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TOXICOVIGILANCE: THE MONITORING OF CHEMICAL HEALTH THREATS

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SUMMARY

Poisoning is an important public health problem. The province of Québec currently monitors a limited number of poisonings, but no formal monitoring structure allowing the rapid detection of new types of poisonings has been implemented. In the present article, the authors address the toxicovigilance principle and offer suggestions regarding the improvement in the Québec system for chemical health risks monitoring from a public health standpoint.

INTRODUCTION

Poisoning is defined as all incidents caused by toxic substances, originating from outside or inside the body.\(^1\) The World Health Organization (WHO) states that poisonings are an important public health problem, and according to its data, approximately 346,000 people died worldwide in 2004 following involuntary poisoning.\(^2\) In Canada, in 2005, death by poisoning was the third cause of unintentional violent death (3.2 deaths per 100,000 people), after deaths by motor vehicle crashes and falls.\(^3\) According to the data from the Infocentre de santé publique du Québec (Québec public health infocentre), 504 poisoning deaths were recorded annually between 2006 and 2008.\(^4\) Deaths by poisoning during these years represented 0.9% of all deaths, compared to 1.1% for all motor vehicle crashes.\(^4\) They also represented 15% of all traumatic deaths. The Québec poisoning death rate was 6.6 per 100,000 people, in decreasing order of importance of poisonings: intentional (3.3/100,000); accidental (2.7/100,000); and where intention could not be determined (0.6/100,000).\(^4\)

In 1998, during the ice storm in Québec, the importance of direct collaboration between the toxicology network, mainly the Centre antipoison du Québec (CAPQ, Québec poison control centre), and public health authorities was noted.\(^5\) Since 2010, the clinical toxicology team of the Institut national de santé publique du Québec (INSPQ) decided to strengthen its ties with the CAPQ in order to develop a toxicovigilance process. Four toxicovigilance bulletins resulted from this collaboration.\(^6\,\,9\) However, no official structure has been implemented to date. The development of such bulletins intends to inform health professionals and the general population of imminent dangers. It thus largely depends on the good will of active professionals to report the emergence of a potential threat. Subsequently, attempts to establish the incidence with information searches are done. However a certain number of threats may never be identified.
In 2014, with our society’s technological advances, one could assume that toxic risks can be followed in real time by means of different databases, and that public health authorities are immediately informed as need be. Unfortunately, the Québec reality is something completely different.

Before proposing a toxicovigilance structure adapted to the Québec context, the literature must be searched in order to document the processes already implemented and their effectiveness. The goals of this study are therefore to define and clarify the definition of toxicovigilance and to document the toxicovigilance programs established elsewhere in Canada and throughout the world.

METHODOLOGY

In the summer and fall of 2013, searches were carried out in the documented databases by “360 Search” (Medline, Embase, Scirus, and several others), as well as by the Google and Google Scholar search engines. The key words used were: toxicovigilance, toxico-vigilance, toxicosurveillance, toxico-surveillance, toxicant, poisoning, toxic exposure, toxicology, monitoring, surveillance, vigilance. The references cited in the identified documents were examined in order to extract the pertinent documentation. Only French and English language documents were retained for this study. Experts were also consulted when the information was not available or not well documented.

RESULTS

Definitions

Toxicovigilance

According to WHO, toxicovigilance is the active process of identifying and evaluating the toxic risks existing in a community, and evaluating the measures taken to reduce or eliminate them. Its role is to determine whether poisonings were caused by specific agents or circumstances, or whether certain populations suffer a higher incidence of poisonings. It can also reveal whether a toxicological problem exists, resulting for example from the reformulation of a product or a change to its packaging or labeling, the availability of a new drug of abuse or an environmental contamination. Its ultimate goal is therefore to reduce the incidence of poisonings by identifying new toxicological risks.\(^{(10)}\)

In Canada, the term toxicovigilance is not used in any law or regulation. However, a definition is proposed by the Translation Bureau of Public Works and Government Services Canada. It is the "systematic notification, registration and evaluation of reactions to toxic substances" (free translation), but this definition seems limited to toxicity in the workplace.\(^{(11)}\)

