutyrate) ▪ Heroin ▪ Chloral hydrate ▪ Hydrocodone ▪ Hydromorphone ▪ Isopropanol ▪ Kentobemidone ▪ Lorazepam ▪ Meperidine (or pethidine) ▪ Meprobamate ▪ Methaqualone ▪ Methadone ▪ Methanol ▪ Midazolam	▪ Morphine ▪ Nitrazepam ▪ Oxazepam ▪ Oxycodone ▪ Oxymorphone ▪ Pentobarbital ▪ Phenobarbital ▪ Propoxyphene ▪ Secobarbital ▪ Temazepam ▪ Tramadol ▪ Triazolam ▪ Zolpidem ▪ Zopiclone
	Disruptors	▪ Cannabis ▪ Dextromethorphan (DM) ▪ Ketamine	▪ MDA (3,4-methylenedioxyamphetamine) ▪ MDEA (3-4-methylenedioxy-N-ethylamphetamine)	▪ MDMA (3,4 ethamph-4-methylenedioxymethampheta mine) ▪ Phencyclidine (PCP)
	Stimulants	▪ Amphetamine ▪ Caffeine ▪ Cocaine ▪ Ephedrine ▪ Fencamfamin	▪ Fenetylline ▪ MDPPP (3-4-méthylènedioxy-alpha-pyrrolidinopropiophenone)	▪ Methamphetamine ▪ Norephedrine ▪ Phendimetrazine ▪ Phentermine
Medications	Antidepressants	▪ Amitriptyline ▪ Bupropion ▪ Citalopram ▪ Desipramine ▪ Dothiepin (or dosulepin)	▪ Doxepin ▪ Duloxetine ▪ Fluoxetine ▪ Imipramine ▪ Mirtazapine	▪ Nortriptyline ▪ Paroxetine ▪ Sertraline ▪ Trazodone ▪ Venlafaxine
	Antipsychotics	▪ Chlorpromazine ▪ Clozapine	▪ Olanzapine ▪ Promazine	▪ Promethazine ▪ Quetiapine

Table 2 Substances investigated, detected, or reported in the selected reviewed (continued)

Class	Category	Substances		
Medications	Antihistamines	▪ Alimemazine ▪ Diphenhydramine	▪ Doxylamine ▪ Hydroxyzine	▪ Ranitidine
	Analgesics (non-opioid), anti-inflammatories and muscle relaxants	▪ Acetaminophen ▪ Acetylsalicylic acid ▪ Carisoprodol	▪ Ibuprofen ▪ Methocarbamol ▪ Orphenadrine	▪ Phenazone ▪ Salicylates
	Other	▪ Atropine ▪ Carbamazepine ▪ Chloroquine ▪ Dihydropropiomazine ▪ Diltiazem	▪ Ergotamine ▪ Gabapentin ▪ Insulin ▪ Lidocaine ▪ Metformin	▪ Metoclopramide ▪ Theophylline ▪ Verapamil
Other	Pesticides	▪ Carbamate ▪ Chlorodifluoromethane ▪ Chlorpyriphos ▪ Dichlorwash ▪ Dimethoate	▪ Endosulfan ▪ Malathion ▪ Methyl parathion ▪ Monocrotophos ▪ Phenothiazine	▪ Phoselon ▪ Phosphamidon ▪ Quinalphos
	Household products	▪ Deodorants ▪ Detergents	▪ Difluoroethane ▪ Smoke from cooking oil fires	
	Industrial products	▪ Ethylene glycol ▪ Freon	▪ Helium ▪ Nitrous oxide	▪ Toluene
	Other	▪ Cyanide	▪ Carbon monoxide	

4 Considerations for the development of toxicovigilance indicators

4.1 Advantages of using ongoing investigations' data

The use of data from toxicological analyses of samples taken from deceased persons in ongoing coroners' or medical examiners' investigations for toxicovigilance purposes has some advantages over other similar data sources: short acquisition time and access to all cases of death by poisoning. In comparison, data from poison control centres, although available within a sufficiently short time frame for toxicovigilance, generally covers only a fraction of poisoning-related deaths, since the majority of calls come from the public (80%) or from health professionals (20%) wanting to obtain an opinion or a differential diagnosis for their patients (Puskarczyk, 2015). In the case of death certificates or coroners' investigation reports, which are popular data sources for monitoring activities, data acquisition times are too long (from several months to several years) for health surveillance purposes. In addition, the codification of the causes of death or of the substances involved in the records could obscure information on substances detected in toxicological analyses, and make identifying cases more difficult and less precise (Gladstone et al., 2016; Slavova et al., 2017).

For example, Moore et al. (2017) retrospectively evaluated the potential contribution of three data sources to the early detection of a larger than usual number of deaths in Chicago due to heroin and fentanyl overdoses. The data collected was from emergency departments, medical examiners, and calls from the Illinois Poison Control Center. The authors reported that emergency department data would have made it possible to detect a peak in probable opioid overdoses during the episode (compared to the annual median) and that medicolegal data could also have shown a spike in deaths by fentanyl and the combination of fentanyl and heroin. However, the authors reported a longer acquisition time for medicolegal data than for emergency department data. Data from the poison control centre would not have made it possible to detect the episode, as the number of calls for heroin overdoses during this period remained stable.

