

# The abuse potential of the synthetic cannabinoid nabilone

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## ABSTRACT

**Aim** Nabilone is a synthetic cannabinoid prescription drug approved in Canada since 1981 to treat chemotherapy-induced nausea and vomiting. In recent years, off-label use of nabilone for chronic pain management has increased, and physicians have begun to express concerns about nabilone becoming a drug of abuse. This study evaluates the evidence for abuse of nabilone, which is currently ill-defined. **Study design** Scientific literature, popular press and internet databases were searched extensively for evidence of nabilone abuse. Focused interviews with medical professionals and law enforcement agencies across Canada were also conducted. **Findings** The scientific literature and popular press reviews found very little reference to nabilone abuse. Nabilone is perceived to produce more undesirable side effects, to have a longer onset of action and to be more expensive than smoked cannabis. The internet review revealed rare and isolated instances of recreational use of nabilone. The database review yielded little evidence of nabilone abuse, although nabilone seizures and thefts have occurred in Canada in the past few years, especially in Ontario. Most law enforcement officers reported no instances of nabilone abuse or diversion, and the drug has no known street value. Medical professionals reported that nabilone is not perceived to be a matter of concern with respect to its abuse potential. **Conclusions** Reports of nabilone abuse are extremely rare. However, follow-up of patients using nabilone for therapeutic purposes is prudent and should include assessment of tolerance and dependence. Prospective studies are also needed to definitively address the issue of nabilone abuse.

**Keywords** Abuse, Canada, cannabinoid, nabilone, pain, survey.

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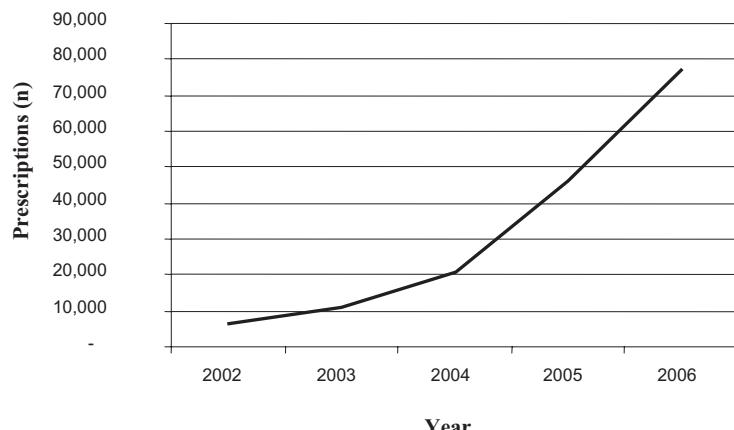
Submitted 5 February 2009; initial review completed 16 March 2009; final version accepted 11 August 2009

## INTRODUCTION

The psychoactive properties of centrally acting medications, particularly opioids, benzodiazepines and psychomotor stimulants, raise the potential for abuse of these drugs when used in a therapeutic context [1,2]. While the abuse of recreational cannabis has been studied extensively, the abuse of medicinal preparations of drugs derived from cannabis (cannabinoids) have not been well addressed. Evidence for the abuse of the cannabinoid dronabinol [tetrahydrocannabinol (THC), marketed as <sup>N</sup>Marinol<sup>®</sup>] was examined when it first appeared for the treatment of acquired immune deficiency syndrome (AIDS)-associated anorexia and chemotherapy-induced nausea and vomiting (CINV) [3]. Multiple sources of information were investigated for signals that dronabinol was a drug of abuse in the United States, including media

and police reports, adverse event databases and surveys of addiction centres. The authors found no evidence that dronabinol was being abused, and concluded that it has a low abuse and dependence potential. While laboratory studies of the abuse potential of THC have been conducted in animals and in healthy human volunteers, no other studies have been conducted to evaluate the abuse of cannabinoids at the population level.

Nabilone (<sup>N</sup>Cesamet<sup>®</sup>) is a synthetic cannabinoid prescription drug approved in Canada since 1981 for CINV. Nabilone is a potent agonist for the CB1 cannabinoid receptor, which is involved in the regulation of nausea and vomiting, appetite, movement and pain [4]. Clinical trials have demonstrated the effectiveness of nabilone in treating anxiety [5], CINV [6] and pain associated with fibromyalgia [7]. The abuse of nabilone has not been examined in population-based studies.