According to the American College of Medical Toxicology (ACMT), toxicovigilance incorporates the active evaluation, assessment and validation of clinical adverse effects related to a toxic exposure.\(^{(12)}\)

In France, toxicovigilance is described as "the monitoring of the toxic human effects of a product, a substance or pollution for the purposes of carrying out warning, prevention, training and information actions." (free translation)\(^{(13)}\)
According to Eilstein et al., toxicovigilance is "interested in any known or new health event, even if it is not related \textit{a priori} to a substance or a mixture of toxic substances. In fact, it operates by starting from the viewpoint that any pathological manifestation not directly identified as having an infectious origin or as being related to another type of vigilance may be of toxic origin." (free translation)

According to Cochet, "like all types of vigilance, toxicovigilance monitors known effects or identifies unknown effects; it is not limited to providing a response to enquiries relating to toxic risks, but also operates upstream from the detection of toxic warning signals." (free translation)

The different functions of toxicovigilance are: the analysis of the consequences of human exposures to xenobiotics, the detection of hazardous situations (known or unknown), and the estimation and documentation of the health impact.

According to Descotes, toxicovigilance is the active process of research, detection, identification, validation and follow-up of adverse effects related to toxic exposures. It helps identify sentinel cases in relation to a certain exposure, and triggers signals on toxic risks not identified beforehand. Toxicovigilance is based on the in-depth medical assessment of acute or chronic poisonings, even on an individual basis.

\textit{Toxosurveillance}

According to Schier, of the Centers for Disease Control and Prevention (CDC) in the United States, the goals of toxosurveillance are: to improve public health surveillance for chemical exposures, to identify early markers of chemical events (including characteristic symptom complexes, temporal or regional increases in hospitalizations, and sudden increases in case frequency or severity) and to track ongoing events.

\textit{Pharmacovigilance}

According to WHO, pharmacovigilance is defined as the science and activities relating to the detection, assessment, understanding and prevention of adverse effects or any other drug-related problem. The aims of pharmacovigilance are to enhance patient care and patient safety in relation to the use of medicines, and to support public health programs by providing reliable, balanced information for the effective assessment of the risk-benefit profile of medicines.

In Canada, the term pharmacovigilance is not used in the Food and Drug Regulations. However, according to the Translation Bureau of Public Works and Government Services Canada, pharmacovigilance is a "branch of the medical sciences dealing with the monitoring of the adverse effects of drugs, as well as with the knowledge, methods and means necessary for implementing this monitoring" (free translation).

In the United States, according to the Food and Drug Administration (FDA), pharmacovigilance mainly involves the identification and evaluation of safety signals. A safety signal is defined as a concern related to an excess of observed adverse effects compared to what would be expected to be associated with a product's use.

In France, the goal of pharmacovigilance is to monitor the risk of adverse effects resulting from the use of drugs or products mentioned in Section L5121-1 of the public health code. It
therefore considers adverse events linked to the therapeutic use of drugs as well as to their misuse or involuntary excessive consumption.\textsuperscript{(21)}

Toxicovigilance programs

France

In France, health vigilance was implemented by the law in 1998 to strengthen health monitoring and the control of the health safety of products intended for humans.\textsuperscript{(22,23)} In 1999, the first toxicovigilance decree emerged.\textsuperscript{(24)} Management and coordination of the national toxicovigilance network were entrusted to the Institut de veille sanitaire (InVS) in 2004.\textsuperscript{(23)}

The InVS is a public institution under the responsibility of the ministry in charge of health. It is responsible for surveillance and warnings in all fields of public health.\textsuperscript{(23)} It has four departments, five cross-sectional services, and 17 regional services.\textsuperscript{(25)} The Département santé environnement (environmental health department) runs nine programs, including "toxicovigilance and monitoring poisonings." This program encompasses various surveillance activities grouped into three components: one general component, which corresponds to the national toxicovigilance mechanism, and two specific components, namely surveillance of lead and carbon monoxide poisonings.

