# Population Trends in Substances Used in Deliberate Self-Poisoning Leading to Intensive Care Unit Admissions From 2000 to 2010

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## ABSTRACT

***Objective:*** To examine population trends in serious intentional overdoses leading to admission to intensive care units (ICUs) in Winnipeg, Manitoba, Canada.

***Method:*** Participants consisted of 1,011 individuals presenting to any of the 11 ICUs in Winnipeg, Canada, with deliberate self-poisonings from January 2000 to December 2010. Eight categories of substances were created: poisons, over-the-counter medications, prescription medications, tricyclic antidepressants (TCAs), sedatives and antidepressants, anticonvulsants, lithium, and cocaine. Using the population of Winnipeg as the denominator, we conducted generalized linear model regression analyses using the Poisson distribution with log link to determine significance of linear trends in overdoses by substance over time.

***Results:*** Women accounted for more presentations than men (57.8%), and the largest percentage of overdoses occurred among individuals in the 35- to 54-year age range. A large proportion of admissions were due to multiple overdoses, which accounted for 65.7% of ICU admissions. At the population level, multiple overdoses increased slightly over time (incidence rate ratio [IRR] = 1.02, $P < .05$), whereas use of poisons (IRR = 0.897, $P < .01$), over-the-counter medications (IRR = 0.910, $P < .01$), nonpsychotropic prescription medications (IRR = 0.913, $P < .01$), anticonvulsants (IRR = 0.880, $P < .01$), and TCAs (IRR = 0.920, $P < .01$) decreased over time. Overdoses did not change over time as a function of age or sex. However, severity of overdoses classified by length of stay increased over time (IRR = 1.08, $P < .01$).

***Conclusions:*** It is important for physicians to exercise vigilance while prescribing medication, including being aware of other medications their patients have access to.

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Over the last half century, suicides have become a growing public health concern, contributing 1.8% to the global burden of disease. Deliberate self-poisoning is a method used in a large proportion of suicide attempts and completions around the world, both in developed and in developing countries, and leads to a significant number of admissions into intensive care units (ICUs).[1–6] However, few studies have systematically examined the substances used in suicide attempts by overdose.

Patients admitted into the ICU with a deliberate self-poisoning represent a group of patients who have made a serious suicide attempt and are therefore at greater risk for future completed suicide.[7,8] Pesticides, poisons,[9–13] over-the-counter medications,[14–16] and prescription medications, including psychotropic and nonpsychotropic medications,[14,15,17–20] have all been implicated in admissions for self-poisoning. It is especially important to examine use of psychotropic medications used for deliberate self-poisonings, as these are often prescribed for psychiatric disorders, which are strong risk factors for suicidal behavior.

Over the last decade, the proportion of people who have received at least 1 prescription for psychotropic medication has increased from 8% to 13%. In addition, approximately 80% of those people are on multiple prescriptions, a significant increase over the last few years.[20] Despite these alarming statistics, Canadian data suggest that prescription rates of psychotropic medications including antidepressants, antipsychotics, mood stabilizers, anxiolytics, stimulants, and cholinesterase inhibitors have been steadily increasing over the last 2 decades.[20] Therefore, it is especially important to examine the role these substances play in deliberate self-poisonings as well as understand trends over time due to fluctuating prescription patterns.

Among the psychotropic medications, tricyclic antidepressants (TCAs) have been strongly implicated in overdoses requiring ICU admission.[21,22] Moreover, TCAs are more lethal in overdose than other antidepressants, including the newer selective serotonin reuptake inhibitors (SSRIs). Notwithstanding the increase in prescription rates of newer antidepressants, and the projected decline in TCA prescriptions,[23] some research shows that the overall rates of TCA use for deliberate self-poisonings have not changed over time. Since the introduction of SSRIs to the market in the late 1980s, they have been widely prescribed, both as antidepressants for clinical depression[24] as well as treatment for some anxiety disorders. Interestingly, prescription rates of older antidepressants have not changed,[21] with some studies showing a minor decline[25] and some showing an increase, but at much lower rates than SSRIs.[26]

The reason for the largely static rates may be that TCAs are often prescribed for chronic pain and sleep conditions, although at much lower doses. There has also been a trend toward a decreasing rate of TCA-overdose admissions into the ICU, although there has been an increase SSRI- and opioid-related overdose admissions.[27] A Canadian study[28]

**Clinical Points**

- A large proportion of severe deliberate self-poisonings are due to multiple drug overdoses, which are increasing over time.
- Physicians must be aware of all medications their patients have access to and carefully monitor medications at times of crisis.