**Figure 1** Nabilone prescriptions in Canada between 2002 and 2006. Data obtained from Valeant Canada Limited and IMS Health

Over the past 8 years there has been a steady increase in prescriptions for nabilone in Canada, predominantly for off-label use as adjunctive treatment for chronic pain (Fig. 1). This trend has led physicians prescribing nabilone to express concerns regarding the possibility of its abuse. This study therefore aimed to find evidence for the abuse of nabilone through a careful review of diverse sources of evidence.

## METHODS

The methods used for this study were similar to those used in an earlier review of the abuse potential of dronabinol [3]. Table 1 lists the data sources consulted for this study, and Table 2 captures the relevant search details.

A careful review of the scientific literature, the popular press and the internet was conducted to detect signals that nabilone was being used or reported as a drug of abuse. Data collected from the internet were categorized as information either found on regular websites or in discussion forums. Newspaper selection criteria were rigorous and resulted in the exclusion of a large number of periodicals on the original list retrieved using <http://www.onlinenewspapers.com> (Fig. 2).

A variety of databases were reviewed to identify situations of nabilone abuse, including those of Health Canada, law enforcement agencies and the Canadian Center for Substance Abuse. Province-specific drug databases and reports were also reviewed. A number of databases were consulted, but no mention of <sup>11</sup>Cesamet® or nabilone use or abuse was found (online supplementary material, Table S1).

Interviews were conducted with representatives from a variety of organizations (online supplementary material, Table S2). Non-random sampling using snowball methodology was employed to identify subjects for interview. Snowball sampling refers to organizing interviews

**Table 1** Data sources.

### Literature review

PubMed  
Science Direct  
Erudit  
Cochrane Library

### Popular press and internet

Newspapers (<http://www.onlinenewspapers.com>)  
<http://www.google.ca>  
Drug Bank (University of Alberta)  
SwiftRx (Calgary)  
Cannabis Health  
[blogsearch.google.com](http://blogsearch.google.com)  
[bluelight.ru](http://bluelight.ru)

### Databases

Laboratory Information Management System  
Canadian Adverse Drug Reaction Monitoring Program  
Adverse Reaction Database (MedEffect)  
Criminal Intelligence Directorate Database  
Drug Squad Pharmacy Database of the Toronto Police Service

### Institutional reports

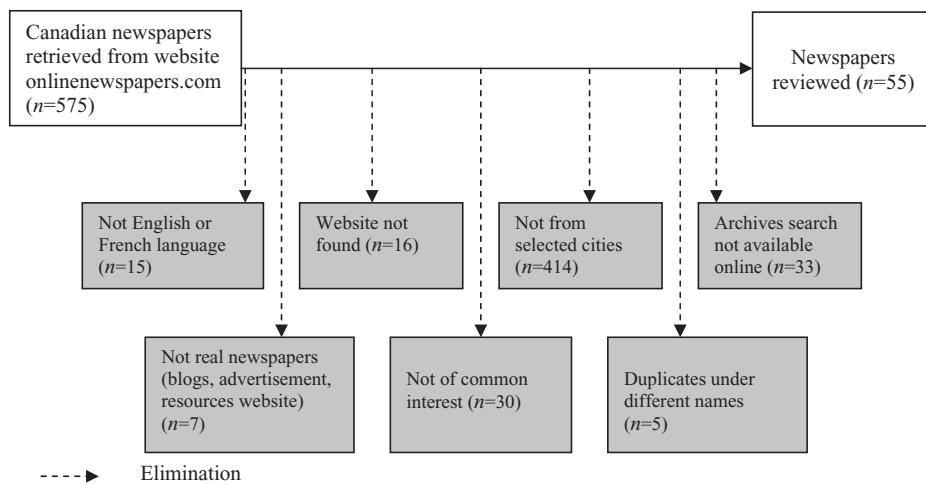
Alberta Alcohol and Drug Abuse Commission  
RCMP: Drug situation Report—2005  
United Nations Office of Drugs and Crime World Drug Report 2007  
Canadian Institute for Health Information: Statistical Report on the Health of Canadians—1999  
Canadian Community Epidemiology Network on Drug Use 2002 National Report  
Ontario Student Drug Use Survey 1977–2005  
Institut National de la Recherche Scientifique  
Canadian Institutes of Health Research  
Statistics Canada  
National Alcohol and Other Drugs Survey 1989