The national toxicovigilance mechanism is coordinated by the InVS, and its expertise is provided by the Comité de coordination de la toxicovigilance (CCTV, toxicovigilance coordination committee). The CCTV is made up of experts from other public agencies, directors of all the poison control and toxicovigilance centres (CAPTV) in France, and delegates from the Ministère de la Santé (ministry of health).\textsuperscript{(15,26)} CCTV members meet three to four times per year; their missions are the participation in poisoning warnings (among others by issuing toxicovigilance bulletins), the implementation of the post-marketing surveillance of new products, the participation in working groups of public health organizations needing clinical toxicology expertise, and the response to specific requests from the Ministère de la Santé or other public health authorities.\textsuperscript{(26)}

The ten French CAPTVs are part of the national toxicovigilance structure. In fact, they are often the source of warning signals which then generate toxicovigilance investigations. CAPTVs are services of university hospitals that participate actively in toxicovigilance and provide a permanent telephone response for emergency departments.\textsuperscript{(13)} Their missions consist of assessing the risk of acute or chronic toxic exposures to any product or substance, and to give advice regarding the diagnosis, prognosis and treatment of the resulting poisonings.\textsuperscript{(13)}

All the data originating from the calls made to a CAPTV are compiled in the poison control and toxicovigilance centres' information system (SICAP). The same SICAP has been generalized to all CAPTVs. Every 2 hours, the Base nationale de cas d’intoxication (BNCI, national poisoning case database) is updated by adding data originating from the SICAP of each of the CAPTVs. Every 24 hours, the Infocentre database, accessible to all physicians and toxicologists, is updated by the addition of data originating from the BNCI and the Base nationale produits et compositions (BNPC, national database of products and compositions). The latter is kept updated by the suppliers of marketed products and by all of the CAPTVs.
Due to the completeness of the BNPC regarding product composition, a causal link can be established between an exposure and the clinical picture presented by a patient.

**Figure 1** Toxicological databases of the French network

A toxicovigilance investigation is initiated following a health signal suspecting an agent or a circumstance likely to lead to a public health hazard. This health signal originates either from the CAPTVs, the health agencies or the European alerts relayed by the InVS (Figure 2). Each CAPTV receives calls concerning cases of exposure to a toxic substance in its region. These calls come from either the exposed individual, or the health professional treating the person. Certain types of exposure *must* be reported by health professionals, mainly exposures to lead as well as to carbon monoxide. According to the law, it has also been "mandatory" since 2009 that industries as well as health professionals report cases of human poisoning caused by any substance or preparation to the CAPTVs.\(^{(27)}\) To date, the decree respecting the application of this statute has still not been voted on.

When a CAPTV receives a call signaling or reporting cases likely to produce a public health hazard, it collects the necessary information by means of a standardized questionnaire. This information is then reviewed by the CAPTV toxicovigilance unit, which applies an accountability method to determine whether a causal link exists, and if need be, to create an epidemiological description. The CAPTV informs the InVS by means of the health monitoring and emergency platform of the region in question. As needed, the latter will trigger an alert and will transmit a definition of the cases investigated by means of toxicovigilance bulletins (developed by the CCTV and the InVS) to the different networks of health professionals, and information and education documents intended for the general public. It is asked that cases be reported to the CAPTV in one's own region.
However, the existing toxicovigilance system is currently in adjustment mode. In a mission relating to the reorganization of the health vigilance system that was entrusted to it in January 2013 by the Minister of social affairs and health, the director general of Health proposed, among others: the establishment of a shared portal for reporting, a shared health signal database, a regional monitoring and health assessment support group, and the strengthening of regional health safety management by the regional health agencies.

