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Suicide following an inpatient hospitalization for a suicide attempt: a Canadian follow-up study

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Abstract This study contributes a Canadian perspective to a growing body of international studies examining suicide among cohorts of suicide attempters, and a much more limited literature on the epidemiology of suicide in Canada. We evaluated the 13-year mortality experience of a regional cohort of 876 first-ever inpatient hospital admissions for a suicide attempt admitted between 1979 and 1981. Compared to the general population, study subjects were 4 times more likely to die of any cause, but 25 times more likely to commit suicide and 15 times more likely to die of accidental or adverse causes. Ten years after then first hospitalization for attempted suicide, 5.9% of study subjects had commited suicide. Baseline age appeared to be a risk factor for women, but not for men. Women under 60 years had the best 10-year survival (3.6% had commited suicide) and women over 60 years had the poorest (17.5%). A total of 8.7% of men under 60 years and 10% of those over 60 years commited suicide within 10 years. The remainder of the analysis focused on those under 60 years of age at the time of their index inpatient hospitalization. Three factors were prognostic for suicide: being male, which had a relative risk (RR) of 5.0, living in a lower income area (RR = 3.2), and having used a violent method during the index attempt (RR = 2.5). The periods of greatest risk for suicide were within the 1st and 4th years following first-ever inpatient hospitalization, with the 4th year representing the time of highest risk. The identification of time periods subsequent to first-ever hospitalization when patients are at greatest risk of suicide can be used to guide the timing and duration of clinical interventions and aftercare to ensure that patients are appropriately supported during periods of highest risk.

Preliminary results from this study were presented at the 6th Annual meeting of the Canadian Society for suicide prevention, 12 October 1995

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Introduction

Clinical and scientific interest in prognosis for suicide following a suicide attempt has been high. One aim has been to identify the point in time when risk is imminent in order to ensure that treatment and prevention efforts are appropriately targeted [1]. Toward this end, the first large studies of suicide among suicide attempters were conducted in the United States [2, 3], followed by others conducted in the United Kingdom [4–7], Scandinavian countries [8–11], and, most recently, other countries in Europe [12, 13]. The present study contributes a Canadian perspective to this growing body of international work and to the much more limited body of knowledge on the epidemiology of parasuicide in Canada [14].

More specifically, this paper describes the mortality experience of a cohort of persons undergoing their first-ever inpatient hospitalization for a suicide attempt who were followed over a 13-year period. Suicides, deaths from accidental or adverse causes, and natural deaths are compared to the general population to determine the magnitude of increased risk experienced by study subjects. Natural deaths refer to deaths associated with disease processes that are not a result of suicide, accident, or other adverse cause (such as homicide). Next, the 10-year cumulative suicide mortality is described for the study cohort as a whole, and for pertinent age and gender groupings, followed by an assessment of putative psycho-social prognostic factors. Finally, the rate of suicide over time is examined to identify the periods of highest risk for suicide subsequent to a first hospitalization following a suicide attempt.

Methods

Study design

A consecutive series of individuals who were residents of Southern Alberta having a first-ever inpatient admission to any acute care general hospital in Calgary for a suicide attempt between 1979 and 1981 was followed for a maximum of 13.3 years.

Cohort assembly

A key requirement for a prognostic study is that the study subjects share a common "zero time," defined as the same well-defined location along the course of the condition being studied. This has been variously defined in terms of first onset of symptoms, first diagnosis, or first treatment [15]. The number of prior suicide attempts has been shown to be a key predictor of subsequent suicide in hospital populations; the greater the number of previous attempts, the greater the risk [16]. Therefore, we defined a common zero time as constituting first-ever inpatient hospitalization for a suicide attempt, thus excluding individuals having a previous inpatient hospitalization for a suicide attempt.

Hospital administrative data from five hospitals were used to identify patients having a final ICD9, (Clinical Modification) diagnosis indicating a suicide attempt (E950 codes) [17]. Individuals having a prior inpatient hospitalization for a suicide attempt were identified using two procedures. First, hospital records of all potential study candidates were reviewed in detail. Admission histories, consultation notes, nursing notes, and discharge summaries of all admissions contained on the chart were scrutinized for any report of an inpatient hospitalization for a suicide attempt predating the study. The remaining eligible individuals were then cross-checked in the computer systems of all study hospitals to rule out previous suicide-related inpatient admissions that may not have been documented in the clinical notes. Matching was based on name, date of birth, and, when available, health care number. Less than 1% of the subjects were excluded as a result of the second-level cross-checking, suggesting that the cumulative clinical notes provided a relatively complete picture of past inpatient hospitalizations.