RCMP: Royal Canadian Mounted Police

based on a series of referrals among people related in various ways (i.e. by occupation, such as law enforcement and drug treatment facility employees) [8]. For this study, instead of focusing on the often hidden and

**Table 2** Search details for the data sources reviewed.

<i>Data sources</i>	<i>Search/interview dates</i>	<i>Keywords/questions</i>	<i>Eligibility criteria</i>
<b>Scientific literature</b>			
PubMed, Science Direct, Erudit, Cochrane Library	June 12/07 June 13/07	Nabilone Cesamet Cannabinoid prescription/abuse/tolerance/dependence	Included: articles referring to abuse or characteristics of the drug that might influence potential for abuse Excluded: language other than English or French
Popular press review			
Newspaper articles			
	June 19/07 (archive search for total period available until June 19/07)	Nabilone Cesamet Cannabinoid Cannabinoïde	Included: all Canadian newspapers of general interest from cities with extrapolated shares of 10% or higher of provincial nabilone sales; available online Excluded: newspapers that did not allow online archive searches or were addressed to specific groups or person; language other than English or French
Internet review			
Regular websites	July 12/07	Nabilone or Cesamet and abuse/redistribution/street value/dependence	Included: Canadian pages from <a href="http://www.google.ca">http://www.google.ca</a> Excluded: language other than English or French; website not available
Discussion forums	July 11/07 July 12/07	Nabilone or Cesamet and discussion forum	Included: pages from <a href="http://www.google.ca">www.google.ca</a> and <a href="http://www.blogsearch.google.com">www.blogsearch.google.com</a> Excluded: language other than English or French; website not available
Databases			
Health Canada; Law enforcement databases; Canadian Centre for Substance Abuse (CCSA); Provincial databases	June 27–August 23/07	Nabilone or Cesamet	Included: data from online search or acquired from third-person directly in database organization
<b>Interviews</b>			
Law enforcement officers	June 26–August 23/07	General knowledge about nabilone and its use; awareness of nabilone abuse	Included: interviewees chosen in RCMP divisions and police departments across Canada and via snowball recruitment technique
Medical professionals	June 26–August 23/07	General knowledge about nabilone and its use; awareness of nabilone abuse	Included: interviewees chosen from selected medical organizations and compassion clubs across Canada and via snowball recruitment technique



**Figure 2** Newspaper selection flowchart

hard-to-reach population of drug users/potential abusers themselves, interviews were arranged with those who were most likely to have contact with individuals using nabilone. The fields of expertise of those interviewed included law enforcement, drug diversion, cancer and palliative care, drug dependence treatment and medical cannabis advocacy. Questions were addressed to each group in English or French, depending on the interviewee's preference (online supplementary material, Table S3). All subjects were informed that their names would not be published in any report following this study, and verbal consent was obtained for divulgence of interview data and name of organization.

## RESULTS

### Scientific literature review

Two studies were identified which tested the subjective and reinforcing effects of nabilone in human subjects. These studies showed that subjective report of mood state was not altered significantly after a single oral dose of 1–5 mg nabilone [9], and that nabilone did not serve as a reinforcer when used in a self-administration paradigm [10]. Additional articles described the characteristics of nabilone (e.g. side effects, tolerance and dependence, comparison with smoked cannabis, cost) that probably play a role in determining its abuse. The three most common side effects of nabilone are negative (drowsiness, dizziness and dry mouth), while positive side effects (euphoria, mood elevation) are reported less frequently [11]. These findings were also corroborated in more recent articles [12–15]. In terms of the euphoric side effects of nabilone, 3–5 mg of nabilone was shown to induce minimal to moderate euphoria in all subjects

[16]. However, when compared to oral THC, the level of euphoria produced by nabilone was lower [17].