Finally, using toxicological analysis data without waiting for coroners' investigations to be completed (i.e., in the absence of a formal cause of death) makes it possible to collect information on substances present in deceased persons, even if they did not necessarily contribute to the death. This information could help in the detection of new substances or emerging phenomena representing potential health risks, and thus encourage preventive action.

4.2 Limitations on the use of ongoing investigations' data

In the absence of certain information on the circumstances of death or formal cause of death, it may be difficult to interpret toxicological analysis data correctly. For example, in the absence of a deceased person's prescription drug history, or without knowing his or her consumption patterns, it may be difficult to interpret the dosages found or to determine whether the person purchased the substance legally or illegally (Slavova et al., 2017).

Furthermore, for some substances whose toxic thresholds are not clearly established, particularly when several substances are present in the body simultaneously, it may be difficult to determine the causal links between the substances and a death that occurred under mysterious circumstances.

5 Conclusion

The purpose of this literature review was to survey publications on toxicovigilance activities using toxicological analysis data on deceased persons and compiled by coroners or medical examiners. No such activities could be identified. However, this approach was supplemented by a survey of coroners and chief medical examiners in Canada, as well as other coroner's offices and public health organizations around the world (Vachon, 2018).

It was possible to determine that the vast majority of substances investigated or detected through surveillance activities or population surveys (related to deaths by poisoning) are drugs or medications. However, this observation must be qualified by the fact that most toxicological analyses carried out on deceased persons prioritize some of these substances at the expense of others, such as pesticides or industrial products. Nevertheless, in Québec, drugs and medications alone are responsible for a very high proportion of deaths due to poisoning. It is important to keep in mind, however, that health surveillance initiatives must also address rare or unusual phenomena that are not necessarily detected using existing surveillance activities.

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Appendix 1

Summary of Selected Scientific Articles

Summary of Selected Scientific Articles

The table on the next page presents the selected scientific articles on the monitoring or investigation of deaths due to chemical poisoning (drugs, medications, poisons) for which data was obtained from coroners, medical examiners, or death certificates. They are classified by country as well as by relevance. The relevance of the articles was assessed according to the following criteria: country where the study was located, data source and similarity with the data collection system of Bureau du coroner du Québec, substances investigated or detected that may be found in Québec, presence of information that may facilitate the development of indicators.

The following relevance scale was used:

- **-** Not relevant
- ***** Not very relevant
- ****** Relevant

Table 3 Summary of selected scientific articles

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Canada						
Sinyor et al., 2012	Toronto, Canada, 1998-2007	Examine the characteristics of suicides by overdose	Office of the Chief Coroner for Ontario	Death by suicide, overdose	Only one substance was detected in half of the cases, while two or more substances were detected in about 40% of the cases. Detected: ▪ Acetaminophen ▪ Amitriptyline ▪ Bupropion ▪ Carbamazepine ▪ Citalopram ▪ Cocaine ▪ Codeine ▪ Diazepam ▪ Diltiazem ▪ Diphenhydramine ▪ Doxepin ▪ Ethanol ▪ Lorazepam ▪ Methadone ▪ Morphine ▪ Olanzapine ▪ Oxycodone ▪ Salicylates ▪ Secobarbital ▪ Temazepam ▪ Venlafaxine	**

Note: No statistically significant demographic or gender differences.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Canada (cont.)						
Poulin, Stein, and Butt, 1998	Halifax, Canada, 1993-1995	Describe the characteristics of deaths from drug or medication overdoses	Office of the Chief Medical Examiner (OCME)	All deaths from drug or medication overdoses	Detected: ▪ Acetaminophen ▪ Antidepressants (amitriptyline, doxepin, imipramine, nortriptyline, sertraline, fluoxetine) ▪ Atropine ▪ Butalbital ▪ Codeine ▪ Cyanide ▪ Diphenhydramine ▪ Ethanol ▪ Choral hydrate ▪ Hydrocarbons ▪ Insulin ▪ Isopropanol ▪ Ketamine ▪ Lidocaine ▪ Meperidine ▪ Methadone ▪ Methanol ▪ Methocarbamol ▪ Morphine ▪ Orphenadrine ▪ Phenobarbital ▪ Ranitidine ▪ Salicylates ▪ Toluene ▪ Verapamil ▪ Zopiclone	**

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States						
Shah, Lathrop, and Landen, 2005	New Mexico, United States, 1994–2003	▪ Determine the methadone mortality rate ▪ Characterize methadone deaths ▪ Discuss the surveillance of methadone deaths	▪ Office of the Medical Investigator (OMI) ▪ Toxicology Bureau of the New Mexico Scientific Laboratory Division (SLD)	Death by unintentional methadone overdose	▪ Methadone	**

