



Research report

How do methods of non-fatal self-harm relate to eventual suicide?

Helen Bergen^a, Keith Hawton^{a,*}, Keith Waters^b, Jennifer Ness^b, Jayne Cooper^c, Sarah Steeg^c, Navneet Kapur^c

^a Centre for Suicide Research, Department of Psychiatry, University of Oxford, United Kingdom

^b Derbyshire Healthcare NHS Foundation Trust, United Kingdom

^c Centre for Suicide Prevention, University of Manchester, United Kingdom

ARTICLE INFO

Article history:

Received 2 August 2011

Received in revised form 24 October 2011

Accepted 24 October 2011

Available online 29 November 2011

Keywords:

Self-harm
Repetition
Suicide
Methods
Survival

ABSTRACT

Background: Methods used at an index episode of non-fatal self-harm may predict risk of future suicide. Little is known of suicide risk associated with most recent non-fatal method, and whether or not change in method is important.

Methods: A prospective cohort of 30,202 patients from the Multicentre Study of Self-harm in England presenting to six hospitals with self-harm, 2000–2007, was followed up to 2010 using national death registers. Risks of suicide (by self-poisoning, self-injury, and all methods) associated with recent method(s) of non-fatal self-harm were estimated using Cox models.

Results: Suicide occurred in 378 individuals. Cutting, hanging/asphyxiation, CO/other gas, traffic-related and other self-injury at the last episode of self-harm were associated with 1.8 to 5-fold increased risks (vs. self-poisoning) of subsequent suicide, particularly suicide involving self-injury. All methods of self-harm had similar risks of suicide by self-poisoning. One-third who died by suicide used the same method for their last self-harm and for suicide, including 41% who self-poisoned. No specific sequences of self-poisoning, cutting or other self-injury in the last two non-fatal episodes were associated with suicide in individuals with repeated self-harm.

Limitations: Data were for hospital presentations only, and lacked a suicide intent measure.

Conclusions: Method of self-harm may aid identification of individuals at high risk of suicide. Individuals using more dangerous methods (e.g. hanging, CO/other gas) should receive intensive follow-up. Method changes in repeated self-harm were not associated with suicide. Our findings reinforce national guidance that all patients presenting with self-harm, regardless of method, should receive a psychosocial assessment.

© 2011 Elsevier B.V. All rights reserved.

1. Introduction

Self-harm is the strongest predictor of future suicide (Cooper et al., 2005; Hawton et al., 2003b; Owens et al., 2002), especially when self-harm is repeated (Zahl and Hawton, 2004), together with other factors such as socio-

economic deprivation, increasing age, male gender, and psychiatric disorder (Beghi and Rosenbaum, 2010; Chen et al., 2011; Kim et al., 2010; Tidemalm et al., 2008). Assessment of suicide risk in individuals who have self-harmed is, however, generally difficult, and the predictive power of risk factors is low (Cooper et al., 2007; Harriss and Hawton, 2005; Stefansson et al., 2010). Nevertheless, an opportunity for intervention and possible prevention of suicide arises when individuals present to emergency departments following non-fatal self-poisoning or self-injury.

There is scope for greater in-depth characterisation of factors associated with risk of future suicide following self-

* Corresponding author at: Centre for Suicide Research, University of Oxford, Department of Psychiatry, Warneford Hospital, Headington, Oxford, OX3 7JX, United Kingdom. Tel.: +44 1865 738585; fax: +44 1865 738674.
E-mail address: keith.hawton@psych.ox.ac.uk (K. Hawton).

harm, to inform the clinical assessment process. One important factor sometimes investigated, though rarely explored in detail, is method of non-fatal self-harm. Methods used at an index 'suicide attempt' were found to predict suicide in a large sample of general and psychiatric admissions in Sweden, even after adjustment for socio-demographic and clinical factors (Runeson et al., 2010). Other related risk factor studies have found increased suicide risk for use of violent methods at the index attempt (vs. less violent methods) in males in Sweden (Skogman et al., 2004), and for more lethal methods such as ingestion of pesticides, inhalation of gas and hanging (vs. less lethal self-poisoning with drugs or cutting) in self-harm patients in Taiwan (Chen et al., 2011), though the latter finding was not significant after controlling for gender. Also, some methods of non-fatal attempt predicted suicide, though not independently, in a large Danish register-based study (Christiansen and Jensen, 2007).