A total of 1572 charts of individuals having a final diagnosis including an E950 suicide code were reviewed. Of these, 876 (55.7%) patients experienced their first-ever inpatient hospitalization for a suicide attempt during the study years, so were included for study. Of those remaining, 507 (32.3%) had a previous inpatient hospitalization for a suicide attempt, 121 files (7.7%) had been miscoded with respect to either the final diagnosis (i.e., were not suicide attempts), or the inpatient status (i.e., were outpatients); 27 (1.7%) made minor suicide attempts while hospitalized for another reason (usually a psychiatric illness); and 7 patients (0.4%) had been counted more than once in the hospitalization data, having been admitted to more than one hospital. Finally, 34 subjects (2.2%) were excluded for miscellaneous reasons including insufficient chart documentation to permit follow-up, court-ordered admissions for a forensic assessment, or misfiled charts which could not be located.

Follow-up

Follow-up varied from 1 day (when death occurred as a result of the index attempt), to 13.3 years. Both provincial and national mortality searches were conducted. Locally, hospital records in the five study hospitals were read to identify subsequent deaths. Secondly, subjects were tracked through available provincial computerized motor vehicle and correctional services registries. Individuals having a valid driver's license were considered to be alive on the date the most recent license was issued. Similarly, individuals who were charged with a criminal offense were considered to be alive as of the date of the most recent court appearance. Finally, the provincial files of the Chief Medical Examiner were reviewed for vital status and manner of death.

A computerized file containing all study information, the presumed vital status, and the last date known to be alive or presumed dead was then forwarded to Statistics Canada for follow-up through the National Mortality database. This database covers all deaths in the country and, at the time of this research, was complete up to 31 December 1989. Vital status and endpoints collected through the provincial search provided Statistics Canada staff with independently gathered information to assess the validity of their own record linkage procedure. Few discrepancies occurred, and these were resolved by returning to hospital files to look for errors in dates, or variations in name spellings. There was only one subject identified as deceased in the provincial search whose death remained unconfirmed by Statistics Canada. The vital status of this subject was determined from the Motor Vehicles Administration Database, which includes reports made by relatives of decedents. Although not specified, it is possible that this person died outside of Canada. As this could not be confirmed, this individual was included in the analysis only until the last date known to be alive and treated as a censored observation thereafter.

To protect the confidentiality of subjects, project staff conducted all provincial follow-up searches and no confidential information was released to any provincial agency. Identification information that was released to Statistics Canada was purged from the linked data file before being returned to the investigators. This made it impossible to identify any individual in the dataset. This procedure received ethical approval from The University of Calgary Conjoint Biomedical Ethics Committee, the Provincial Solicitor General's Department (for access to both motor vehicles and correctional databases), the Office of the Chief Medical Examiner, and Statistics Canada.

Prognostic data

Prognostic data at baseline were abstracted from the hospital records using a standardized data collection form designed for this purpose and pretested on 100 records. Research assistants underwent reliability testing using 25 of the records that were coded during the pretest. Weekly meetings were held to clarify emerging issues and prevent coding drift.

Social and clinical factors were chosen for study if prior literature revealed them to be risk factors for suicide, and if they could be reliability abstracted from the health record using the standardized protocol. These reflected baseline characteristics and included gender, age group (under 21; 21–30; 31–40; 41–50; 51–60; over 60), marital status (married/common-law; living alone), ethnic background (Caucasian; non-Caucasian), most responsible diagnosis (grouped according to ICD9 codes into psychotic disorders; depressive disorders; other disorders; no diagnosis recorded), psychiatric comorbidities (multiple comorbidities; single comorbidity; no diagnosis), physical comorbidities (yes; no), prior non-hospitalized suicide attempts (yes/no or unknown), prior inpatient psychiatric admissions non-suicide related (yes/no or unknown), alcohol as a factor in the suicide attempt as identified on the paramedic or emergency room report (yes/no), and violent suicide method (e.g., gun, explosives, hanging, jumping, etc). Because depressive symptoms are considered to be strongly predictive of suicidality, 'depressive disorders' were defined in their broadest sense to include any non-schizophrenic disorder in which the primary feature was a disturbance of mood, regardless of the etiology. This category included presenile and senile dementia with depressive features (290.13, 290.21), arteriosclerotic dementia with depressive features (290.43), affective psychoses (296), depressive-type psychosis (298.0), neurotic depression (300.4), affective personality disorder (301.1), acute reaction to stress with predominant disturbance of emotions (308.0), brief depressive reaction (309.0), prolonged depressive reaction (309.1), adjustment reaction with mixed emotional features or disturbance of emotions (309.28, 309.4), depressive disorders not elsewhere classified (311), and misery and unhappiness disorder (313.1). Psychoses included codes for

schizophrenia and all remaining 200 codes. For analytic convenience, where multiple diagnoses were recorded, subjects were initially assigned to a single diagnostic category based on its potential prognostic relevance to suicide; first schizophrenia, followed by depressive theme disorders, then any other diagnosis. Additional diagnoses were then evaluated as comorbidities.