Note: Indicators: number of cases of unintentional methadone overdose per year; proportion of cases of unintentional methadone overdose in relation to total number of unintentional drug overdoses Cases of unintentional methadone overdose: death by methadone, simultaneous poisoning by methadone and other prescription medications, simultaneous poisoning by methadone and other illegal drugs.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Sternfeld, Perras, and Culross, 2010	Los Angeles, United States, 2000-2008	Present the surveillance program in order to: ▪ Detect deaths by drugs or medications ▪ Analyze mortality trends ▪ Provide death data to addiction treatment and prevention agencies	Los Angeles County Coroner (LACC)	All deaths by intentional or unintentional poisoning ▪ Excludes deaths where substances were present but did not cause death	Classification of substances into 15 classes: 1. Non-opioid analgesics 2. Opioid analgesics 3. Local anesthetics 4. Antidepressants 5. Anti-epileptics 6. Antihistamines 7. Antipsychotics 8. Cardiovascular 9. Ethanol 10. Hallucinogens 11. Muscle relaxants 12. Sedatives (including hypnotics and tranquilizers) 13. Stimulants 14. Other drugs, medications 15. Other substances (e.g., volatile compounds, cyanide, arsenic) Most frequently detected: Opioid analgesics, stimulants See Table 2 in the article for a list of substances found in > 100 deaths by drugs or medications.	**

Note: Heroin: Presence of 6-monoacetylmorphine OR positive for morphine AND coroner's mention of "heroin." Deaths were categorized into four distinct categories: legal drugs only, illegal drugs only, combinations of legal and illegal drugs, and negative test results. Mortality rate per drug or medication per year calculated by: demographic group, substance category, intentional or unintentional, and legal status of the substance.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class		Relevance
United States (Cont.)							
Lee et al., 2014	Florida, United States, 2001–2012	▪ Examine trends and patterns of deaths where drugs or medications were detected ▪ Assess the proportion of deaths caused by a drug or medication compared to those where the substance was not the cause	Florida Medical Examiner Commission (MEC)	All deaths where drugs or medications were detected	Detected: ▪ α-Hydroxyalprazolam ▪ α-Hydroxytriazolam ▪ 7-Aminoclazepam ▪ Alprazolam ▪ Amphetamine ▪ Methamphetamine ▪ Buprenorphine ▪ Cannabis ▪ Carisoprodol ▪ Chlordiazepoxide ▪ Chlorodifluoromethane ▪ Clonazepam ▪ Cocaine ▪ Codeine ▪ Desalkylflurazepam ▪ Diazepam ▪ Difluoroethane ▪ Estazolam ▪ Ethanol ▪ Fentanyl ▪ Flunitrazepam ▪ Flurazepam ▪ Freon ▪ Gamma hydroxybutyrate (GHB) ▪ Helium ▪ Heroin ▪ Hydrocodone	▪ Hydromorphone ▪ Ketamine ▪ Lorazepam ▪ MDA ▪ MDEA ▪ MDMA ▪ Meperidine ▪ Methadone ▪ Midazolam ▪ Morphine ▪ Oxazepam ▪ Oxycodone ▪ Nitrous oxide ▪ Oxymorphone ▪ Phencyclidine (PCP) ▪ Phentermine ▪ Propoxyphene ▪ Temazepam ▪ Toluene ▪ Tramadol ▪ Triazolam ▪ Zolpidem ▪ Other amphetamines ▪ Other benzodiazepines ▪ Other opioids ▪ Other volatile substances	**