determined that TCAs were among the most common substances associated with suicide overdose deaths. In contrast, SSRI antidepressants are rarely fatal in single drug overdoses, and nearly all SSRI fatalities have included combinations of other drugs or alcohol.[22]

The objective of this study was, therefore, to conduct a detailed population-based examination of trends in substances used in deliberate self-poisoning admissions to the ICU over a 10-year period. Owing to declining prescription rates of TCAs, we hypothesized a decline in admissions for TCA-related overdose over this period and a consequent increase in deliberate self-poisonings caused by other antidepressants. In addition, because of the rising rates of multiple psychotropic prescriptions and increased morbidity most likely associated with the need for multiple prescriptions, we hypothesized a trend toward multiple overdose deliberate self-poisonings over time. Because of the unique health care system in Canada, an examination of these trends would not only inform public health policy but guide clinician assessment among patients using certain high-risk substances.[27]

## METHOD

### Setting

The data used in this study came from the ICU Database Project, a multisite project spanning 11 intensive care units in Manitoba, Canada. Data elements in the ICU Database include patient demographics, a primary diagnosis, and up to 5 secondary diagnoses. The ICU Database was created in 1988, and inclusion of all 11 ICU sites began in 1999. Data are collected by research nurses who review a diagnostic summary completed by physicians and enter this information into the database. They then audit all data sheets at discharge and, if necessary, review charts to obtain missing information. The software, dataset, data verification, and collection procedures are under the supervision of a stakeholder database management committee in order to maintain the integrity and quality of the database.

### Study Population

The study population included all patients admitted to any of the 11 ICUs with drug overdoses (intentional, accidental, or iatrogenic) from January 2000 to December 2010 (n = 1,830). For the purposes of this study, only intentional overdoses were included in the data analysis. People who presented with accidental or iatrogenic overdoses or those in whom the specific drug could not be determined were excluded (n = 819). This yielded a sample of 1,011 individuals who were admitted to the ICU with intentional overdoses. It is important to note that ICU admissions represent near-lethal overdoses.

### Baseline Patient Assessment

Doctors determined intent of the overdose based on patient history, self-report, and reports from family or friends. Toxicologic reports of levels of the drugs in the patient's blood were also obtained and assisted in the diagnoses given. In our study, patients were classified as having an intentional overdose if any of their 6 diagnoses revealed the presence of an intentional drug overdose. Drug categories included sedatives and antidepressants, TCAs, barbiturates, anticonvulsants, lithium, methanol, ethylene glycol, acetylsalicylic acid (aspirin), acetaminophen, aminophylline, iron, β-blockers, carbon monoxide, hypoglycemics, digoxin, cocaine, angiotensin-converting enzyme (ACE) inhibitors, malathion, and toluene. If a person overdosed on several substances and they were present in the system, this outcome was coded as "multiple overdose." If a person overdosed on drugs not specified by these categories, this outcome was coded as "other overdose." These categories were developed by the administrators of the database based on common presentations to the ICU.

We classified the drugs into new categories, such as nonpsychotropic prescription medications (aminophylline, β-blockers, hypoglycemics, ACE inhibitors, and digoxin), over-the-counter medications (ASA, iron, acetaminophen), poisons (ethylene glycol, methanol, malathion, toluene), TCAs, sedatives and antidepressants, cocaine, lithium, and anticonvulsants. Barbiturates were excluded from this study due to very low numbers (n < 2). If a person had only 1 drug present in his or her system, he or she was coded as having a "single overdose"; however, if more than 1 drug was present, or if multiple overdose was indicated, regardless of whether individual drugs were specified, the person was coded as having a multiple overdose.

In addition, we classified each overdose using a length of stay as a proxy variable. A stay longer than 2 days was classified as a more severe overdose.[28]

### Reliability Analysis

We conducted a reliability analysis on the sample to determine the reliability of the data and the diagnoses on a sample from one of the hospitals. A random selection of charts in each drug category was reviewed to determine what percentage of the time the diagnosis entered by the attending physician in the database matched the diagnosis entered in the charts.

Of the 88 charts we reviewed, the reliability analysis revealed agreement between the physician and an independent coder in 75% of cases. In the remainder of the charts reviewed, the diagnoses entered were inconsistent with the information contained in the charts or were missing information. In this instance, we deferred to the information in the database, as we reviewed only a subsample of the charts. This speaks to the accuracy of the database, as other interrater reliability

studies place physician-coder agreement from 19% to 29%.[29] A descriptive examination of the errors made revealed that there were no consistent errors in the coding of information into the charts (for example, classification of Tylenol 3 as an over-the-counter medication). Therefore, it is highly likely that most errors were human error on the part of data entry. An examination of trends over time revealed that misclassification most likely decreased over time, but, possibly due to small samples and a lack of power, these results were not significant and we were therefore unable to categorically delineate misclassification trends over time (see Supplementary eFigure 1).