Because hospital records did not include information on income, the 1988 Demographic and Income Statistics for Postal Areas [18] was used to identify the median income reported for each subject's postal code area. Data for this publication were derived from tax returns filed in the spring of 1989. Income data were indexed to the median Alberta income for both sexes, then grouped to provide income quintiles. This ecological measure reflects broad environmental influences, area pressures, and living conditions, assuming a level of homogeneity in an area that may not necessarily exist at the individual level.

An attempt was also made to determine usual occupational status on or around the time of the target admission, although a lack of standardized chart data made this challenging. For patients not in the workforce, such as students or housewives, an attempt was made to determine the occupation of the primary provider: the husband, father, mother, or other family member. Occupations were ranked into three broad groups using Hollingshead's Occupational Scale as a guide [19]: professional, managerial, and administrative personnel (levels 1,2,3 of Hollingshead's Occupational Scale), clerical and skilled manual employees (levels 4 and 5), and machine operators, semi-skilled, and unskilled employees (levels 6 and 7).

Finally, the classification of physical comorbidities was approached descriptively. Discharge ICD9-CM diagnostic codes from all previous inpatient admissions were used to identify physical comorbidities that (1) existed prior to the suicide attempt, (2) were terminal or associated with high mortality, (3) typically would follow a chronic or degenerative course, (4) were not easily resolvable through medical/surgical interventions, and/or (5) were associated with significant impairment, disability, or chronic pain. Where a primary condition was listed along with a number of secondary conditions, only the primary condition was coded. Physical comorbidities recorded in subsequent admissions were not included, because it was impossible to assess whether the condition existed prior to the index admission and, even if this could be inferred, it was impossible to tell whether the patient was aware of having had the condition.

Table 1 Comparison of selected demographic and clinical factors between first-ever hospitalized suicide attempters and attempters having had prior hospitalizations

Factor (measured at baseline)	Suicide attempters	
	First-ever hospitalization for an attempt *n* (% of 876)	Prior hospitalization(s) for an attempt *n* (% of 507)
Gender (χ^2 on 1 $df = 0.07$, $P = 0.794$)		
Male	331 (37.8%)	188 (37.1%)
Female	545 (62.2%)	319 (62.9%)
Age group (χ^2 on 3 $df = 10.97$, $P = 0.01$)		
Under 21	210 (24.0%)	100 (19.7%)
21–40	502 (57.3%)	299 (59.0%)
41–60	121 (13.8%)	94 (18.5%)
Over 60	43 (4.9%)	14 (2.8%)
Psychiatric diagnosis (χ^2 on 1 $df = 7.36$, $P = 0.007$)		
Yes	691 (78.9%)	430 (84.8%)
No	185 (21.1%)	77 (15.2%)
Diagnostic group for those with a psychiatric diagnosis (χ^2 on 3 $df = 15.09$, $P = 0.002$)		
Schizophrenic disorders	34 (4.9%)	38 (8.8%)
Depressive disorders	473 (68.5%)	249 (57.9%)
Other psychoses	18 (2.6%)	12 (2.8%)
Other neuroses	166 (24.0%)	131 (30.5%)

Results

Description of the study cohort

Table 1 compares selected demographic and clinical characteristics of the first-ever suicide attempters included in this study with those who were excluded from study by virtue of having had a previous suicide attempt. Groups were similar with respect to gender, but differed in age and broad psychiatric diagnoses. First-ever attempters were younger and less likely to have received a formal psychiatric diagnosis. If diagnosed, however, they were more likely to be suffering from a depressive theme disorder.

Table 2 describes the distribution of prognostic factors in the study cohort by gender. Most notable is the small proportion of non-Caucasian subjects and the large proportion of subjects for whom occupational data were missing. Income quintile (based on median income by postal code area) and employment status also proved to be difficult to acquire. Subsequent analyses revealed a higher suicide rate among those with missing occupational and employment data (but not postal code based income data). Missing data were disproportionately concentrated among people who died shortly after being admitted to hospital, presumably resulting in an incomplete social history. Table 2 also shows noteworthy differences between males and females with respect to marital status, ethnic background, occupational status, employment on admission, alcohol as a factor in the suicide attempt, and use of a violent method.

Mortality experience

The median period of observation was 2659 days or 7 years with a maximum follow-up of 13.3 years. Length of follow-up did not fluctuate significantly among subgroups defined on the basis of putative prognostic factors. A total of 94 of the 876 study subjects died during the follow-up period. Eighty-three deaths (88.3% of 94) occurred in the Province of Alberta, 7 (7.4%) occurred in the neighbouring British Columbia, 2 (2.1%) in Ontario, and the remaining 2 in the Maritimes (New Brunswick 1.1%, and Nova Scotia 1.1%). Five of the 49 suicides (10.2%) occurred out-of-province.