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Slavova et al., 2017	Kentucky, United States, 2013–2014	Link different databases to improve the assessment of drug poisoning	▪ Kentucky state Medical Examiners Office (KSMEO) ▪ Kentucky Office of Vital Statistics ▪ Kentucky All Schedule Prescription Electronic Reporting ▪ Kentucky State Police Central Forensic Laboratory	All deaths from drug or medication overdose	Detected: ▪ Alprazolam ▪ Amphetamine ▪ Buprenorphine ▪ Clonazepam ▪ Cocaine ▪ Diazepam ▪ Fentanyl ▪ Gabapentin ▪ Heroin ▪ Hydrocodone ▪ Methadone ▪ Morphine ▪ Oxycodone ▪ Oxymorphone ▪ Tramadol	**
Sims, Snow and Porucznik, 2007	Utah, United States, 1997–2004	Determine trends in methadone overdose deaths using a combination of databases	▪ Utah Controlled Substances Database (CSDB) ▪ Office of the State Medical Examiner ▪ Office of Vital Records and Statistics ▪ Emergency Department Encounter Database	All deaths from methadone overdose, excluding suicides	▪ Methadone	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Leon et al., 2004	New York City, United States, 1993–1998	Report the proportion of suicides in children under 18 in whom paroxetine or other antidepressants were detected	Office of the Chief Medical Examiner of New York City	All suicides by children under 18	Investigated: ▪ Paroxetine chlorhydrate ▪ Other antidepressants Detected: ▪ Amitriptyline ▪ Fluoxetine ▪ Imipramine	*
Nourjah et al., 2006	United States, 1998–2005	Determine the prevalence of acetaminophen overdoses	▪ National Hospital Ambulatory Medical Care Survey (NHAMCS) ▪ Consumer Product Safety Commission's (CPSP) National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) ▪ National Hospital Discharge Survey (NHDS) ▪ National Multiple Cause of Death File ▪ Toxic Exposure Surveillance System (TESS) ▪ Adverse Event Reporting System (AERS)	All deaths from acetaminophen overdose	▪ Acetaminophen	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Sinyor et al., 2009	Kentucky, United States, 1999–2005	Assess gender differences in poisoning and the contribution of domestic violence	▪ Kentucky Violent Death Reporting System (KVDRS) ▪ CDC's Web-based Injury Statistics Query and Reporting System (WISQARS) ▪ Coroner Investigation Report (CIR)	All deaths by suicide	Detected: ▪ Alcohol ▪ Amphetamine ▪ Antidepressants ▪ Opioids	*
Shah et al., 2012	West Virginia, United States, 2005–2007	Describe the characteristics of alprazolam deaths	▪ West Virginia Office of the Chief Medical Examiner (Wv OCME) ▪ West Virginia Board of Pharmacy Controlled Substances (CSMP)	Death by poisoning (drugs or medication) or death favoured by the presence of alprazolam	▪ Alprazolam (benzodiazepine) Detected together with Alprazolam: ▪ Amitriptyline ▪ Citalopram ▪ Cocaine ▪ Diazepam ▪ Diphenhydramine ▪ Ethanol ▪ Fentanyl ▪ Hydrocodone ▪ Methadone ▪ Morphine ▪ Oxycodone ▪ Propoxyphene	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Shah et al., 2008	New Mexico, United States, 1994–2003	▪ Explore the drug combinations involved in poisoning deaths ▪ Identify ethnic and gender differences in overdose trends	Office of the Medical Investigator (OMI)	All deaths from drug or medication overdoses	▪ Cocaine ▪ Codeine ▪ Fentanyl ▪ Heroin ▪ Hydrocodone ▪ Hydromorphone ▪ Meperidine ▪ Methadone ▪ Morphine ▪ Oxycodone ▪ Propoxyphene	*
Sinyor et al., 2008	Florida, United States, 2004–2005	Identify the circumstances of deaths caused by hurricanes	▪ Medical Examiners Commission (MEC) ▪ Death certificates	Deaths directly or indirectly related to hurricanes	▪ Carbon monoxide	*
Sinyor et al., 2004	United States, 1998–2005	Assess the pathology, toxicology, causes, and circumstances of deaths involving MDMA	Medical Examiner and Coroner Information Sharing Program (MECISP)	Deaths where MDMA was detected in urine or blood	▪ 3,4-methylenedioxy-methamphetamine (MDMA)	*
Mueller, Shah, and Landen, 2006	New Mexico, United States, 1994–2003	Examine trends in drug- and medication-related deaths and describe the characteristics of the deceased	▪ New Mexico Office of the Medical Investigator (OMI) ▪ Toxicology Bureau of the New Mexico Scientific Laboratory Division (SLD)	Death by unintentional poisoning by drugs or medication (excluding other poisons)	Prescription medications classified as: ▪ Antidepressants ▪ Barbiturates ▪ Opioids ▪ Tranquilizers ▪ Other	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Hall et al., 2008	West Virginia, United States, 2006	Characterize drug overdose deaths	▪ Death certificates ▪ Office of the Chief Medical Examiner (OCME) ▪ Health Statistics Centre	All overdose deaths involving a prescription drug	Detected (in decreasing order of frequency): ▪ Methadone ▪ Hydrocodone ▪ Diazepam ▪ Oxycodone ▪ Alprazolam ▪ Antidepressants (amitriptyline, bupropion, citalopram, desipramine, doxepin, fluoxetine, imipramine, mirtazapine, nortriptyline, paroxetine, sertraline, trazodone, venlafaxine) ▪ Morphine ▪ Fentanyl ▪ Benzodiazepines (chlordiazepoxide, clonazepam, temazepam) ▪ Other opioids ▪ Other psychotherapeutic medications	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Sinyor et al., 2004	New York City, United States, 1990–1998	▪ Examine the methadone overdose trend ▪ Compare data on deaths related to methadone and heroin use to data from England ▪ Compare the characteristics of methadone deaths to those of heroin deaths	Office of the Chief Medical Examiner of New York City (OCME)	All deaths by methadone and heroin overdose, in the 15–64 age group	▪ Heroin ▪ Methadone	*
Centers for Disease Control and Prevention CDC, 2006	West Virginia, United States, 2004–2005	Measure the prevalence of road accident fatalities where ethanol or legal or illegal drugs were detected	West Virginia Office of the Chief Medical Examiner (OCME)	All road accident deaths where a toxicological analysis was performed	Detected: ▪ Alprazolam ▪ Diazepam ▪ Ethanol ▪ Hydrocodone ▪ Methadone ▪ Methamphetamine ▪ Oxycodone ▪ Also, ethanol + drug combination, and combination of two or more drugs	*