**United States**

In the United States in 2003, the CDC was entrusted with creating a national chemical terrorism surveillance system. Because of its collaboration with the American Association of Poison Control Centers (AAPCC), it was able to access the data recorded in the National Poisoning Data System (NPDS). Toxicosurveillance was thus born.\(^{17}\)

Since 1985, the AAPCC has been collecting data on poisoning cases from its PCC members.\(^{28}\) Created in 2006, the NPDS consists of all this previous data as well as all the subsequently issued data originating from the 57 PCCs in the United States.\(^{29}\)

For each call placed to a PCC, demographic and clinical information about the exposed individual is recorded on a local server. This information must be chosen from among the 131 clinical symptoms and the 72 case treatment, decontamination, and management options, predetermined and encoded on the server. The products in question are classified according to POISINDEX™ codes.\(^{28}\) The data entered on the local server are sent in quasi real time, meaning every 21 minutes, to a national database, the NPDS (Figure 3).\(^{30}\) The codes used by the local servers correspond to those used by the NPDS.
The NPDS includes algorithms that perform three types of automated surveillance.\(^\text{(17,30,31)}\)

1. Call volume surveillance in relation to the volume of calls placed in PCCs. This algorithm performs hourly in the local databases and the NPDS and determines whether the number of calls is too high compared to the reference value established from the data of previous years.

2. Surveillance of anomalies with respect to the number of cases. This algorithm performs daily in the NPDS and determines for each of the 131 clinical symptoms whether the number of calls is too high compared to the reference value established from the data of previous years.

3. Case-based surveillance. This algorithm detects all new cases corresponding to the already established definitions. Currently, the CDC uses 11 definitions of cases in the NPDS to identify potential cases of exposure to a toxic substance considered of high priority. During an epidemic, case definitions can also be created temporarily that the computer system will also have to search for in the NPDS data.\(^\text{(19)}\)

When an anomaly is detected, an e-mail is automatically sent to the state public health department, the local public health department, the regional PCC, and to the members of the toxicosurveillance teams of the AAPCC and CDC. A case review is then undertaken jointly by the toxicosurveillance teams of the AAPCC and CDC to determine the risk of public health threat. If need be, these teams will send out an official warning. Through toxicovigilance bulletins, they will directly or indirectly inform the local and government public health departments, which will be responsible for informing the population and health professionals about the situation (Figure 4).
The American College of Medical Toxicology (ACMT), created in 1993, is an organization of medical toxicologists. In 2008, the ACMT created the Toxicology Investigator’s Consortium (ToxIC), a broad national network for research and collaboration between medical toxicologists. To improve clinical research, ToxIC’s members established a new clinical national database, the ToxIC Registry, which includes cases evaluated or managed by the members in their practices in a hospital or clinical environment. Participation in this Registry by the latter is voluntary. The data collection form is accessible on the Internet, and, to improve its surveillance process, ToxIC Registry is equipped with a mechanism identifying all unusual or suspect cases (a checkmark must be placed in a specific field on the form in order to specify that a case is unusual or new). The information included in the ToxIC Registry as well as the toxicovigilance reports produced by ToxIC’s toxicosurveillance committee are available to members only. However, the frequency of this committee’s meetings is not specified. The ultimate goals of ToxIC Registry are to do toxicosurveillance in real time (detection of the emergence or increase in secondary reactions to a particular substance), to perform syndromic surveillance, and to generate study hypotheses, thus promoting even more clinical research.

In the United States, a major group of databases exists that can be used for toxicosurveillance, despite the fact that they are not equipped with an automated data analysis system. This group is the Health Indicators Warehouse (HIW), a centre of public health data originating from multiple sources and based on the recording of health indicators. These indicators are predefined, and because of their amalgamation, national, state and local maps, tables, graphs and trends can be obtained. The latter therefore shows
the many dimensions of the population's health, the health system and health determinants. The HIW is maintained by the CDC's National Center for Health Statistics in collaboration with several agencies and offices of the Department of Health and Human Services, but the data entered in it are available to everyone.

The Drug Abuse Warning Network (DAWN), included in the HIW, is a particularly interesting database for toxicology. DAWN is a public health surveillance system maintained by the Substance Abuse and Mental Health Services Administration (SAMHSA), an agency of the Department of Health and Human Services of the United States. This system retrospectively reviews medical files from emergency departments as well as deaths noted by medical examiners and coroners, in investigating exposures to the following substances: prescription medications, non-prescription pharmaceutical products, substances used unlawfully or illegally. Reports are issued and available to the general public.