Official death certificates identified 49 suicides (52.0%), 5 accidental deaths (5.3%), 2 homicides (2.1%), 2 deaths from natural causes (2.1%), 2 unde-

Table 2 Description of study cohort

Factor (measured at baseline)	Male ($n = 331$)	Female ($n = 545$)
Age group (χ^2 on 5 df = 4.86, P = 0.43)		
<21	73 (22.1%)	137 (25.1%)
21–30	131 (39.6%)	190 (34.9%)
31–40	67 (20.2%)	114 (20.9%)
41–50	24 (7.3%)	45 (8.3%)
51–60	16 (4.8%)	36 (6.6%)
60+	20 (6.0%)	23 (4.2%)
Marital status (χ^2 on 1 df = 6.13, P = 0.01)		
Married/common-law	109 (33.2%)	227 (41.7%)
Living alone	219 (66.8%)	318 (58.3%)
Unknown	3	
Ethnic background (χ^2 on 1 df = 4.28, P = 0.04)		
Caucasian	308 (93.1%)	484 (88.8%)
Non-Caucasian	23 (6.9%)	61 (11.2%)
Median income by postal code area[a] (χ^2on 4 df = 0.47, P = 0.98)		
1	70 (22.2%)	115 (21.6%)
2	55 (17.5%)	95 (17.8%)
3	68 (21.6%)	122 (22.9%)
4	56 (17.8%)	87 (16.3%)
5	66 (21.0%)	114 (21.4%)
Unknown	16	12
Occupational status (χ^2 on 2 df = 10.74, P = 0.005)		
High (e.g., professional)	38 (12.9%)	78 (16.4%)
Medium (e.g., clerical/skilled)	92 (31.2%)	189 (39.7%)
Low (e.g., unskilled/retired)	165 (55.9%)	208 (43.9%)
Unknown	36	69
Employment on admission (χ^2 on 1 df = 16.61, P < 0.001)		
Employed (full or part time)	105 (33.1%)	108 (20.5%)
Not employed	212 (66.9%)	418 (79.5%)
Unknown	14	19
Primary diagnosis (χ^2 on 3 df = 3.41, P = 0.33)		
Psychotic disorder	24 (7.3%)	28 (5.1%)
Depressive disorder	173 (52.3%)	300 (55.0%)
Other disorder	69 (20.8%)	97 (17.8%)
No diagnosis	65 (19.6%)	120 (22.0%)
Psychiatric comorbidity (χ^2 on 2 df = 2.10, P = 0.35)		
Multiple diagnoses	107 (32.3%)	152 (27.9%)
Single diagnosis	159 (48.0%)	273 (50.1%)
No diagnosis	65 (19.6%)	120 (22.0%)
Physical comorbidity (χ^2 on 1 df = 0.63, P = 0.43)		
Yes	73 (22.1%)	108 (19.8%)
No	258 (77.9%)	437 (80.2%)
Prior non-hospitalized attempt (χ^2 on 1 df = 0, P = 0.96)		
Yes	72 (21.8%)	118 (21.7%)
No	258 (78.2%)	426 (78.3%)
Unknown	1	1
Prior psychiatric admissions (χ^2 on 1 df = 1.12, P = 0.289)		
Yes	87 (26.3%)	126 (23.1%)
No	244 (73.7%)	419 (76.9%)
Alcohol as a factor in the attempt (χ^2 on 1 df = 5.45, P = 0.02)		
Yes	140 (43.1%)	190 (35.1%)
No	185 (56.9%)	351 (64.9%)
Unknown	6	4
Violent method used (χ^2 on 1 df = 36.42, P < 0.001)		
Yes	78 (23.6%)	48 (8.8%)
No	253 (76.4%)	497 (92.2%)

[a] 1 = lowest quintile, 5 = highest quintile

termined (2.1%), and 34 unclassified deaths (36.1%). Alberta is one of only two provinces in Canada which uses specialty trained physicians, Medical Examiners, to classify deaths. Medical Examiners in Alberta assign a status of 'unclassified death' to cases that can be ascribed to the misfortunes of alcohol or substance abuse, which were self-inflicted, but which *did not* reflect suicidal intent. An example of an unclassified death is a

person who dies of alcohol poisoning after guzzling huge quantities of alcohol at a party. For the purposes of this analysis, unclassified deaths were not reclassified as suicides.

Table 3 uses indirect standardization [20] to compare the deaths observed in the study cohort to those that would be expected based on general population rates, using the 1989 census population as the standard [21]. This year corresponded to the last year for which full national follow-up data were available for the study cohort. The rate of suicides observed in study subjects was significantly higher than the general population rate. For example, 28 suicides were observed among study males and 21 among study females, whereas only 1 in each group would have been expected. Suicide rates peaked among study males who were in the 10–14 age group at the time of their baseline admission. A second, slightly lower, peak occurred in the 25 to 34-year-old group, followed by a third, yet lower, peak among those over the age of 55 years. By comparison, no suicide deaths were reported for females in either the 10–14 or 45–54 age categories. Otherwise, the rate rose steadily with baseline age.