Note: When several drugs were detected, only three of them were recorded in the following order: narcotics, depressants, stimulants, marijuana, other legal medications. Data on substance detection is therefore biased because of this restriction.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Leon et al., 2006	New York City, United States, 1999–2002	Report on the proportion of suicides among young people in whom an antidepressant was detected during the autopsy	Office of the Chief Medical Examiner (OCME)	Death by suicide in children under 18	Bupropion and sertraline detected in only one case (out of 41 suicides)	*
Sinyor et al., 1997	United States, 1998–2005	Examine deaths among former or current clozapine users	▪ Social Security Administration Death Master Files ▪ National Death Index	Death by agranulocytosis, convulsions, cardiac electrical conduction disorder, pulmonary embolism, or suicide among former or current clozapine users	▪ Clozapine	*
Leon et al., 2007	New York City, United States, 2001–2004	Determine the proportion of suicides where antidepressants were detected	New York City Office of Chief Medical Examiner	All deaths by suicide	Detected: ▪ Bupropion ▪ Citalopram ▪ Fluoxetine ▪ Nortriptyline ▪ Paroxetine ▪ Sertraline ▪ Venlafaxine	*
Stanley et al., 2016	Maryland, United States, 2003–2011	Describe the circumstances of violent deaths among the homeless	Maryland Violent Death Reporting System (MVDRS)	Deaths among the homeless	Detected: ▪ Alcohol ▪ Cocaine ▪ Opioids ▪ Other drugs	-

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Kim et al., 2007	Cook County, Chicago, United States, 1995-2004	Describe the causes and characteristics of deaths in a prison	Medical Examiner's reports	All deaths among prisoners	▪ Not reported	-
Liu et al., 1993	California, United States, 1990-1991	Examine the characteristics and trends of deaths due to carbon monoxide poisoning	Death certificates	All deaths by carbon monoxide poisoning	▪ Carbon monoxide	-
Hingson, Zha, and Weitzman, 2009	United States, 1998–2005	Examine changes in the trend in alcohol-related road traffic deaths among 18–24-year-olds	▪ National Highway Traffic Safety Administration's Fatality Analysis Reporting System ▪ Centers for Disease Control ▪ U.S. Census Bureau ▪ Substance Abuse and Mental Health Services Administration ▪ Medical Examiners' studies	All road traffic deaths among 18–24-year-olds	▪ Ethanol	-

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
United States (Cont.)						
Wysowski, 2007	United States, 1998–2005	Identify trends in drug- and medication-related deaths	Division of Vital Statistics (NCHS)	All deaths by drug and medication poisoning	▪ Not specified, by ICD-10 code only	-
Sinyor et al., 2006	District of Columbia, United States, 1996-1998	Describe the circumstances of deaths by poisoning	▪ District of Columbia Adolescent Injury Surveillance System ▪ Office of the Chief Medical Examiner (OCME)	Adolescents (10–19 years old) in a predominantly African-American neighbourhood who were victims of poisoning	▪ Alcohol (1 death)	-

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
France						
Champeau et al., 2016	Languedoc-Roussillon, France, 2009-2013	Analyze deaths related to psychotropic drugs or illicit substances	"Drames" survey, an annual prospective study that surveys toxicologists for data on overdose-related deaths	All deaths by overdose of psychotropic medications or other substances	Detected: ▪ Alimemazine ▪ Amphetamine ▪ Buprenorphine ▪ Cannabis ▪ Cocaine ▪ Codeine ▪ Diazepam ▪ Ethanol ▪ Hydroxyzine ▪ Ketamine ▪ MDMA ▪ Methadone ▪ Morphine ▪ Oxazepam ▪ Temazepam	**

Note: The concentrations of the substances found were compared to toxic doses found in reference works. The substances involved in deaths were those whose doses exceeded toxic thresholds. Only peripheral venous blood samples or cardiac blood samples were used. The presence of > 1 g/L ethanol or THC was associated with death, but not the cause.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Australia and New Zealand						
Pilgrim, Gerostamoulos, and Drummer, 2011b	Victoria, Australia, 2002–2008	Examine the incidence of deaths caused by incorrect drug therapy using serotonergic medications	National Coroners Information System (NCIS)	All deaths where a serotonergic medication was detected	▪ Citalopram ▪ Fluoxetine ▪ Paroxetine ▪ Sertraline ▪ Tramadol ▪ Venlafaxine	**
Pilgrim, Gerostamoulos, and Drummer, 2014	Victoria, Australia, 2002–2008	Determine the prevalence of duloxetine deaths and the blood levels detected	National Coroners Information System (NCIS)	All deaths where duloxetine was detected	▪ Duloxetine Other detected substances that may have contributed to toxicity: ▪ Antidepressants ▪ Non-steroidal anti-inflammatory medications ▪ Antipsychotics ▪ Benzodiazepines ▪ Fentanyl ▪ Selective serotonin reuptake inhibitors (SSRIS) ▪ Metoclopramide ▪ Mirtazapine ▪ Oxycodone	**

Note: The study focused on known interactions between these and other medications, classified into 4 categories: Serotonin medications detected in the presence of a contraindicated medication; [...] detected in the presence of a medication that may cause a serious interaction; [...] detected in the presence of a medication that may cause a moderate interaction; [...] detected in the presence of a medication that may cause a weak interaction.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Australia and New Zealand (Cont.)						
McDowell, Fowles, and Phillips, 2005	New Zealand, 2001–2002	Describe the characteristics of deaths by drug, medication, and chemical poisoning	Coronial Service Office	All deaths by poisoning	Detected: ▪ Caron monoxide (43.9 % of poisonings) ▪ Amitriptyline ▪ Chlorpromazine ▪ Clozapine ▪ Codeine ▪ Cyanide ▪ Dextropropoxyphene, paracetamol ▪ Dothiepin ▪ Doxepin ▪ Ethanol ▪ Ethylene glycol ▪ Cooking oil fire ▪ Gamma-hydroxybutyrate (GHB) ▪ Heroin ▪ Hydrocarbons ▪ Insulin ▪ Methadone ▪ Methamphetamine ▪ Methanol ▪ Morphine ▪ Nortriptyline ▪ Paroxetine ▪ Propranolol ▪ Triazolam ▪ Zopiclone	**