**Canada**

Since 1965, Health Canada’s Marketed Health Products Directorate has been collecting reports of presumed adverse effects related to the use of health products in the context of the Canadian Adverse Drug Reaction Monitoring Program (CADRMP). In 2007, this program was renamed the "Canada Vigilance Program" which now carries out surveillance on all marketed products in Canada (prescription and non-prescription medications, natural health products, biologics, radiopharmaceuticals, human cells, tissues and organs) after their marketing, by collecting and evaluating reports of presumed adverse effects associated with them. These reports are mandatory for market authorization holders (MAHs), and on a voluntary basis for any other individual. Each report is recorded electronically in the MedEffect database and is considered a potential signal (without necessarily having an established causal link). Canada Vigilance is a program that handles the reports from start to finish. If need be, Health Canada can even issue an advisory, a warning in the monograph, an update of the monograph, or even write in the Canadian Adverse Reaction Newsletter. Also, Health Canada can be contacted by other countries regarding certain adverse effects detected elsewhere and thus issue an alert regarding a foreign product (Figure 5).
In Canada, no institution carries out, in a formal and centralized way, one of the previously described toxicovigilance models. In 1958, Health Canada established the Poison Control Program, a national program that ensured the sharing of information on products available in Canada and the issuing of statistical reports on their harmful effects. Manufacturers voluntarily provided Health Canada with product cards containing the information on the products sold on the market. The program ensured their distribution to all Canadian hospitals. If a hospital noted that information was missing or that it had to deal with exposure to a product where no information was available, it was Health Canada's role to try to find it. On their side, hospitals were responsible for keeping statistics on cases of exposure to toxic substances and to report them to the program. Annual reports were produced from this national database. This federal program ceased to exist in 1998, and the annual statistical reports were no longer produced and distributed. In 2002, Health Canada conducted a pilot project, called Prod Tox, which consisted of a database of information and statistics on the products available in Canada. However, due to a lack of funds, the project was abandoned.\(^{(40,41)}\)

There are five PCCs in Canada that must ensure the toxicological coverage of the entire country. Québec's PCC is the Centre antipoison du Québec (CAPQ).\(^{(42)}\) Its mandate is to respond to the population and health professionals about questions involving: acute, real or suspected poisonings; exposures to household or industrial products, pesticides, plants, poisonous mushrooms, drugs or poisonous animals; the ingestion or inhalation of a chemical; skin or eye contact with a chemical; improper use of a drug; occupational accidents involving acute exposure to a toxic product; and a request for information on a toxic product.\(^{(43)}\)

The data collected by Canadian PCCs depends on the reports made either by an individual exposed to a toxic substance or by the health professional treating this individual. The data are collected electronically or manually, according to the requirements of the PCC in question. Since the funding of PCCs is provincial, each has its own database and there is no
national register for sharing these databases. The data from PCCs are not generally made available to public health departments or to the public.\(^{(44)}\) Also, no Canadian PCC uses the expertise of analysts or epidemiologists devoted to surveillance to manage and analyze the data that is collected in it.\(^{(3)}\) However, for the most part, they produce an unpublished annual report for their own internal use only, which serves as a retrospective evaluation of their data. The data can be collected and prospectively analyzed if an investigation is undertaken for a specific exposure to a substance, but will not be systematically done.

Currently, there is no standardized communication protocol in Canada by which a PCC would be able to rapidly and efficiently signal a chemical health threat to public health or to other relevant organizations. The information reported to public health is reported informally. In British Columbia, however, since October 2010, the British Columbia Drug and Poison Information Centre (BC DPIC) has been integrated into the province's public health network, the British Columbia Centre for Disease Control (BCCDC).\(^{(3)}\) Without there being a well-established route for dealing with a possible health threat, the direct link between the PCC and the BCCDC allows rapid communication between the two organizations and more effective public health actions than before.\(^{(3)}\) The PCC data is accessible by the BCCDC. It is stored in one of the electronic systems used in the United States, which the PCCs in Ontario and the Maritime Provinces also have, with the goal being to eventually carry out vigilance and surveillance over a larger territory. Other sources of data are also used by the BCCDC for the purpose of increased surveillance, such as reports of deaths and hospital and pre-hospital records relating to poisoning cases. As it does with infectious diseases, British Columbia public health now has the goal of carrying out prevention, public education, as well as analysis of poisoning case data. Toxicovigilance is now taking off in this province. Other provinces, notably Ontario, are currently attempting to follow its lead.