A number of studies [10,18] and reviews [19,20] concluded that there is a low potential for the development of tolerance to nabilone. One study suggested that tolerance may develop to the euphoric effects of nabilone [16,17]. The study also indicated that tolerance did not develop to the relaxant and anti-emetic effects of nabilone, even among patients who experienced continued benefits after having received the drug for several months.

Current evidence from epidemiological studies suggests that patients who have tried oral ingestion of isolated cannabinoids find smoked cannabis more effective [21], with fewer unwanted effects [22]. Medical professionals and patients report that nabilone, in comparison to smoked cannabis, has a slower onset of action, more variable efficacy, is harder to titrate to effect, has more side effects and less overall effectiveness for symptom relief [23,24].

Six articles drew direct conclusions regarding the abuse potential of nabilone, five of which reported a low abuse potential [11,17,19,20,22]. The sixth mentioned a high abuse potential but offered no justification for this claim [14]. A Vancouver study revealed that neither the name <sup>®</sup>Cesamet nor nabilone were associated with a street value [25], inferring that the drug is not sought-after on the black market. Taken together, the existing literature reviewed suggests a low abuse potential for nabilone.

### Popular press review

Of the 575 Canadian newspapers retrieved, 55 national newspapers were selected from cities showing 10% or more of provincial nabilone sales (online supplementary material, Table S4). The geographical distribution of

these newspapers was somewhat irregular: two were from British Columbia, and all others were published in Ontario, Quebec and the Atlantic provinces. Of the 51 newspaper articles selected, 14 of relevance dated to the period between 1999 and 2006, with nine published in the last 4 years. The main finding of this review was that nabilone does not provide the same positive effect as smoked cannabis with respect to its therapeutic and recreational properties [26–31]. Nabilone was perceived as more expensive, less safe and less convenient than smoked cannabis [30,32,33]. Physicians reportedly preferred to prescribe nabilone rather than smoked cannabis, given its slower onset and better efficacy, precise dosage [34], cannabis-like effectiveness [35] and absence of recreational [36] or toxic [37,38] effects. Overall, the results of the popular press review suggest that current abuse of nabilone is unlikely.

#### Internet review

Of the 729 websites reviewed, four sites of relevance to this study suggested the existence of potentially reinforcing side effects of nabilone such as euphoria or 'high' [39,40], but also of untoward side effects including dizziness, drowsiness, memory problems, dry mouth and headaches [41]. Clinical studies demonstrated that nabilone users did not experience withdrawal symptoms upon drug cessation [39]. The higher cost of nabilone compared with cannabis was also reported [42].

On the basis of the search criteria, 23 of 832 discussion forums were reviewed, and 17 relevant posts were identified. Many of the discussion forum posts came from Bluelight, an international message board that educates the public and drug users about responsible drug use by promoting free discussion [43]. Members of this forum are not necessarily using drugs prescribed for medical conditions, as it includes users of any kind of drug from anywhere in the world. Other posts took the form of surveys, where users could share and compare specific points of view and experiences, or blogs. The content of the 17 posts revealed discrepancies in members' opinions of nabilone (online supplementary material, Fig. S1). Several posts implied a low abuse potential, describing nabilone as a drug of slow release [44], with negative side effects [45], at a high price [46,47] and not as effective as smoked cannabis [44,47,48], or with therapeutic benefits without a cannabis-like high [49,50]. Of note, almost half (eight of 17) of all posts reported that users who did not appear to take nabilone for medical purposes enjoyed it in recreational circumstances. Some of these posts suggest explicitly that nabilone was abused, mentioning users taking more than the maximum recommended dose of 6 mg/day. It was also stated clearly that some users tried routes of administration that differed

from the method prescribed. The nationality of such users is unknown, however, as Bluelight is an international forum and the geographical location of the posted information was not indicated specifically.

The review of discussion forums suggests that while there is limited evidence of abuse of nabilone, it did not necessarily happen in Canada. Almost all cases of abuse were recorded on the Bluelight forum. With the exception of those posts, most users did not experience an enjoyable high with nabilone. Elevated price, slow onset of action and lower effectiveness were the most common reasons why patients prefer smoked cannabis instead of nabilone. Those who still use nabilone take it for its therapeutic properties and not to achieve a cannabis-like feeling.