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Australia and New Zealand (Cont.)						
Zador and Sunjic, 2002	New South Wales, Australia, 1996	▪ Identify the methadone formulation involved in the poisonings ▪ Estimate the proportion of deaths related to the use of methadone other than for treatment (diversion) ▪ Estimate the proportion of methadone deaths relative to the total number of patients starting treatment	▪ Division of Analytical Laboratories (DAL) ▪ Pharmaceutical Services Branch (PSB) ▪ Coroner's records	Methadone deaths, including those of people who had started treatment	▪ Methadone (syrup + tablets)	*
Rintoul et al., 2011	Victoria, Australia, 2002–2008	Identify trends in oxycodone deaths and associated demographic and socioeconomic characteristics	National Coroners Information System (NCIS)	Deaths where oxycodone was detected	▪ Oxycodone	*

Note: Case: detection of oxycodone in urine, blood, or tissue, unless detected in hair only.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Australia and New Zealand (Cont.)						
Kaye, Darke, and Duflou, 2009	Australia, 2000–2005	Determine the number of deaths per MDMA and its characteristics	National Coroners Information System (NCIS)	All deaths where MDMA or MDA was detected	Detected: ▪ Antidepressants ▪ Antipsychotics ▪ Benzodiazepines ▪ Cocaine, benzoylecgonine ▪ Codeine ▪ Ethanol ▪ Gamma-hydroxybutyrate (GHB) ▪ Ketamine ▪ MDA ▪ MDMA ▪ Methadone ▪ Methamphetamine, amphetamine ▪ Morphine ▪ Tetrahydrocannabinol (THC)	*
Pilgrim, Dorward, and Drummer, 2017	Australia, 2003-2013	Estimate the mortality rate and patterns of drug- or medication-related deaths among health professionals	National Coroners Information System (NCIS)	Death by poisoning among health professionals	Detected: ▪ Antidepressants, Antipsychotics ▪ Barbiturates (pentobarbital, phenobarbital) ▪ Benzodiazepines ▪ Ethanol ▪ Opioids (morphine, fentanyl, oxycodone, Methadone)	*
Pilgrim and Drummer, 2013	Victoria, Australia, 2002–2008	Determine the prevalence and characteristics of deaths involving quetiapine	National Coroners Information System (NCIS)	All deaths where quetiapine was detected	▪ Quetiapine	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Australia and New Zealand (Cont.)						
Pilgrim, Woodford, and Drummer, 2013	Victoria, Australia, 2002–2008	Examine the role of cocaine in sudden and unexplained deaths	National Coroners Information System (NCIS)	All deaths where cocaine or its metabolites were detected	▪ Cocaine ▪ Benzoylecgonine	*
Pilgrim, Gerostamoulos, and Drummer, 2011b	Victoria, Australia, 2002–2008	Examine the role of ecstasy (MDMA) in sudden and unexplained deaths due to drug or medication interactions	National Coroners Information System (NCIS)	All deaths where MDMA was detected	▪ MDMA	*
Roxburgh et al., 2013	Australia, 2000–2012	Document fentanyl prescription trends and associated deaths	▪ Drug Utilisation Sub-Committee of the Pharmaceutical Benefits Advisory Committee ▪ National Coroners Information System (NCIS)	All deaths where fentanyl was detected	▪ Fentanyl Detected together with fentanyl (in decreasing order of frequency): ▪ Benzodiazepines ▪ Antidepressants ▪ Morphine ▪ Oxycodone ▪ Ethanol ▪ Cannabis ▪ Codeine ▪ Antipsychotics ▪ Tramadol ▪ Amphetamine ▪ Cocaine	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Australia and New Zealand (Cont.)						
Degenhardt, Roxburgh, and Barker, 2005	Australia, 1997-2002	Examine trends and patterns of deaths where opioids, cocaine, or amphetamine was detected	Cause of Death (COD) collection of Australian Bureau of Statistics (ABC)	All deaths where cocaine, an opioid, or amphetamine was detected	▪ Amphetamine ▪ Cocaine ▪ Opioids	*
Reith, Fountain, and Tilyard, 2005	New Zealand, 2001–2002	Determine the mortality rate due to opioids	Coronial Services Office (CSO)	All deaths by opioids	▪ Codeine ▪ Dextropropoxyphene ▪ Dihydrocodeine ▪ Methadone ▪ Morphine	*
Roxburgh et al., 2015	Australia, 2001-2013	Examine trends and patterns in deaths by codeine, heroin, and other opioids	National Coroners Information System (NCIS)	All deaths involving codeine	Detected: ▪ Amphetamine ▪ Antidepressants ▪ Benzodiazepines ▪ Cannabis ▪ Codeine ▪ Doxylamine ▪ Ethanol ▪ Ibuprofen ▪ Methadone ▪ Oxycodone ▪ Paracetamol ▪ Tramadol	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Australia and New Zealand (Cont.)						
Cutajar et al., 2010	Victoria, Australia, 2002–2008	Examine the risk of suicide and unintentional poisoning in a population of people who have been sexually abused in childhood	Victorian Coronial Information Database (VCID)	All deaths by overdose in people who have been sexually abused in childhood	Detected: ▪ Carbon monoxide ▪ Other (unspecified substances)	*
Roxburgh et al., 2011	Australia, 2002-2008	Present morphine and oxycodone consumption trends and deaths related to oxycodone use	National Coroners Information System (NCIS)	All deaths involving oxycodone	▪ Oxycodone	*
Berecki-Gisolf et al., 2017	Victoria, Australia, 2002–2008	Describe the population's exposure to opioids, as well as the frequency and distribution of hospital admissions and deaths due to opioids	Cause of Death Record file, provided by the Victorian Injury Surveillance Unit	All deaths involving an opioid	Detected (death data only, according to ICD10): ▪ Codeine ▪ Methadone ▪ Morphine ▪ Other synthetic narcotics	-
Williamson et al., 1997	South Australia, 1984–1994	Identify deaths by methadone overdose and determine the impact of formulation	South Australian Coroner's Office	All deaths by methadone overdose	▪ Methadone	-