All studies to date have used the first (or index) non-fatal episode in a study period as a predictor of suicide risk (Chen et al., 2011; Christiansen and Jensen, 2007; Runeson et al., 2010; Skogman et al., 2004). However, since repetition of self-harm is common (Sakinofsky, 2000), in individuals with repeat episodes it may be preferable to look at the last non-fatal episode, as it is closer in time and therefore potentially more relevant to the fatal act. Also, no studies to our knowledge have (i) investigated whether change or continuity of methods of self-harm in individuals who repeat self-harm is relevant to suicide risk, or (ii) estimated risks of 'suicide involving self-poisoning' and 'suicide involving self-injury' separately. These aspects are worthy of exploration as we might expect a progression in suicidal intent and hence method across repeat non-fatal episodes, or from the last non-fatal episode to the fatal act. Associations between suicide intent and choice and lethality of method are complex; they may be related where attempters have accurate knowledge of the method's lethality (Beck et al., 1975; Brown et al., 2004; Zhang and Xu, 2007), though other factors such as availability of means are also relevant (Chuang and Huang, 2004). Also a correlation between high suicide intent and violence of method is not always found (Held et al., 1998; Nordentoft and Branner, 2008).

Methods used in non-fatal self-harm are readily determined when an individual presents to the emergency department, and this knowledge may be important both for assessment of imminent suicide risk and as an indicator of need for enhanced aftercare and follow-up after the individual leaves hospital. We have investigated associations between methods used in the last one (or two) episodes of non-fatal self-harm and completed suicide in a cohort of self-harm patients who presented to emergency departments in six general hospitals in three centres in England, between 2000 and 2007. The aims of the study were:

- i. To estimate the relative risk of suicide according to the most recent method of self-harm, adjusting for gender, age, socioeconomic status and clinical history;
- ii. To investigate the extent to which the same method was used for self-harm and suicide, and the relationship of this to time between the last self-harm episode and suicide; and
- iii. To determine if changes in methods of self-harm in the two most recent episodes, in individuals with one or

more repeat episodes, were associated with increased risk of suicide.

2. Methods

2.1. Setting and sample

The study was undertaken in three centres currently involved in the Multicentre Study of Self-harm in England (Bergen et al., 2010; Hawton et al., 2007). Data were collected on all individuals who presented with non-fatal self-harm to general hospital emergency departments (ED) in Oxford (one), Manchester (three) and Derby (two) during the 8-year period 1st January 2000 to 31st December 2007. Non-fatal self-harm (hereafter referred to as self-harm), was defined as intentional self-poisoning or self-injury, irrespective of motivation (Hawton et al., 2003a). Following self-harm the majority of patients received a psychosocial assessment by specialist psychiatric clinicians (and some by ED staff). Demographic, clinical and hospital management data on each episode were collected by clinicians using standardised forms or were entered directly into a computerised system. Patients not receiving an assessment were identified through scrutiny of ED and medical records, from which more limited data were extracted by research clerks. Data recorded included details of the method of self-injury and substances taken in self-poisoning. Repeat episodes were identified where individuals re-presented to hospitals within the same centre.

2.2. Ethical approval

The monitoring systems in Oxford and Derby have approval from local Health/Psychiatric Research Ethics Committees to collect data on self-harm for local and multicentre projects. Self-harm monitoring in Manchester is part of a clinical audit system, and has been ratified by the local Research Ethics Committee. All three monitoring systems are fully compliant with the Data Protection Act of 1998. All centres have approval under Section 251 of the NHS Act 2006 (formerly Section 60, Health and Social Care Act 2001) to collect patient identifiable information without patient consent. The centres also had ethical approval to release patient details to the Medical Research Information Service of the NHS (MRIS) for the retrieval of mortality information on these individuals.