In Québec, toxicovigilance bulletins are occasionally disseminated on the clinical toxicology portal of the Institut national de santé publique du Québec (INSPQ) in a sporadic way. However, no official structure exists, and these bulletins came into existence due to good collaboration between members of CAPQ and the INSPQ.

Nonetheless, Québec is the only Canadian province with a policy of follow-up of toxicological and environmental exposures. The Public Health Act (PHA) adopted in 2001 makes it mandatory to report certain types of chemical exposures: notifiable diseases of chemical origin (MADO-C).\(^{(45)}\) In November 2003, Québec adopted the Minister's Regulation under the Public Health Act which lists them.\(^{(46)}\) The criteria for including a notifiable disease of chemical origin are listed in the Regulation under the Public Health Act.\(^{(47)}\) Nosological definitions are established by committees of experts, with the most recent update being in December 2013.\(^{(48)}\) Nine diseases are defined and must be reported by physicians. Also, physicians must report heart, gastrointestinal, hematopoietic, renal, pulmonary or neurological disorders caused by twelve families of contaminants. Laboratories must report the results of biological indicator measurements for eight families of contaminants if they exceed recognized public health thresholds. A provincial recording, health surveillance, and monitoring system for notifiable diseases attributable to a chemical or physical agent is used to collect data relating to notifiable diseases of chemical origin. The Infocentre de santé publique makes available the data from the MADO-C system only. Access to the data and surveillance products is reserved for people who have received permission from their regional public health director. Each regional public health branch is responsible for carrying
out the epidemiological investigations of cases belonging to its respective region. They can launch a regional alert and, as need be, contact the Direction de la protection santé publique (public health protection branch) of the ministère de la Santé et des Services sociaux (MSSS, ministry of health and social services), which is able to launch a province-wide and even national alert (Figure 6).

The results of the analyses entered at the Infocentre de santé publique allow statistical tables to be created and provide useful indicators for analyzing the frequency of notifiable diseases of chemical origin reported in Québec.(49) The primary objective of the mandatory reporting of certain diseases is to carry out health surveillance in order to detect threats to the population’s health and to protect the health of the population. These threats are likely to trigger an epidemiological investigation or lead to control measures.(50)

**Figure 6**  Diagram of issuing an alert of a threat to public health in Québec

INSPQ: Institut national de santé publique du Québec, MADO-C: notifiable diseases of chemical origin, MSSS: ministry of health and social services.
DISCUSSION

Toxicovigilance

The previous section demonstrated that several aspects differentiate pharmacovigilance from toxicovigilance. First, pharmacovigilance is interested in human or animal health products (drugs, medical instruments) after their marketing, while toxicovigilance considers all substances (health products, drugs, chemicals, household products, plants, mushrooms, heavy metals, etc.), whether they have a marketing authorization or not. Also, pharmacovigilance relates to adverse effects, while toxicovigilance relates instead to toxic effects. An adverse effect is an "undesired or harmful effect, of variable intensity, occurring as a response to the administration of a drug, to a treatment or a diagnostic, curative or preventive intervention." (free translation)\(^{(51)}\) However, a so-called toxic substance is a substance that "acts as a poison." (free translation)\(^{(52)}\) A poison is defined as "any substance that, by external application or by internal absorption, disrupts or stops the life of all or part of the living thing; [...] Any substance that, when it is absorbed is likely to cause lesions or threaten life." (free translation)\(^{(53)}\)

Trade in products not certified by Health Canada occupies a non-negligible place in our society, for example: the black market for illegal drugs, the on-line sale of so-called legal recreational substances, and the sale of certain food supplements and products of traditional medicine. It should be noted that these uncontrolled products have a higher hazard potential than certified products. Attention should be paid to them as agents that can be sources of health threats.