### Statistical Analysis

We generated prevalence rates for each of the variables at baseline using SPSS 21.0.[30] Then, using the population of Winnipeg as the denominator, we examined temporal trends for the period 2000–2010. Using STATA version 13.1,[31] we ran generalized linear model regression analyses using the Poisson distribution with log link. This produced incidence rate ratios (IRRs) and their 95% CIs. Next, we examined the significance of these linear trends for overdose by substance over time for both single and multiple overdoses. We then created locally weighted scatterplot smoothing (LOWESS) graphs of the yearly rates of overdose for each category of overdose. We also examined temporal trends from 2000 to 2010, using the average annual percent change (AAPC) in suicide rate per 100,000 population. These results are reported alongside the generalized linear model results. We calculated the AAPC with 95% CIs using the following equation:

$$\mathrm{AAPC} = (e^{\beta} - 1) \times 100,$$

where β is the slope from a regression of log rates on year.

### Sensitivity Analysis

In addition to the statistical analyses, we conducted a sensitivity analysis to determine whether addition of poisonings deemed unintentional affected trends over time. A new analysis was conducted that combined intentional and unintentional self-poisonings. In this analysis, we also included narcotics, a category present in the ICU Database under the "other" category. We were unable to use this category in the original analyses, as narcotics in this category were not classified by intentionality. The inclusion of unintentional poisonings did not have a large effect on overdose trends over time.

## RESULTS

Over the course of the study period (2000–2010), 1,011 individuals were admitted to the ICU with intentional overdoses. The characteristics of individuals with an intentional overdose are presented in Table 1. Women accounted for more presentations of deliberate self-poisoning than men (57.8%), and the largest percentage of overdoses occurred among individuals in the 35- to 54-year age range.

**Table 1. Characteristics of Deliberate Self-Poisonings From 2000 to 2010 (n = 1,011)**

| Characteristic | n (%) |
|---|---|
| Sex | |
| Male | 427 (42.2) |
| Female | 586 (57.8) |
| Age, y | |
| 16–34 | 365 (36.1) |
| 35–54 | 665 (65.7) |
| 55–93 | 131 (12.9) |
| Attempt characteristics | |
| Single overdose | 348 (34.4) |
| Multiple overdose | 665 (65.7) |
| Year | |
| 2000 | 83 (8.2) |
| 2001 | 95 (9.3) |
| 2002 | 67 (6.6) |
| 2003 | 93 (9.1) |
| 2004 | 87 (8.6) |
| 2005 | 90 (8.9) |
| 2006 | 113 (11.1) |
| 2007 | 100 (9.8) |
| 2008 | 99 (9.7) |
| 2009 | 83 (8.2) |
| 2010 | 101(9.9) |

**Table 2. Breakdown of Substances Featured in Intensive Care Unit Admissions for Deliberate Self-Poisoning**

| Drug Type | n (%) |
|---|---|
| Poisons | 80 (10.4) |
| Over-the-counter medications | 83 (10.8) |
| Nonpsychotropic prescription medications | 69 (9.04) |
| Anticonvulsants | 34 (4.45) |
| Lithium | 18 (2.35) |
| Tricyclic antidepressants | 195 (25.5) |
| Sedatives and antidepressants | 251 (32.8) |
| Cocaine | 33 (4.32) |
| Total | 763[a] |

[a]Other admissions were for nonspecified multiple overdoses.

From 2000 to 2010, the largest proportion of admissions for deliberate self-poisoning could be attributed to TCAs (25.5%) and to sedatives and other antidepressants (32.8%). Poisons, over-the-counter medications, and nonpsychotropic prescription medications each accounted for approximately 10% of admissions. Of all the admissions, multiple overdoses accounted for over twice as many ICU admissions compared to single overdoses (Tables 1 and 2).