Table 4 shows the manner of death. Yates' χ^2 statistic, the relative risk (RR), and 95% exact confidence intervals for the relative risk (95% CI) were calculated to assess whether deaths that were observed in the study cohort were greater than would be expected by chance. All-cause mortality significantly exceeded that of the standard population by a factor of 4.3 (95% CI = 2.7–7.1, $\chi^2 = 42.26$, $P < 0.001$). Natural deaths occurred significantly less often. Nineteen deaths were expected (11 males and 8 females), but only 2 (both male) were observed (RR = 0.1, 95% CI = 0.01–0.43; $\chi^2 = 12.34$, $P < 0.001$). Deaths from accidental and adverse consequences occurred 15.1 times more frequently in the study cohort than the general population (95% CI = 4.8–76.2, $\chi^2 = 33.96$, $P < 0.001$). It is noteworthy that the magnitude of risk for study females compared to their general population counterparts was greater than that for males: 23:1 compared to 10:1 respectively. Suicides were also over-represented in the study cohort compared to the general population. Study subjects were 25.9 times more likely to commit suicide (95% CI = 6.8–220.3, $\chi^2 = 42.73$, $P < 0.001$).

Cumulative suicide mortality

The Kaplan-Meier estimation method was used to derive cumulative suicide probability estimates, first for the study cohort as a whole, then for sub-groups defined on the basis of putative prognostic factors. Cox's proportional hazards modelling was then used to collapse factors into homogeneous risk groups (as presented), to assess confounding and effect modification, and to ex-

Table 3 Observed and expected mortality from suicide by baseline age group and gender

Age at baseline	Person-years of observation (study cohort)		Study cohort mortality rates/ 100,000 person-years		Standard population mortality rates/100,000[a]		Deaths by suicide			
							Observed		Expected	
	M	F	M	F	M	F	M	F	M	F
10–14	58.4	195.2	1712.3	–	2.0	0.7	1	0	0.001	0.001
15–24	1168.6	1935.5	599.0	206.7	26.3	4.7	7	4	0.3	0.1
25–34	993.8	1623.5	1308.1	369.6	28.3	7.4	13	6	0.3	0.1
35–44	363.8	748.9	824.6	534.1	25.7	9.1	3	4	0.1	0.07
45–54	147.2	373.2	679.3	–	24.5	10.2	1	0	0.04	0.04
55–64	164.7	234.9	1214.3	1702.9	25.9	7.7	2	4	0.04	0.02
65+	80.4	77.8	1243.8	3856.0	29.6	5.8	1	3	0.02	0.005
Total	2976.8	5189.1	940.6	404.7	23.6	6.0	28	21	1[b]	1[b]

Yates $\chi^2 = 42.73$, $P < 0.001$, RR = 25.9, exact 95% CI = 6.8–220.3
[a] 1989 Canadian population mortality rates for E950–E959 ICD-9 codes
[b] Rounded to nearest whole number

Table 4 Observed and expected mortality by cause of death

Cause of death	Observed no.		Expected no.[a]		Risk ratio (exact 95% CI)
	M	F	M	F	
Natural causes	2	0	11	8	0.1 (0.01–0.43)
Accidental/adverse	20	23	2	1	15.1 (4.8–76.2)
Suicide	28	21	1	1	25.9 (6.8–220.3)
All causes	50	44	14	10	4.3 (2.7–7.1)

[a] Population standard derived from Statistics Canada data, 1989. Estimates for natural deaths were derived by subtracting deaths due to Accidental/Adverse Events (E800 to E949 and E960 to E999 ICD codes) and Suicides (E950 to E959 ICD codes) from figures describing all-cause mortality

plore the relationship of each factor to suicide while simultaneously controlling for the effects of the other factors [22, 23].

The lethality of first-hospitalized suicide attempts in this cohort was high. Almost half of those who died by suicide (24 of 49; 49%) did not survive to be discharged. The 10-year cumulative suicide mortality for the cohort reached 5.9% (95% CI = 4.5–7.8%). We examined outcomes among successive gender by 10-year age groups and found that women over the age of 60 at baseline had the highest 10-year cumulative mortality (17.5%, 95% CI = 6.99–39.9%) of any group. No age differences were noted among women in the younger age groupings, so these categories were collapsed. Women 60 years of age or younger at baseline had the lowest 10-year cumulative mortality (3.6%, 95% CI = 2.2–5.8) of any group. Significant age differences were not noted among males. For example, men 60 or younger at baseline recorded a cumulative suicide mortality of 8.7% (95% CI = 6.0–12.5%). This was similar to males over the age of 60 at baseline, 10% of whom had commited suicide by the close of the 10 years (95% CI = 2.6–34.4%).