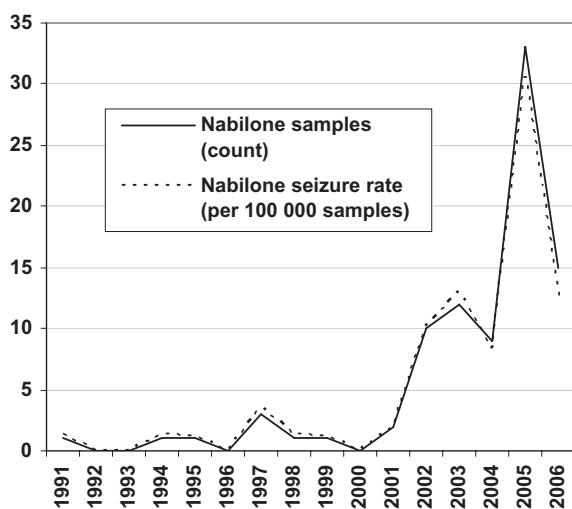
Based on the information retrieved from the internet, nabilone abuse appears to be an isolated phenomenon.

#### Database review

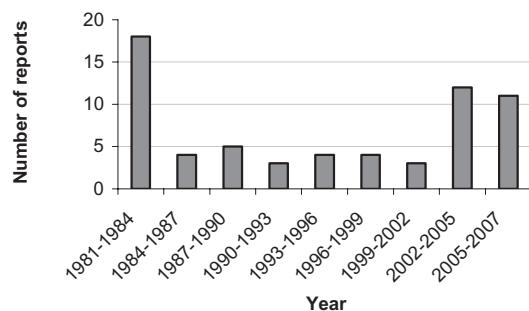
Although the number of databases referring to nabilone was very limited, especially with respect to its abuse, extrapolations can be made from statistics on nabilone seizures, adverse reactions, cost and use.

#### Health Canada databases

Illegal substances that are seized by Canadian police officers and custom agents are analysed by Health Canada's Drug Analysis Service (DAS) and the results are entered into the Laboratory Information Management System (LIMS). According to the LIMS database, nabilone seizures ranged from zero to three between 1991 and 2001 to nine to 33 from 2002 to 2006 (Fig. 3), representing an increase in the number of nabilone samples per 100 000 seized per year. As of 29 June 2007, 14 samples had been recorded for 2007. Provincially, 64 of 103 nabilone



**Figure 3** Trends in national seizures of nabilone between 1991 and 2006



**Figure 4** Number of adverse reactions to nabilone reported to Health Canada between 1981 and 2007

samples recorded came from Ontario (online supplementary material, Fig. S2), representing 62% of all nabilone seizures across Canada for the past 16 years. For both Ontario and Canada, nabilone seizures peaked during 2005, with 32% of all nabilone samples seized during that year.

Adverse event reports involving nabilone were retrieved from Health Canada's Adverse Reaction database. Between 1981 and 2008, 14 results were obtained with 'nabilone' as health product name, and 50 with 'Cesamet' (Fig. 4). In most cases, the drug involvement in the reaction was either suspected or concomitant (online supplementary material, Fig. S3). Nabilone dose information was available in 37 cases (58%), of whom 34 (92%) had taken doses of nabilone that were equal to or below the normal adult dose (1–2 mg twice daily [4]). Only one case reported a dose of nabilone higher than the maximum recommended dose of 6 mg daily, but in this case nabilone was not suspected as being involved in the adverse reaction. When considering only cases where nabilone involvement was suspected in the adverse reactions, 22 reports (64 reactions) were reviewed, of which one reported euphoria concurrent with depression and suicide.