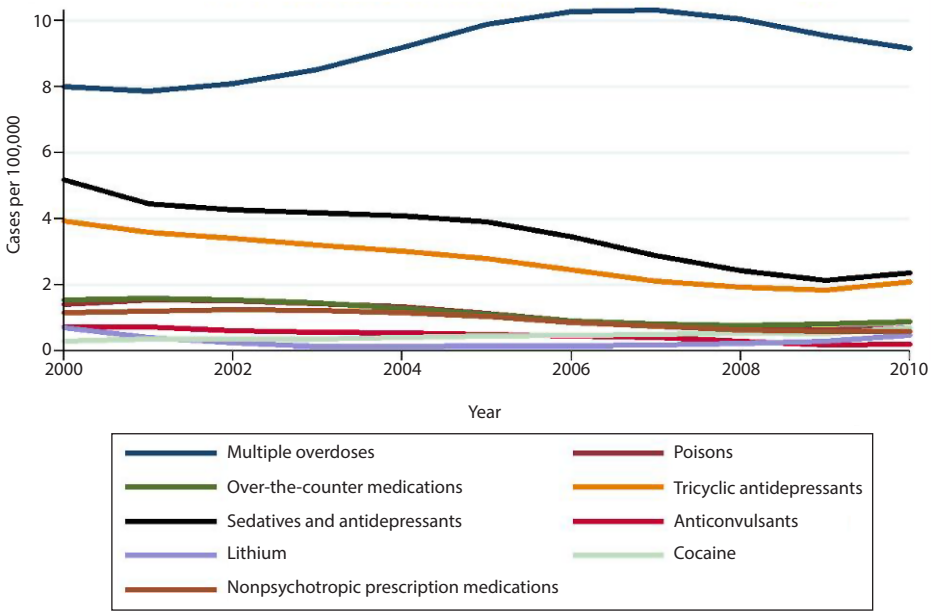
Table 3 displays prevalence analyses and the relationship between the year and the use of the drug for a deliberate self-poisoning at the population level. Table 3 refers to drugs including those taken in multiple overdoses. Multiple overdoses increased slightly over time, whereas use of poisons, over-the-counter medications, nonpsychotropic prescription medications, anticonvulsants, and TCAs decreased over time. The use of sedatives and antidepressants did not follow a linear trend, and therefore, although the results show a decrease in time, they should be interpreted with caution. The results, however, show no change in trends over time for cocaine or lithium. The LOWESS graph displays these trends over time (Figure 1). Performing the same analyses excluding the multiple overdose drugs resulted in a lack of statistical power. The results reveal trends in a similar

**Table 3. Generalized Linear Model Regression and Average Annual Percent Change With the Winnipeg Population as the Denominator to Examine Trends Over Time**

| Variable | All Deliberate Self-Poisonings | Multiple Overdoses | Poisons | Over-the-Counter Medications | Nonpsychotropic Prescription Medications | TCAs | Sedatives and Antidepressants | Anticonvulsants | Lithium | Cocaine |
|---|---|---|---|---|---|---|---|---|---|---|
| Year, n | | | | | | | | | | |
| 2000 | 83 | 48 | 10 | 10 | 7 | 25 | 32 | 3 | 5 | 1 |
| 2001 | 95 | 58 | 8 | 10 | 9 | 24 | 32 | 8 | 2 | 4 |
| 2002 | 67 | 38 | 11 | 10 | 6 | 17 | 16 | 3 | 0 | 3 |
| 2003 | 93 | 60 | 14 | 12 | 11 | 24 | 28 | 4 | 1 | 2 |
| 2004 | 87 | 53 | 6 | 7 | 7 | 21 | 33 | 0 | 1 | 2 |
| 2005 | 90 | 67 | 5 | 9 | 7 | 17 | 25 | 5 | 0 | 0 |
| 2006 | 113 | 77 | 10 | 4 | 7 | 18 | 29 | 6 | 2 | 7 |
| 2007 | 100 | 69 | 3 | 5 | 3 | 14 | 14 | 1 | 2 | 5 |
| 2008 | 99 | 71 | 5 | 3 | 3 | 9 | 13 | 2 | 0 | 1 |
| 2009 | 83 | 55 | 2 | 8 | 6 | 10 | 11 | 0 | 1 | 2 |
| 2010 | 101 | 67 | 6 | 5 | 3 | 16 | 18 | 2 | 4 | 6 |
| Incidence rate ratio | 1.01 | 1.02 | 0.897 | 0.910 | 0.913 | 0.920 | 0.918 | 0.880 | 0.960 | 1.062 |
| 95% CI lower | 0.99 | 1.00 | 0.84 | 0.87 | 0.87 | 0.89 | 0.88 | 0.78 | 0.96 | 1.00 |
| 95% CI upper | 1.03 | 1.05 | 0.96 | 0.96 | 0.96 | 0.96 | 0.98 | 0.99 | 1.18 | 1.13 |
| Average annual percent change | 1.08 | 2.73 | −10.29 | −8.91 | −8.64 | −8.00 | −8.17 | −11.97 | −3.93 | 6.21 |
| 95% CI lower | −0.93 | 0.05 | −15.80 | −13.34 | −13.49 | −11.40 | −11.88 | −22.02 | −24.72 | −4.25 |
| 95% CI upper | 3.13 | 5.48 | −4.41 | −4.26 | −3.51 | −4.47 | −4.30 | −0.63 | 22.60 | 17.80 |
| *P* | .295 | .046 | .001 | .001 | .001 | <.001 | <.001 | .039 | .747 | .255 |