Prognostic factors

Table 5 reports the results of proportional hazards modelling, which examined the effects of putative prognostic factors for those individuals aged 60 or younger at baseline. The analysis was restricted because the small numbers of people over the age of 60 made it impossible to account appropriately for the age effect noted among women. Results are presented in terms of the cumulative suicide probabilities calculated from the Kaplan-Meier approach for the 1st, 5th, and 10th year of follow-up, and their associated 95% confidence intervals. In addition, the hazard ratio (HR) and 95% confidence intervals from the proportional hazards modelling estimate the added risk, if any, each factor contributes when the effects of all other factors are controlled. In order to provide comparability across models, records were excluded if they missed information on any one of the factors under consideration, resulting in 793 subjects for analysis.

Three factors appeared to be predict suicide following a first-hospitalized attempt in the age-restricted cohort. Females were at 0.5 times the risk of suicide compared to

Table 5 Survival analysis of prognostic factors among those aged 60 years and younger at baseline admission

Putative prognostic factor (at baseline)	Cumulative probability (%) of suicide (95%CI) (unadjusted Kaplan-Meier estimate)			Adjusted[a] hazard ratio
	1 year	5 years	10 years	HR (95% CI)
Gender				
Male	4.8 (7.9–12.9)	7.2 (4.8–10.7)	8.7 (6.0–12.5)	Baseline
Female	1.3 (0.6–4.5)	2.7 (1.6–4.5)	3.6 (1.3–5.8)	0.5 (0.2–0.9)
Marital status				
Married/common-law	3.2 (1.7–5.9)	5.5 (3.4–8.6)	7.0 (4.4–10.9)	Baseline
Living alone	2.1 (1.2–3.8)	3.3 (2.1–5.3)	4.2 (2.8–6.4)	0.6 (0.3–1.1)
Income group (based on median income by postal code)				
Moderate/high	1.2 (0.5–3.3)	1.9 (0.8–4.1)	2.8 (1.5–5.4)	Baseline
Low	3.7 (2.4–5.9)	6.3 (4.4–8.8)	7.5 (5.4–10.5)	3.2 (1.4–7.3)
Primary diagnosis				
Depressions	2.5 (1.4–4.4)	3.4 (2.0–5.5)	4.4 (2.7–7.1)	Baseline
Other psychoses	2.1 (0.3–14.2)	8.8 (3.4–21.8)	8.8 (3.4–21.8)	2.1 (0.6–6.8)
Other neuroses	0.6 (0.1–4.3)	3.8 (1.7–8.2)	5.4 (2.7–10.6)	1.1 (0.4–2.7)
No diagnosis	5.1 (2.7–9.5)	6.2 (3.5–11.0)	7.4 (4.4–12.4)	1.4 (0.6–3.1)
Psychiatric comorbidity				
No	3.4 (2.2–5.3)	5.5 (3.9–7.7)	6.5 (4.7–9.0)	Baseline
Yes	0.8 (0.2–3.2)	1.6 (0.6–4.2)	3.4 (1.4–6.3)	0.4 (0.2–1.1)
Physical comorbidity				
No	2.8 (1.8–4.4)	4.4 (3.1–6.3)	5.3 (3.8–7.5)	Baseline
Yes	2.0 (0.6–6.0)	4.0 (1.8–8.7)	6.1 (3.2–11.4)	1.3 (0.6–2.5)
Prior non-hospitalized attempt				
No	2.5 (1.5–4.0)	4.1 (2.8–5.9)	5.2 (3.6–7.4)	Baseline
Yes	2.7 (2.5–4.0)	4.9 (2.6–9.3)	6.0 (3.4–10.6)	1.7 (0.8–3.5)
Prior psychiatric admissions				
None	3.0 (1.9–4.7)	4.3 (3.0–6.2)	5.3 (3.7–7.5)	Baseline
One or more	1.5 (0.5–5.5)	4.5 (2.4–8.5)	6.1 (3.5–10.4)	0.8 (0.4–1.7)
Alcohol as a factor				
No	3.0 (1.8–4.9)	4.6 (3.1–6.8)	5.2 (3.6–7.5)	Baseline
Yes	1.6 (0.7–3.7)	3.5 (2.0–6.2)	4.7 (2.8–7.8)	1.1 (0.6–2.3)
Non-violent method used				
No	1.5 (0.9–2.8)	3.3 (2.2–4.9)	4.4 (3.0–6.4)	Baseline
Yes	9.3 (5.3–16.1)	11.0 (6.5–18.2)	11.9 (7.2–19.2)	2.5 (1.3–5.0)