Furthermore, in France and the United States, while the practice of pharmacovigilance is well established, there has also been for a few years now a distinct practice of toxicovigilance.

Surveillance and vigilance

In North American English texts, toxicosurveillance is a term used much more than toxicovigilance. No difference is made between the terms vigilance and surveillance. In the United States, toxicosurveillance therefore encompasses the two types of activities. However, in the French language, there is an etymological difference between these two terms and a consensus does not always exist about their respective definitions. Eilstein, a French author, illustrates it well: "The lookout on a boat performs vigilance: this is not surveillance, because it is not focused on one type of event, but wants to be sensitive to anything that can occur, to all events occurring in a particular "field," in this case the horizon. [...] Vigilance would thus be an "open" watch activity. [...] The night watchman, however, "does his rounds at regular intervals, passes through specific locations and performs programmed checks and thus carries out a surveillance activity." (free translation)\(^{(14)}\)

The MSSS of Québec also feels the need for clarifying the difference between health vigilance and surveillance. "Health vigilance is used to detect a health threat and to implement an effective intervention in order to control it." (free translation)\(^{(54)}\) Surveillance has the goal of supporting decision-making related to the planning and production of policies, programs and action plans in the health sector and the other involved sectors, as well as to inform the population about health and its determinants.\(^{(55)}\)
Limitations of the actual system

Health Canada’s Canada Vigilance Program has several limitations. It is a passive-type program, also called a spontaneous reporting program, which means that there is no active investigation of adverse reactions. As well, it involves only marketed products. Knowing that adverse effects are not extensively reported to passive surveillance systems, regardless of whether the reports are made in a voluntary or mandatory way, the number of reports received can therefore not be used to determine the incidence of a reaction to a chemical exposure.\(^{(39)}\) In fact, the total number of adverse effects and the number of patients exposed to health products are unknown. Also, a report consists of a suspected association between a product and an adverse effect. It is therefore the opinion or observation of the individual who initiate the reporting rather than a diagnosis involving causality.

The notifiable-disease-of-chemical-origin system also has certain limitations. Just like notifiable diseases of infectious origin, they are probably underreported. While physicians have a duty to report the listed diseases, only 30% of cases are reported by them.\(^{(49)}\) It is noted that the reporters are mainly laboratories. It is true that by reporting only poisonings whose diagnosis is confirmed, the risk of obtaining false positives drops. However, some cases inevitably remain unreported to our surveillance systems. Nonetheless, it is encouraging that the reported cases of notifiable diseases of chemical origin have increased since the adoption of the PHA in 2001 and the Minister’s Regulation under the Public Health Act in 2003.\(^{(49)}\)

The law stipulates that poisonings on the list of notifiable diseases of chemical origin or the presence of clinical signs characteristic of one of these poisonings must be reported. However, if the agent or its clinical symptoms are still not known, it becomes difficult to make a diagnosis, or even to suspect what the clinical signs are. The components of uncontrolled products, and even sometimes those of controlled products, as well as their effects on consumers, may be unknown. Nonetheless, these could constitute a health risk and must be considered as such. It should be noted that certain products, for example synthetic drugs, often change chemical formulation and would require increased vigilance and surveillance.

A lack of transmission of information to public health exists in our Québec health system. For example, despite the fact that he should report a notifiable disease of chemical origin to public health, a physician dealing with a case that he suspects to be of toxic origin will first be tempted to call CAPQ, because his first concern is the health of the patient under his care. This is all the more true if the patient’s state is unstable, which could furthermore mean the presence of an agent even more harmful to the patient’s health, and potentially other individuals. Since CAPQ’s mandate is to focus on telephone response and assisting the caller, the situation might not be reported to public health if the treating physician neglects to do so. The high flow in Québec emergency departments often does not give the treating physician the time necessary to make calls that are sometimes considered as less of a priority, and the appropriate follow-up with public health could be compromised.