Abbreviation: TCA = tricyclic antidepressant.

**Figure 1. Locally Weighted Scatterplot Smoothing Analysis of Overdoses by Year**




direction (eTable 1). Rates of poisons (IRR = 0.91, $P < .004$) decreased over time. Rates of other drugs, such as over-the-counter medications (IRR = 0.96, $P > .05$), nonpsychotropic prescription medications (IRR = 0.96, $P > .05$), TCAs (IRR = 0.97, $P > .05$), sedatives and antidepressants (IRR = 1.04, $P > .05$), anticonvulsants (IRR = 0.92, $P > .05$), lithium (IRR = 1.05, $P > .05$), and cocaine (IRR = 1.06, $P > .05$) did not change over time. However, results of this analysis must be interpreted with caution due to the low sample sizes and lack of power.

Table 4 displays prevalence analyses and the relationship between the year of the overdose and age, sex, and severity of overdoses at the population level. With regard to age and sex distributions, these did not change over time. However, the severity of overdoses increased over time, with more intentional overdoses since 2000 requiring longer stays in the ICU (>2 days). A further analysis of these trends was conducted to determine whether the concurrent increase in severity of admissions and multiple overdoses was significant. This was done using a 2-by-2 $\chi^2$ analysis comparing type of overdose (multiple versus single) to severity of overdose (>2 days in the ICU vs <2 days in the ICU). Results for this analysis reflected no difference in the severity of overdose between the 2 groups ($\chi^2 = 0.334$,

**Table 4. Generalized Linear Model Regression and Average Annual Percent Change With the Winnipeg Population as the Denominator to Examine Age, Sex, and Severity Trends Over Time**

| Variable | Female Sex | Male Sex | Age < 25 y | Age 25–54 y | Age ≥ 55 y | Severity < 2 d | Severity > 2 d |
|---|---|---|---|---|---|---|---|
| Year, n | | | | | | | |
| 2000 | 30 | 53 | 12 | 62 | 9 | 60 | 23 |
| 2001 | 41 | 54 | 16 | 69 | 10 | 74 | 21 |
| 2002 | 27 | 40 | 7 | 58 | 2 | 50 | 17 |
| 2003 | 44 | 49 | 8 | 72 | 13 | 71 | 22 |
| 2004 | 33 | 54 | 10 | 68 | 9 | 55 | 32 |
| 2005 | 36 | 54 | 11 | 67 | 12 | 65 | 25 |
| 2006 | 45 | 68 | 25 | 76 | 12 | 76 | 37 |
| 2007 | 49 | 51 | 18 | 66 | 16 | 65 | 35 |
| 2008 | 39 | 60 | 13 | 65 | 21 | 76 | 23 |
| 2009 | 40 | 43 | 14 | 58 | 11 | 51 | 32 |
| 2010 | 43 | 58 | 10 | 75 | 6 | 65 | 36 |
| Incidence rate ratio | 1.021 | 1.003 | 1.018 | 0.998 | 1.030 | 0.996 | 1.046 |
| *P* value | .105 | .786 | .521 | .85 | .384 | .77 | < .001 |
| 95% CI lower | 0.996 | 0.980 | 0.965 | 0.981 | 0.953 | 0.970 | 1.021 |
| 95% CI upper | 1.047 | 1.027 | 1.073 | 1.016 | 1.134 | 1.023 | 1.073*** |