[a] Hazard ratios adjusted using Cox's Proportional Hazards Modelling. Values are adjusted for all other factors in the Table. There were 40 missing values for one or more prognostic factors. Therefore, the *N* size for this analysis is 793

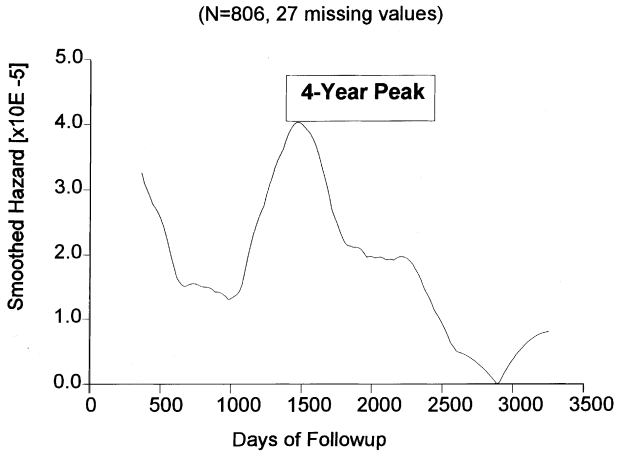

Fig. 1 Smoothed hazard function (Smoothed to 365-day bandwidth) for those aged among those 60 years of age and younger at baseline admission (adjusted for gender, median income by postal code group, and violent method)

males (95% CI = 0.2–0.9). Persons living in areas having lower than average incomes were at 3.2 times the risk compared to those living in areas having moderate or higher than average median incomes (95% CI = 1.4–7.3), and those using a violent method during their first suicide attempt were at 2.5 times the risk of suicide (95% CI = 1.3–5.0). Factors that were not prognostic for suicide were marital status, psychiatric diagnosis, psychiatric comorbidities, physical comorbidities, prior non-hospitalized suicide attempts, prior psychiatric admissions, and alcohol use as a factor in the index attempt.

Survival time

To assess the average time until suicide (or survival time), the number of days were calculated from the time of inpatient hospitalization until the time of suicide, death from another cause, or the last date known to be alive. Figure 1 depicts the smoothed hazard function (smoothed across 365 days) from a proportional hazards model for those individuals who were 60 years of age or younger at baseline. Results are adjusted for the three significant prognostic factors: gender, income group (measured by postal code), and violent method. The hazard function depicts the force of suicide mortality over time in the study cohort, measured in terms of the daily suicide rate for subjects surviving to that point in time [22]. The shape of the curve depicts periods of greatest risk for suicide.

This hazard function reveals a bimodal pattern of risk peaking in the 1st and 4th years following first-ever inpatient hospitalization for a suicide attempt. Because data were smoothed over 365 days, the first peak is partly explainable by those individuals who died while in hospital, but it did remain, although slightly lower, when in-hospital deaths were excluded from the analysis. The peak at 4 years is noteworthy because it indicates the period of highest risk subsequent to initial inpatient hospitalization. Individuals who survived their 1st year were at greatest risk of a suicide during their 4th year post-discharge. Less emphasis should be placed on the tail of the distribution (beyond 2500 days), due to declining numbers. Although not shown, the pattern of the hazard curve was similar across genders.

Discussion

Results from this study do not apply to all individuals attempting suicide, but only to those whose made an attempt serious enough to warrant inpatient hospitalization. It has been estimated that the majority of suicide attempts (75%) are not serious enough to require treatment. Only 18% require hospital treatment and 7% require treatment in other settings [24]. As hospitals admit only the most serious attempters, they continue to be a key locus for secondary prevention efforts. Because we accumulated subjects from all acute-care general hospitals in a geographically defined regional catchment area, results can be considered to reflect population-based estimates, where population refers to a clinical population.

Compared to the general population, first-ever hospitalized suicide attempters were found to be at high risk of death from suicide as well as death from adverse causes. Study subjects were 26 times more likely to die of suicide and 15 times more likely to die of accidental or adverse events. They were significantly less likely to die of natural causes, perhaps as a consequence of competing risks.

The cumulative 10-year suicide mortality was 5.9%, significantly lower than the 10% cumulative 10-year suicide mortality reported elsewhere [6, 25–29]. One explanation for these findings may be that the Canadian population is at lower risk of suicide than populations of other countries. In 1980, Canadians ranked in the middle of 62 countries reporting suicide rates to the World Health Organization [24]. Within Canada, Alberta has consistently reported one of the highest provincial suicide rates [30]. In 1990, suicide ranked third in potential years of life lost from 75 years for Albertan males (993/100,000) and fifth for Albertan females (273/100,000) – a significant increase over previous years [31, 32]. Comparison of parasuicide rates in an Edmonton Alberta sample with the 14 WHO/EURO centers taking part in the multi-center parasuicide study reveals that Albertans had the highest rate [15]. Thus, lower endogenous risk is an implausible explanation for these findings.