#### Law enforcement databases

Three law enforcement databases provided information regarding clandestine activities involving nabilone. Between 2005 and 13 August 2007, six occurrences of <sup>N</sup>Cesamet<sup>®</sup> theft were recorded in the Toronto Drug Squad Pharmacy Database (five break-and-enter and one robbery). The most recent record was made in April 2007, and the largest amount ever stolen was recorded as 150 pills. Information from the LIMS database indicated that 16 samples of nabilone were sent from the Toronto division to the Drug Analysis Service between 2005 and 2007. The Drug Squad Pharmacy database does not indicate the circumstances surrounding the drug seizure. The extent of overlap between the two databases is

not ascertainable; it seems clear, however, that nabilone diversion or abuse has been observed in the Toronto area.

The search for <sup>N</sup>Cesamet<sup>®</sup> and nabilone did not yield any results regarding illegal laboratories, suggesting that police interventions did not apprehend any clandestine laboratory producing <sup>N</sup>Cesamet<sup>®</sup> in Toronto during the period of 2005 to 13 August 2007. Further indirect evidence for a low abuse potential of nabilone comes from the fact that it does not appear in the list of most often abused prescription drugs established by the prescription drug abuse FAQs [51], and published by the Canadian Centre for Substance Abuse (CCSA).

#### Provincial databases

A report by the Alberta Alcohol and Drug Abuse Commission (AADAC) in 2004 described prescription drugs with abuse liability [52]. Medical use of cannabis was addressed, and in that section nabilone was mentioned. The report stated that nabilone 'does not seem to have attracted much attention from the drug-using section of society', and hypothesized that this could be due to the fact that the effects of nabilone are less dramatic than those obtained with cannabis, which is also more accessible.

A study on the use of <sup>N</sup>Cesamet<sup>®</sup> and <sup>N</sup>Marinol<sup>®</sup> was presented in the March 2007 issue of the bulletin of the Conseil du Médicaments [53]. The study showed that the number of new prescriptions for nabilone in Quebec had increased in the past few years, from 48 in 2002 to 144 in 2003 and to 329 in 2004. Before 2001, 80% of users were prescribed nabilone for its approved indication (treatment of chemotherapy-induced nausea and vomiting), but between 2001 and 2005 this proportion dropped to 42%.

As reported in the study, <sup>N</sup>Marinol<sup>®</sup> was assigned the status of an 'exceptional' drug (meaning it would be paid for by the provincial health plan only under exceptional conditions) in October 2000, but nabilone retained its status of a regular drug, covered by the provincial plan. This designation could explain the increase in non-approved utilization of nabilone. Non-approved utilization does not mean illegal use or abuse, but includes off-label use including appetite stimulation, analgesia, migraine headaches and pain, which are the most frequent non-approved uses of nabilone. The study included only patients who were covered by the public drug insurance programme, and thus patients with private insurance are not represented.

#### Interviews

Interview data from law enforcement officers across Canada suggested that the abuse of nabilone is rare. Nabilone abuse was not a commonly encountered

problem by law enforcement representatives, and cannabis users were not perceived to be interested in nabilone. The fact that cannabis is more accessible than nabilone also led them to suggest that nabilone probably does not have a high potential for abuse. Interviews with workers from compassion clubs (private businesses which occupy a grey legal zone providing cannabis to patients) revealed that a few cases of nabilone diversion might have occurred in Canada. Some medical professionals were also concerned that nabilone abuse may be under-reported. However, most interviewees felt that nabilone has a low abuse potential, and many of them stated that as they were not aware of nabilone abuse, it is probably extremely unlikely. An interview (held after this study was completed) with a senior physician working in the federal penitentiary system revealed that nabilone abuse was not recognized in the inmate population.

## DISCUSSION

This study represents an important contribution to the current understanding of the abuse of the synthetic cannabinoid nabilone. To our knowledge, it is the first study to investigate nabilone abuse as a primary objective.

### Strengths of study design

One major strength of this study is that the wide range of sources used provide different levels of information and perspectives, painting a global picture that probably reflects the current attitudes towards nabilone abuse in Canada. The diversity of sources also decreases the probability of bias that could occur when using only one specific source, including the publication bias that may be present in scientific literature and the popular press, censoring on the internet, interviewee selection bias and recall bias in the interviews.