***$P < .001$.

**Table 5. Cross Tabulation of Drug Categories[a]**

| | Over-the-Counter Medications (n = 83) | | Nonpsychotropic Prescription Medications (n = 69) | | Poisons (n = 80) | | TCAs (n = 195) | | Sedatives and Antidepressants (n = 251) | | Anticonvulsants (n = 34) | | Lithium (n = 18) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Drug | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| Over-the-counter medications | … | … | 19 | 13.0 | 1 | 1.3 | 13 | 6.6 | 19 | 7.5 | 3 | 8.3 | 0 | 0 |
| Nonpsychotropic prescription medications | 9 | 10.8 | … | … | 0 | 0 | 10 | 5.1 | 13 | 5.1 | 1 | 2.7 | 0 | 0 |
| Poisons | 1 | 1.2 | 0 | 0 | … | … | 2 | 1.0 | 40 | 15.9 | 0 | 2.7 | 0 | 0 |
| TCAs | 13 | 15.6 | 10 | 14.9 | 6 | 7.5 | … | … | 47 | 18.7 | 1 | 2.7 | 0 | 0 |
| Sedatives | 19 | 22.8 | 13 | 18.8 | 40 | 50.0 | 40 | 20.5 | … | … | 14 | 38.0 | 3 | 33.3 |
| Anticonvulsants | 3 | 3.6 | 1 | 1.4 | 0 | 0 | 1 | 0.5 | 14 | 5.5 | … | … | 0 | 0 |
| Lithium | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1.6 | 0 | 0 | … | … |

[a]Percentages refer to column percentages. For example, in row 2, column 2, percentage is the total number of combined prescription and over-the-counter overdoses as a proportion of the total number of over-the-counter overdoses.
Abbreviation: TCA = tricyclic antidepressant.

$P > .05$). A generalized linear model regression of long-stay admissions over time revealed that these increased over time (IRR = 1.08; 95% CI, 1.04–1.10; $P < .01$). Short-stay admissions did not show any difference over time (IRR = 0.99; 95% CI, 0.95–1.03; $P > .05$).

We conducted an analysis of the combinations of drugs in multiple overdoses. Most multiple overdoses occurred in conjunction with sedatives and antidepressants (Table 5). An analysis of patterns of these combinations revealed that from 2000 to 2005 and from 2006 to 2010, there were no significant differences in the combinations between those 2 time points; however, these results need to be interpreted with caution given our limited sample size (eTable 2).

The results of the sensitivity analyses revealed that, even when unintentional overdoses were included, trends over time did not change (IRR = 1.01, $P > .05$) (Table 3). Rates of poisons (IRR = 0.89, $P < .01$), over-the-counter medications (IRR = 0.91, $P < .01$), nonpsychotropic prescription medications (IRR = 0.91, $P < .01$), TCAs (IRR = 0.91, $P < .01$), sedatives and antidepressants (IRR = 0.91, $P < .01$), and anticonvulsants (IRR = 0.88, $P < .05$) decreased over time. However, rates of lithium, cocaine, and narcotics did not change over time.

## DISCUSSION

Using the 1,011 individuals in the ICU Database, we estimated that admissions for deliberate self-poisoning involving multiple substances increased from 2000 to 2010; however, they were not restricted to a specific age or gender. Conversely, rates of admissions for overall deliberate self-poisoning remained relatively stable over time. Psychotropic medications were the most common substance in deliberate self-poisoning admissions; however, use of individual psychotropic medication overdoses, such as TCAs and sedatives and antidepressants, declined over time. The use of poisons, over-the-counter medications, nonpsychotropic prescription medications, and anticonvulsants also declined in their contribution to ICU admissions over the study period.

With respect to TCAs, our study showed a decline in ICU admissions, but previous literature[28] suggests that

TCAs are the primary cause in suicide deaths. This may be explained by the fact that TCAs are more toxic in overdose and therefore patients may have died before being admitted into the ICU. Although rates of sedatives and antidepressants also declined over time, these results need to be interpreted with caution due to the nonlinear trend.

While overall rates of deliberate self-poisonings did not decline over time, use of individual substances for deliberate self-poisonings such as poison, anticonvulsants, and nonpsychotropic prescription medications decreased over time. This could be due to increased vigilance about prescription practices and the limits on prescriptions. The decline in over-the-counter medication use may be due to better labeling regarding acetaminophen-containing products.[32] However, this increased vigilance about prescription and nonprescription substances, which could explain the decrease in individual poisonings over time, could also contribute to the need for persons to take multiple substances to ingest sufficient quantities for overdose.[27] In addition, the severity of overdose over time has increased, suggesting that there is a trend toward increased severity of overdose in admissions over time, but this was not reflected in a correlation with multiple overdoses, suggesting that there is a general trend toward an increasing overdose severity.