2.3. Mortality

Mortality information was supplied by the MRIS, which traced and flagged individuals using the Central Health Register Inquiry System for patients in the UK, and equivalent sources in Scotland. Data used for tracing included name, gender, date of birth, NHS number and post-code of last known address. Individuals were followed up from 1st January 2000 to 31st December 2010; thus the minimum follow-up period was 3 years and the maximum was 11 years.

Suicide was defined as death where the underlying cause was intentional self-harm (ICD-10 codes X60–X85) or undetermined intent (Y10–Y34) (Linsley et al., 2001). For this study sub-categories were defined as follows: self-poisoning with analgesics (X60, Y10), antidepressants and

tranquillisers (X61, Y61), and other substances (X62–X66, X68–X69, Y12–Y16, and Y18–Y19). Self-injury by use of: CO/other gas (X67, Y17); hanging/asphyxiation (X70, Y20); drowning (X71, Y21); firearms/fire-related (X72–X77, Y22–27); cutting/sharp/blunt object injury (X78–X79, Y28–29); jumping from a height (X80, Y30); jumping or lying before moving object (X81, Y31); other self-injury including motor vehicle and aircraft crashes, electrocution and unspecified means (X82–X84, Y32–Y34). The text of coroners' verdicts (including 29 narrative verdicts) was cross-checked against ICD-10 codes for underlying cause of death. In one case an ICD-10 code was missing, and in another case the ICD-10 code (W761) did not match the stated verdict. We used information from the associated narrative description to recode cause of death for these two cases as intentional self-harm by hanging (X70).

2.4. Statistical analyses

Hazard ratios for risk of suicide following the last episode of self-harm were estimated from Cox proportional hazard models. These were determined for three outcomes: all suicides, suicide by self-poisoning, and suicide by self-injury. All individuals who were traced by MRIS for any length of time were included. Observation time was censored when the individual died or embarked overseas. Data were scrutinised to make certain that when a non-fatal episode occurred on the same day as suicide these were distinctly separate events. These cases ($n=2$) had 'time since last episode' recoded from 0 to 1 to ensure inclusion into survival analyses (as 1 day was the unit of analysis). For the analysis relating to the first research question (estimation of the relative risk of suicide according to last method of self-harm), unadjusted models were determined initially for method of self-harm as the sole independent variable, coded into 6 categories: self-poisoning alone (reference), cutting or stabbing injury with a sharp object—hereafter denoted as 'cutting', hanging/asphyxiation, use of CO/other gas, traffic-related, and other self-injury (including mixed methods which involved self-poisoning) (Table 2). Variables for gender, age, unemployment or sickness or disability status, and current or previous psychiatric treatment were coded from information gathered at the last episode of non-fatal self-harm. These potential confounders were significant in univariate models ($P<0.2$) and thus were included in multivariate models to give an adjusted hazard ratio. Clustering by centre was adjusted for using the 'vce(cluster)' option of the 'stcox' command in Stata. For the analysis relating to the third research question (method changes in the last two episodes), method of self-harm was coded into 3 categories (self-poisoning alone, cutting, and all other self-injuries), thus resulting in a 9-category variable for all possible combinations of methods used at the last two episodes of self-harm, denoted by [*method at penultimate episode, method at last episode*], for example [cutting, self-poisoning]. This variable was used as the independent predictor in Cox models for three outcomes: all suicides, suicide by self-poisoning, and suicide by self-injury. Because of multiple analyses, a Bonferroni-corrected level of significance ($P<0.006$) was used. Proportional hazards assumptions were tested and upheld in all models. For the second research question, the timing between non-fatal and fatal acts

was plotted against proportions using a 2-category method of harm (self-poisoning or self-injury), with binomial 95% confidence intervals. Analyses were conducted using SPSS v17.0 (SPSS Inc, 2008) and Stata v10.0 (Stata Corporation, 2007).