This evaluation was designed as a Canadian study and therefore the sources were distributed nation-wide, allowing a general picture of the Canadian situation to be drawn. As observed in most sections of this study, relevant data were not found equally across Canada. Some provinces provided more information than others, either because more sources were available or because nabilone prescriptions were more prevalent. Important information relevant to the study would have been missed had only one region of Canada been studied. The selected design also provides the possibility of breaking the results into geographic areas, to compare them and assess the diversity of trends.

### Study limitations

The most significant limitation of this study is that, as for studies of other drugs of abuse, the events of interest

are, in the main, isolated and hidden. No sampling frame exists for nabilone abusers, and abuse of the drug was expected to be limited to very few cases. Therefore, standard sampling methods, such as random or systematic sampling, would be inefficient in identifying such events. The method used to counter this potential problem, by increasing the chances of capturing relevant information, was snowball recruitment [54]. The sampling strategy did not target nabilone users directly, but rather targeted professionals who might have been in contact with nabilone users.

There are some limitations to snowball sampling that need to be considered when interpreting the results of the study. Literature regarding this sampling method has underlined specific types of bias, including social distance (the probability of one individual being connected to the other is a function of the social distance between them) and force field bias (certain characteristics, such as popularity, can confer a greater likelihood of targeting certain individuals) [8]. Indeed, the results showed that an important number of respondents came from Ontario, especially the Toronto area. Data provided by Valeant Canada Limited and IMS Health, along with those of the LIMS database, indicated that Ontario was the province with the most nabilone sales and the highest number of nabilone seizures recorded, thereby justifying the larger number of interviewees from Ontario. One caveat to interpreting the LIMS data is that there is no way of tracking the legality of the origin or source of the drug.

An initial selection effect can result from convenience sampling, although this effect can be overcome by selecting an initial sample that is as large as possible [54]. When identifying potential subjects for interviews, a special effort was made to include a variety of organizations in all Canadian provinces. Snowball sampling for the interviews does not allow conclusions to be drawn regarding the rates or risk of nabilone abuse in Canada, but can act as an indicator of the overall situation across the country.

The duration of the study may have also influenced data collection, particularly for the popular press review. More than half the newspapers found in an initial search were excluded because they were from cities where nabilone sales were below 10%, making the review feasible given the amount of time available. So few articles were retrieved in cities where nabilone is most prevalent that inclusion of newspapers from smaller cities would have been unlikely to increase substantially the amount of relevant information obtained.

Another potential limitation of this study is that the methodology used to search and identify signals of nabilone abuse has not been validated; we used similar methods for a previous study of dronabinol [3]. We are

not aware of any studies using a similar approach for other potential drugs of abuse. Epidemiological studies tend to use early detection systems such as the Research Abuse, Diversion and Addiction-Related Surveillance System [55] or the Drug Abuse Warning Network (DAWN). One study compared such signals to poison centre data [56]. In our study, we included standard warning system data and expanded it to include other potential sources. Validating our approach by comparing our strategy with conventional approaches, as above, using drugs with known abuse potential would be very interesting and useful but would necessitate another study. However, a Google search for 'nabilone abuse' (conducted during the peer-review process on 17 April 2009) revealed five hits, two of which are references to this work in abstract form; a Google search for 'oxycodone abuse' on the same date resulted in 16 000 hits. We believe that our extensive search would have revealed significant evidence of nabilone abuse if it was reported publicly. Finally, we did not specifically target young illicit drug users, who may have awareness of nabilone as a drug of abuse. However, our search of the Bluelight website, where such users share their experiences, showed that some attempts to abuse nabilone had been made but the results were not very rewarding; it is not known whether a more systematic interview of such users would yield more insightful data.