Although this study provided important information about trends in substances used in near lethal deliberate self-poisonings, there were several limitations. First, we did not have access to survival outcome data and were therefore unable to discriminate between fatal and near-fatal overdoses, although all admissions to the ICU were near-fatal overdoses. Second, the multiple overdoses category was not particularly informative with regard to combinations of drugs in overdose. Thus, we were able to determine the specific combination of drugs in only some cases. In addition, we were not able to access a representative sample of charts for the multiple overdoses. The charts we were able to access for the reliability analysis included only a small subsample of the charts and therefore would not have provided comprehensive information. Third, in the analyses, drugs that were reported under the multiple overdose categories were also reported in the trend analysis of that particular drug, as there was not enough power to conduct an accurate population trend analysis of single overdose drugs; therefore, data must be interpreted with caution. However, the data do reveal trends in use of the drugs in ICU admissions regardless of whether they were taken in conjunction with other substances or not. Fourth, the database is relatively dated, having been created in 1989 and therefore missing several drugs potentially relevant to our study, including opioids, which have been implicated in overdose deaths.[28] These drugs, although indicated in the data collection, do not have subcodes designating the overdoses as intentional, accidental, or iatrogenic, and therefore we were unable to use them for this study. Fifth, although a trend analysis of length of stay can provide invaluable information regarding severity of overdose, this could be confounded by early expiration and late admissions into the ICU.

However, the ICU Database has the advantage of large amounts of informative and quite accurate data. The database contained information from all ICUs in Winnipeg, which allowed us to make population-level comparisons. In addition, for most drugs the dataset distinguished between intentional, iatrogenic, and unintentional overdoses; therefore, we could distinguish deliberate and intentional self-poisonings from other overdoses. Although we were unable to determine the individual drugs involved in multisubstance overdoses due to the unavailability of charts to review, we were able to determine the change in severity of multiple overdoses over time using the length of stay as an indicator of clinical severity.

Rates of deliberate self-poisonings did not decline over time, although use of many individual drugs taken in overdose declined. There are several strategies that could be utilized to reduce rates of deliberate self-poisonings. These include (1) restricting the quantity of drug prescribed or sold over the counter, (2) raising awareness among physicians and pharmacists on safe prescription practices, and (3) as most suicide attempts occur during times of acute psychological distress,[33] attempting to monitor patients' mental health and adjusting prescription patterns accordingly, especially among an at-risk population.

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***Drug names:*** digoxin (Lanoxin and others), lithium (Lithobid and others).

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***Additional information:*** The ICU Database is a clinical database that contains detailed clinical information about all adult intensive care unit (ICU) admissions in the Winnipeg Regional Health Authority (WRHA). The

data are maintained by the Critical Care Medicine Information Management and Research program of the WRHA Department of Medicine and Critical Care. For more information or to access the data, please contact Manitoba Centre for Health Policy Population Health Research Data Repository, Manitoba Centre for Health Policy, Winnipeg Regional Health Authority, 4th Floor, 650 Main Street, Winnipeg, Manitoba, Canada R3B 1E2.

***Supplementary material:*** See accompanying pages.

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*Editor's Note:* We encourage authors to submit papers for consideration as a part of our Focus on Suicide section. Please contact Maria A. Oquendo, MD, at moquendo@psychiatrist.com.

Supplementary material follows this article.

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# Supplementary Material

**Article Title:** Population Trends in Substances Used in Deliberate Self-Poisoning Leading to Intensive Care Unit Admissions From 2000 to 2010

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## List of Supplementary Material for the article

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2. eTable 1 — GLM regression and Average Annual Percentage Change with the Winnipeg Population as the Denominator to Examine Trends over time (Only single overdoses)
3. eTable 2 — Cross Tabulation of Drug Categories

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Figure 1. Reliability Analysis of misclassification errors over time.