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other						
Schaper et al., 2006	Germany, 1996-2003	Provide a summary of substances that caused death	GIZiNDEX poison center database	All deaths by poisoning	▪ Acetylsalicylic acid ▪ Tricyclic antidepressants ▪ Beta blockers ▪ Calcium channel blockers ▪ Chloroquine ▪ Cyanide ▪ Metformin ▪ Methanol ▪ Carbon monoxide ▪ Organophosphorus pesticides ▪ Theophylline ▪ Carbamazepine Other ▪ Food poisoning ▪ Plant and mushroom poisoning (Taxus, Aconitum, Amanita) ▪ Cosmetic poisoning (e.g., deodorant inhalation) ▪ Deaths caused by breathing in detergents	**

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class		Relevance
Other (Cont.)							
Jonsson et al., 2007	Switzerland, 2002–2003	Examine the characteristics and substances involved in overdose deaths	National Board of Forensic Medicine	All deaths by overdose	Detected (in order of decreasing frequency) : ▪ Ethanol ▪ Morphine ▪ Amphetamine ▪ Codeine ▪ Tetrahydrocannabinol (THC) ▪ Diazepam ▪ Nordazepam ▪ 6-monoacetylmorphine ▪ 7-Amono-flunitrazepam ▪ Acetaminophen ▪ Methadone ▪ Alimemazine ▪ Propoxyphene ▪ Tramadol ▪ Citalopram ▪ Carbamazepine ▪ Benzolecgonine ▪ Methamphetamine ▪ Zopiclone ▪ 7-Amino-nitrazepam ▪ 7-Amino-clonazepam ▪ Alprazolam ▪ Mirtazapine ▪ MDMA	▪ Promethazine ▪ Dihydropropiomazine ▪ Fentanyl ▪ Sertraline ▪ Orphenadrine ▪ Fluoxetine ▪ Levomepromazine ▪ Lidocaine ▪ Ethylmorphine ▪ Oxazepam ▪ MDA ▪ Ketobemidone ▪ Phenazone ▪ Zolpidem ▪ GHB ▪ Ephedrine ▪ Caffeine ▪ Olanzapine ▪ Ketamine ▪ Chloroquine ▪ Norephedrine ▪ Carisoprodol ▪ Bromazepam ▪ Paroxetine ▪ Meprobamate	**

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other (Cont.)						
Koski, Vuori, and Ojanpera, 2005	Finland, 1995–2002	Analyze alcohol and drug concentrations in deaths involving alcohol and either amitriptyline, propoxyphene, or promazine	Forensic Toxicology Division of the University of Helsinki	All deaths due to alcohol and drug interactions	Ethanol, together with one of these substances: ▪ Amitriptyline ▪ Promazine ▪ Propoxyphene	**

Note: Cases included: Death by amitriptyline OR propoxyphene OR promazine; presence of ethanol and one of these substances; presence of ethanol and one of these substances at concentrations equal to or higher than the therapeutic dose: ≥ 0.2 mg/L for amitriptyline, 0.75 mg/L for propoxyphene, 0.4 mg/L for promazine. Cases consisted of accidental deaths, suicides, or deaths of undetermined cause.

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other (Cont.)						
Risser and Schneider, 1994	Vienna, Austria, 1985–1992	Present trends in poisoning deaths and possible causes	Institute of Forensic Medicine in Vienna	All deaths by poisoning	Detected: ▪ Alcohol ▪ Barbiturates ▪ Cannabis ▪ Cocaine ▪ Diazepine ▪ Fencamfamin ▪ Fenetylline ▪ Methaqualone ▪ Methadone ▪ Morphine ▪ Phendimetrazine	*
Shi et al., 2012	Yunan, China, 2006–2009	Report on monitoring results and control measures for poisoning cases caused by *Trogia venenata* (mushroom)	Medical autopsy reports	Sudden and unexplained deaths	▪ *Trogia venenata (mushroom)*	*