### Physiological effects of nabilone

The results of this study, as well as others, suggest that nabilone does not induce the same level of positive psychoactive, and therefore reinforcing, effects that are experienced upon use of herbal cannabis [10–17]. While we found evidence that nabilone was unlikely to be reinforcing or to cause important desirable psychoactive effects [9,10], it should be noted that the self-administration study involved subjects with previous history of marijuana use, and that the nabilone doses of 2 mg (orally) administered in the study may have been too low to produce effects in subjects with existing tolerance to cannabinoids. It seems generally agreed that nabilone does not produce the same high as smoked cannabis, and that the adverse effects (drowsiness, dizziness, dry mouth) overcome the potential recreational benefits. Tolerance to the side effects of nabilone (including euphoria) may develop, but most studies involved short-term use of nabilone as an anti-emetic; because long-term use for chronic pain disorders is being considered, care should be taken to monitor this in clinical practice. Additionally, cannabis withdrawal has been defined as a clinically significant syndrome, with symptoms that include decreased appetite, weight loss, difficulty sleep-

ing, aggression, anger, irritability and depression [57], whereas no withdrawal symptoms have been reported for nabilone [39]. In therapeutic settings, prescription cannabinoids have been reported as having a slower onset, lower perceived efficacy and as being less easily titrated than smoked cannabis. The MedEffect database of Health Canada recorded only one excessively high dose of nabilone, and it was associated with unpleasant reactions. We can hypothesize that the higher number of reported adverse events in response to nabilone from 1981–1984 (Fig. 4) were due to initial use of a new drug with associated increased awareness of adverse events; this may also explain the increase in reported adverse events as use increased from 2002–2007, because an increase in absolute numbers of prescriptions would be expected to result in an increase in the number of adverse events reported. It is noteworthy that national surveys of drug abuse did not mention nabilone.

### Cost and availability of nabilone

Although cannabis is illegal, it remains more widely accessible and available at a lower cost than nabilone. These characteristics make nabilone unattractive for drug users, although it is possible that interest will increase when generic, and therefore less expensive, nabilone options become available. The current study revealed, however, that nabilone has no known street value. Two cases of diversion were reported, but this was not an issue encountered frequently by law enforcement personnel. The isolated experiences of abuse that were described on internet discussion forums were posted on international forums, and therefore we cannot assess whether they occurred in Canada or elsewhere.

Databases from Health Canada showed an increasing number of nabilone seizures over the past few years, most of them in Ontario. The Toronto Police Drug Squad reported six thefts of nabilone in Toronto over the past 2 years. This is consistent with the data provided by Valeant Canada Limited and IMS Health, which indicate that Ontario is the Canadian province where the largest nabilone sales are recorded. As all those cases occurred recently, they could reflect an increased interest and curiosity towards that drug rather than a real abuse trend. Indeed, debates on cannabis decriminalization, approval of other cannabinoid drugs by Health Canada and the arrival of nabilone on the American market are all events that occurred recently and could contribute to the emerging popularity of nabilone. Despite these cases, professionals interviewed in both law enforcement and medical organizations seem convinced that the abuse potential of nabilone is low.

## CONCLUSION

The overall findings of this study suggest that the prevalence of current abuse of nabilone is low, and that cases of diversion and abuse are isolated and rare. One caveat associated with this finding is that with increased awareness of the therapeutic utility of nabilone, increases in off-label use and the possibility for reduced costs upon production of generic formulations, there may be an increase in abuse. Further studies would be useful to investigate the potential for abuse of nabilone in specific groups, such as prison populations, people with previous history of drug use and those within specific age categories. Such studies would allow the targeting of special care and interventions among patients who are dispensed nabilone, as well as the opportunity to better inform those prescribing and monitoring the use of nabilone.

### Declarations of interest

Mark Ware conceived, designed and supervised the study conduct and participated in report writing. Emmanuelle St Arnaud-Trempe carried out the data collection and analysis, and wrote and edited the manuscript. Valeant had no input on the conception, design, conduct or report development of this study. There are no contractual constraints on publication.

### Acknowledgments

Support for this work was provided by an unrestricted grant from Valeant Canada Limited. We gratefully acknowledge the assistance of Nicole Poitras and Linda Ferguson, and the staff of Valeant Canada Limited and IMS Health for nabilone sales data. The authors thank Kaleidoscope Strategic for editorial support in preparing the final draft for publication. MW is supported by the FRSQ and the Louise and Alan Edwards Foundation.

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### Supporting information

Additional Supporting Information may be found in the online version of this article:

**Figure S1** Distribution of opinion regarding nabilone in sample of discussion forum posts.

**Table S1** Databases with no mention of abuse of Cesamet, or nabilone.

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