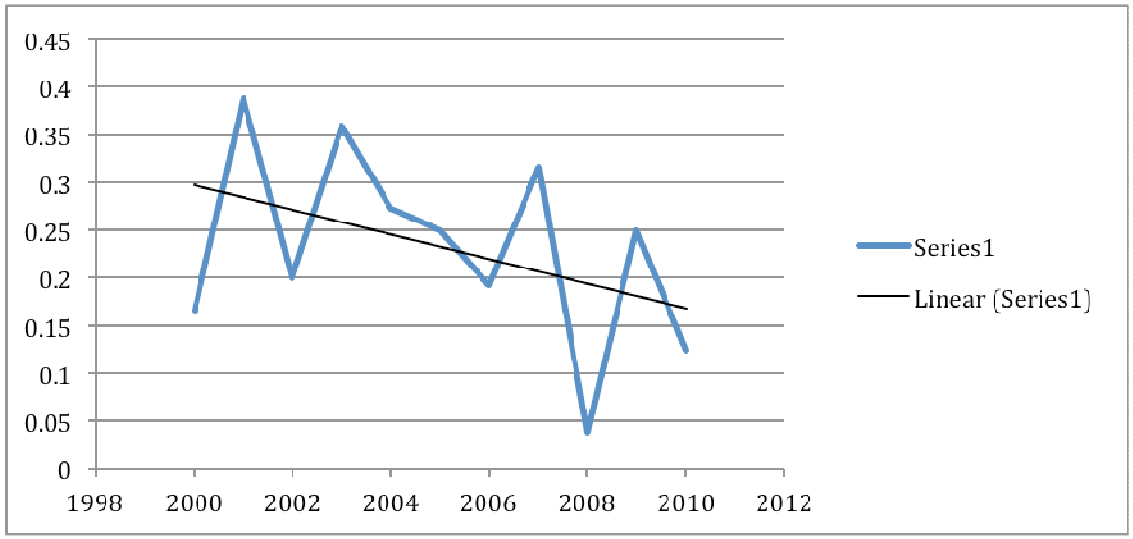

Table 1. GLM regression and Average Annual Percentage Change with the Winnipeg Population as the Denominator to Examine Trends over time (Only single overdoses)

| | All DSPs | Multiple | Poison | OTC | Prescription | TCA | Sedative /Antidepressant | Anticonvulsant | Lithium | Cocaine |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | | | | | | | | | | |
| **2000** | 83 | 48 | 10 | 4 | 4 | 7 | 6 | 2 | 2 | 0 |
| **2001** | 95 | 58 | 6 | 5 | 4 | 9 | 8 | 3 | 0 | 1 |
| **2002** | 67 | 38 | 6 | 6 | 1 | 10 | 3 | 2 | 0 | 1 |
| **2003** | 93 | 60 | 13 | 2 | 3 | 8 | 3 | 2 | 1 | 1 |
| **2004** | 87 | 53 | 4 | 1 | 2 | 12 | 12 | 0 | 1 | 2 |
| **2005** | 90 | 67 | 5 | 1 | 3 | 5 | 7 | 2 | 0 | 0 |
| **2006** | 113 | 77 | 10 | 1 | 5 | 5 | 8 | 2 | 1 | 4 |
| **2007** | 100 | 69 | 3 | 1 | 1 | 7 | 11 | 1 | 2 | 4 |
| **2008** | 99 | 71 | 5 | 3 | 1 | 6 | 9 | 2 | 0 | 0 |
| **2009** | 83 | 55 | 2 | 5 | 3 | 7 | 10 | 0 | 1 | 0 |
| **2010** | 101 | 67 | 5 | 4 | 3 | 9 | 7 | 2 | 2 | 2 |
| IRR | 0.980 | 1.027 | 0.912 | 0.961 | 0.961 | 0.971 | 1.045 | 0.929 | 1.055 | 1.069 |
| $p$[a] | 0.031 | 0.046 | 0.004 | 0.458 | 0.295 | 0.127 | 0.133 | 0.152 | 0.608 | 0.324 |

[a] *The results in this table reflect a lack of statistical power and should be interpreted with caution.*

Table 2. Cross Tabulation of Drug Categories.

| Drugs | OTC | | Prescription | | Poison | | TCA | | Sedative | | Anticonvulsant | | Lithium | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2000-2005 | 2006-2010 | 2000-2005 | 2006-2010 | 2000-2005 | 2006-2010 | 2000-2005 | 2006-2010 | 2000-2005 | 2006-2010 | 2000-2005 | 2006-2010 | 2000-2005 | 2006-2010 |
| **OTC** | X | X | 9 | 0 | 1 | 0 | 11 | 2 | 17 | 2 | 2 | 1 | 0 | 0 |
| **Prescription** | 9 | 0 | X | X | 0 | 0 | 7 | 3 | 11 | 2 | 1 | 0 | 0 | 1 |
| **Poison** | 1 | 0 | 0 | 0 | X | X | 2 | 0 | 5 | 35 | 0 | 1 | 0 | 0 |
| **TCA** | 11 | 2 | 7 | 3 | 2 | 2 | X | X | 33 | 7 | 1 | 0 | 0 | 0 |
| **Sedative** | 17 | 2 | 11 | 2 | 5 | 35 | 33 | 7 | X | X | 8 | 3 | 2 | 1 |
| **Anticonvulsant** | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 8 | 3 | X | X | 0 | 0 |
| **Lithium** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | X | X |