Also, all cases of poisonings are not reported to PCCs. According to the U.S. Institute of Medicine, only half of the cases are reported to PCCs.\(^{(56)}\) Such data do not exist in Québec. However, it is reasonable to believe that the proportions are similar. It therefore becomes necessary to educate health professionals and the public about the roles of a PCC. An increase in case reporting or case signaling could lead to more rapid identification of
emerging public health threats and an improvement in public health's response to them. This would allow better follow-up of these threats and possibly reduce the morbidity and mortality associated with exposure to toxic substances. In Québec, CAPQ would benefit from support from public health in communicating and teaching health professionals and the public about the potential health threats of these toxic substances and how to react to them. Currently, due to a lack of funds, CAPQ cannot appropriately carry out its prevention mandate, because it must give priority to telephone response about poisonings.

Public Health Act

"Under the Public Health Act, the national public health director has the responsibility of monitoring the state of health of his population and to implement the measures to protect it when there is any threat."(45) "Ongoing surveillance of the health status of the general population and of health determinants shall be carried out so as to obtain an overall picture of the health status of the population, monitor trends and temporal and spatial variations, detect emerging problems, identify major problems, develop prospective scenarios of the health status of the population, monitor the development within the population of certain specific health problems and of their determinants."(57,58) "Ongoing surveillance of the health status of the population is a function conferred exclusively on the Minister and the public health directors. However, the Minister may confer on the Institut national de santé publique du Québec the mandate to exercise all or part of the Minister's surveillance function or certain surveillance activities, on the conditions and to the extent the Minister considers appropriate."(59) Centralization of data on poisoning cases, including CAPQ's data, and the regular analysis of this data by professionals with expertise in epidemiology and clinical toxicology, would allow the ministers and directors of public health to perform their surveillance function. This could also improve the design of surveillance indicators, helping the INSPQ to carry out its mandate of knowledge development and dissemination or transfer.

In the Public Health Act, "a threat to the health of the population means the presence within the population of a biological, chemical or physical agent that may cause an epidemic if it is not controlled."(60) According to the classical meaning of the word epidemic, which has been retained in the current law, an epidemic exists when the number of observed cases exceeds the number of cases normally expected. The absolute number is therefore not necessarily high, with a single case being sufficient to constitute a threat (free translation).(50) An automated system, such as the U.S. NPDS, would allow the rapid detection, in "quasi real time," of the emergence of an epidemic. If need be, the public health director, who possesses several powers for protecting the population,(61) could act more quickly.

Suggestions

In the light of this literature review, we suggest a health monitoring system in toxicology with an exhaustive Québec database. This should include the data from CAPQ, hospitalizations (MedEcho), the Office of the Chief Coroner of Québec, the Registre des événements démographiques – Fichier des décès (RED/D, demographic events registry – death file) of the MSSS, consultations in emergency departments, as well as those done by toxicologists. We also suggest that an automated alert system be integrated into this provincial database whose reference thresholds would be based on Québec retrospective data and on reference thresholds already established in North America, for example by the U.S. CDC. This health monitoring system would thus be able to detect threats to the population's health, even those
unknown up to that time. If all the provinces could bring about the electronic sharing of such data, a real Canadian toxicovigilance system could be contemplated and would make it possible to see the emergence potential threats.

We suggest the formalization of direct collaboration between CAPQ and the different levels of public health, essential to the rapid and effective sharing of accurate and up-to-date information about potential toxicological health risks.

A surveillance system should be linked to this health monitoring system, which would allow certain pre-identified poisonings to be precisely assessed. When the health monitoring process detects an alert, this alert should be communicated rapidly to the different actors involved, in order to monitor or stop the causal substance as quickly as possible.

**CONCLUSION**

Countries such as France and the United States have a well-defined system for documenting, analyzing and taking action when toxicological events and risks arise, called toxicovigilance in France and toxicosurveillance in the United States. Like Canada, Québec has no toxicovigilance program, but has almost all the elements and competency necessary to create such a system.

By developing an active and not passive process for identifying and assessing the chemical health risks existing in our community and by ensuring greater cooperation between the different actors in the health network, we would be even more able to identify rapidly new toxicological threats and to implement the measures necessary for reducing the incidence of foreseeable as well as emerging toxicological events.

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