A second explanation may rest with our cohort assembly procedure. In an effort to establish a common zero time, we excluded individuals with a prior inpatient hospitalization for a suicide attempt. Previous studies have followed consecutive series of admissions to hospital without such an exclusion [1–13]. Given that prior serious suicide attempts are prognostic for suicide [33],

the exclusion of high-risk subjects in this study should have deflated the cumulative mortality from suicide figures reported elsewhere. In addition, it could be argued that the relatively large proportion of unclassified deaths noted in this study could also have played a role, since these may be classified differently in other locales.

With respect to survival time, the 1st and 4th years following inpatient hospitalization were the periods of greatest subsequent risk for individuals under the age of 60 years at baseline, regardless of whether in-hospital suicides were included or excluded from the analysis. Although past research has consistently identified the first year (or two) following a suicide attempt as a time of high risk [6, 25–29], to our knowledge, a bimodal distribution of risk has not been reported. This intriguing finding may also be a reflection of our cohort assembly method. Had we included higher-risk cases by inducting a consecutive series of subjects, study outcomes could have been skewed forward in time and compressed into the first year or two following inpatient hospitalization. By excluding those with a prior inpatient hospitalization for a suicide attempt, we have avoided this problem and perhaps uncovered a second period of risk.

Regarding the clinical implications of this finding, since most hospital settings treat heterogeneous patient populations, it will continue to be useful to consider a 1-year risk window as a general guide to immediate treatment and aftercare decisions. However, as Pallis et al. argued, 'forecasting that a person will commit suicide within the next 2 or 3 years offers no guarantee for detecting the point in time at which risk is imminent, information which is crucial if we want to ensure that preventive efforts are to be used most profitably' [1, p 38]. Thus, it may also be useful to consider longer-term management strategies based on a knowledge of the patient's current and future level of risk. Theoretically, at least, this could be done if the date of first-ever inpatient hospitalization for a suicide attempt were known, by plotting the time elapsed against the hazard plot presented in Fig. 1. More generally, an awareness that patients approach their period of greatest risk some 4 years following their first-ever inpatient hospitalization for a suicide attempt has implications for ongoing risk monitoring, as patients, their families, and clinical caregivers should be on higher guard approaching this time.

Finally, a number of prognostic factors were found to independently increase the risk of suicide in the age-restricted cohort. These included being male (RR = 5.0), living in an area having a lower than average income (RR = 3.2), and having used a violent method (RR = 2.5). The large proportion of in-hospital suicide deaths noted among first-ever admissions for a suicide attempt (49% of all those who died by suicide) reinforces the importance of developing and implementing primary prevention efforts aimed at reducing the incidence of suicide attempts, especially among lower-income males who have access to violent means.

A number of baseline factors that are typically considered to be risk factors for suicide did not predict outcome: marital status, broad psychiatric diagnostic category, presence of psychiatric comorbidities, presence of physical comorbidities, prior non-hospitalized suicide attempts, prior psychiatric admissions, and concomitant alcohol use as a factor in the suicide attempt. This may not be so surprising when one considers that these were baseline characteristics that were collected, in many cases, far in advance of the eventual suicide. These findings highlight the importance of distinguishing factors that increase the likelihood of suicide (risk factors) from factors that may predict clinical course and outcome [34] once initial treatment has been sought (prognostic factors).

To summarize, this study has used survival analytic techniques to assess the mortality experience of a cohort of persons experiencing their first-ever inpatient hospitalization for a suicide attempt. Because not every patient presenting at a hospital emergency unit for a suicide attempt requires inpatient hospitalization, findings are not representative of all suicide attempters presenting to hospital. Rather they reflect only the most serious attempters. Nevertheless, because study subjects were accumulated from all inpatient admissions in acute-care general hospitals in the city, and reflect all cases meeting the study criteria admitted during the study years, they can be considered to be fairly representative of first-ever inpatient hospitalizations resulting from an act of deliberate self-injury in a large urban catchment area.

The results of this study:

1. Confirm that hospitalized suicide attempters are a high risk group for suicide and for deaths from accidental or adverse causes
2. Suggest a lower cumulative mortality among cohorts composed of first-ever hospitalized attempters compared to consecutive series of attempters
3. Indicate that elderly women (over the age of 60 at baseline) have the highest 10-year cumulative suicide rate, followed by men, and finally, women 60 years of age and under

   In addition, considering individuals 60 years or under at the time of their first-ever inpatient hospitalization, we were also able to identify:
4. A bimodal pattern of subsequent risk, with peaks during the 1st and 4th years subsequent to inpatient hospitalization and the highest period of risk during the 4th year
5. An increased risk associated with being male, living in an area of lower than average income, and having used a violent method during the index attempt.

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