Note: Cases: loss of autonomy and mortality within < 24 hours, after excluding other probable causes Cluster: Two cases in the same village in < 30 days.
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Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other (Cont.)						
Papadopoulos et al., 2010	Greece, 1996–2001	Determine the frequency of road accidents caused by alcohol and drug use	Athens Forensic Medical Department	Death by road accident involving alcohol and drug use	Investigated: ▪ Alcohol ▪ Amphetamine ▪ Tricyclic antidepressants ▪ Benzodiazepines ▪ Cannabis ▪ Heroin ▪ Carbon monoxide ▪ Phenothiazine ▪ Poisons ▪ Salicylates ▪ Detected: ▪ Alcohol ▪ Amphetamine ▪ Cannabis ▪ Heroin	*
Sinyor et al., 2016	Cukurova, Turkey, 2007–2011	Examine the number and nature of poisoning deaths	Council of Forensic Medicine	All deaths by poisoning	Investigated: ▪ Alcohol ▪ Amphetamine ▪ Barbiturates ▪ Benzodiazepines ▪ Cocaine ▪ Prescription medication ▪ Carbon monoxide ▪ Opioids ▪ Pesticides ▪ THC ▪ Other volatile substances	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other (Cont.)						
Konstantinova-Larsen et al., 2011	Norway, 2000–2009	Describe trends in deaths from illegal drugs	Norwegian Institute of Public Health (NPHI)	Deaths among 15–64 year olds	Detected: ▪ Alprazolam ▪ Amphetamine ▪ Cannabis ▪ Clonazepam ▪ Cocaine ▪ Diazepam ▪ Ethanol ▪ Phenazepam ▪ Flunitrazepam ▪ Heroin ▪ MDMA ▪ Methamphetamine ▪ Nitrazepam ▪ Opioids (rare) ▪ Oxazepam ▪ Zolpidem ▪ Zopiclone	*
Lee, Rhee, and Yum, 2012	Seoul, South Korea, 2005–2010	Determine a baseline for cyanide poisoning deaths	National Forensic Service	Death by cyanide	▪ Cyanide	*
Bedford, O'Farrell, and Howell, 2006	Cavan, Monaghan, and Louth, Ireland, 2001–2002	Identify ethanol concentrations found in people who had died as a result of an accident or suicide	Coroner's records	Death by accident or suicide	▪ Ethanol	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other (Cont.)						
Sidlo, 2009	Slovakia, 2000–2007	Examine the circumstances surrounding road accidents involving psychoactive substances	Slovak medical forensic workplaces – Heathcare Surveillance Authority	Death by road accident involving psychoactive substances	Detected: ▪ Amphetamine ▪ Benzodiazepines ▪ Cannabis ▪ Cocaine ▪ Ethanol ▪ Heroin ▪ MDMA ▪ Methadone ▪ Toluene ▪ Other opioids	*
Lai, Yao, and Lo, 2006	Singapore, 2003–2004	Determine the prevalence, incidence, and characteristics of deaths caused by buprenorphine	Centre for Forensic Medicine and Centre for Forensic Science	Death by buprenorphine overdose	▪ Buprenorphine	*
Varma, Shinde, and Lamb, 2012	India, 2008–2009	Assess trends in pesticide poisoning	Autopsies performed in hospitals	All deaths from pesticide poisoning	Detected (in order of decreasing frequency): ▪ Monocrotophos ▪ Quinalphos ▪ Methyl parathion ▪ Endosulfan ▪ Malathion ▪ Dimethoate ▪ Dichlorwash ▪ Phoselon ▪ Chlorpyriphos ▪ Carbamate ▪ Phosphamidon	*

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other (Cont.)						
Dermengiu et al., 2013	Romania, 2008–2011	Examine trends in deaths due to drug and medication poisoning	Institutes of legal medicine	All deaths by drug and medication poisoning	▪ Barbiturates ▪ Benzodiazepines ▪ Cannabis ▪ Cocaine ▪ Ergotamine ▪ Ketamine ▪ MDE ▪ MDMA ▪ MDPPP ▪ Methadone ▪ Methorphan ▪ Morphine ▪ Oxycodone ▪ Pethidine ▪ Tramadol ▪ Zopiclone	-
Carlini-Cotrim and da Matta Chasin, 2000	Sao Paulo, Brazil, 1994	Examine the association between alcohol consumption and deaths due to accident or violence	Sao Paulo Institute of Forensic Medicine	All violent deaths among people aged 13 and over	▪ Ethanol	-

Table 3 Summary of selected scientific articles (continued)

Author, Year	City, Country, Period	Study Objective	Data Source	Population and/or Circumstance of Death	Substance or Substance Class	Relevance
Other (Cont.)						
Marasovic Susnjara et al., 2011	Split-Dalmatia County, Croatia, 1986–2000	Examine trends and patterns of drug or drug overdose deaths before (1986–1990), during (1991–1995), and after (1996–2000) the war	▪ Department of Forensic Medicine, University Hospital Split ▪ National register of death records ▪ Archives of the Split-Dalmatia County Police ▪ Register of Treated Drug Addicts of the Croatian National Institute of Public Health	All deaths by overdose	▪ Alcohol ▪ Benzodiazepines ▪ Heroin ▪ Other (unspecified)	-

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