3. Results

During the 8-year study period 1st January 2000 to 31st December 2007, 30,950 individuals presented with self-harm to the six hospitals in the three study centres. Individuals who could not be traced by MRIS (748, 2.4%) were excluded from analyses. Follow-up information was available for 30,202 individuals, and of these 378 (1.25%) died by suicide. There were 17,709 females (58.6%), with a median age of 27 years (IQR, 17–37), and 12,474 males (41.3%), with a median age of 31 years (21.5–40.5) (for 19 (0.1%) individuals the gender was not known). The majority of individuals (23,002, 76.2%) had one episode of self-harm in the study period, and of these 249 (1.08%) died by suicide; 3943 (13.1%) had two episodes, and of these 62 (1.57%) died by suicide; and the remainder (3257, 10.7%) had three or more episodes, and of these 67 (2.06%) died by suicide. Suicide deaths involving self-injury were more common in males (180/242, 74.4%) than females (70/136, 51.5%; $\chi^2=20.405$, $P<0.001$; see Table 1).

The median follow-up time was 1938 days for the combined sample, 300 days in those who died by suicide and 1956 days in those who were alive at the end of the follow-up period.

3.1. Relative risk of suicide associated with last method of self-harm

Hazard ratios from Cox survival models for risk of (a) suicide by all methods, (b) suicide involving self-poisoning, and (c) suicide involving self-injury are presented in Table 2. Analyses were adjusted for gender, age, unemployment/sickness/disability status and psychiatric treatment at the last

Table 1

Underlying cause of death for individuals who died by suicide (intentional self-harm and undetermined intent) following presentation for self-harm in 2000–2007, followed up to the end of 2010.

Cause of death	Number (%) of all deaths		
	Males	Females	Combined
Self-poisoning with			
Analgesics	9 (3.7)	5 (3.7)	14 (3.7)
Antidepressants/tranquillisers	14 (5.8)	23 (16.9)	37 (9.8)
All other substances	39 (16.1)	38 (27.9)	77 (20.3)
Total self-poisoning	62 (25.6)	66 (48.5)	128 (33.9)
Self-injury by			
Hanging/asphyxiation	94 (38.8)	39 (28.7)	133 (35.2)
Drowning	12 (5.0)	4 (2.9)	16 (4.2)
Jumping from height	12 (5.0)	4 (2.9)	16 (4.2)
Jumping before moving object	9 (3.7)	4 (2.9)	13 (3.4)
Firearms/fire-related	10 (4.1)	2 (1.5)	12 (3.2)
CO/other gas	8 (3.3)	3 (2.2)	11 (2.9)
Cutting/sharp/blunt object	6 (2.5)	2 (1.5)	8 (2.1)
All other self-injuries	29 (12.0)	12 (8.8)	41 (10.8)
Total self-injury	180 (74.4)	70 (51.5)	250 (66.1)
Total suicide deaths	242	136	378

non-fatal episode, except for analysis (b) where adjustment was not required (see below).

(a) Risk of suicide by all methods

When all methods of suicide combined were analysed, significant associations with suicide were found for all methods of self-injury at the last episode, relative to self-poisoning. The hazard ratios indicated increased risks of suicide of between 1.8 and 5-fold for cutting, hanging or asphyxiation, use of CO/other gas, traffic-related and other self-injury (Table 2, columns 3–5).

(b) Risk of suicide by self-poisoning

No significant associations were found between any category of self-injury, relative to self-poisoning, and suicide by self-poisoning. Thus the risk of suicide by self-poisoning was similar for all six methods of self-harm at the last episode (Table 2, columns 6–8).

(c) Risk of suicide by self-injury

In contrast, strong significant associations were found for several methods of self-injury at the last episode, relative to self-poisoning, and suicide by self-injury. Hazard ratios indicate increased risks of suicide of between 2 and 6-fold for cutting, hanging or asphyxiation, use of CO/other gas, and traffic-related self-injury (Table 2, columns 9–11).

3.2. Methods used for last episode of self-harm and for suicide in individuals who died by suicide

3.2.1. Time between self-harm and suicide, and continuity of method

Considering broad methods of self-harm and suicide as either self-poisoning or self-injury, we determined the proportion of individuals who died using the same method as their last episode of self-harm at various times between the non-fatal and fatal act (from 1 day to 200 days). Fig. 1 shows a relatively smooth logarithmic decline in proportion using the same method, with increasing time between non-fatal and fatal acts. Thus, for example, there was continuity of method in 83% (95% CI 36–99) of individuals when death occurred within 1 day of the last non-fatal episode, compared

to approximately 55% (95% CI 47–63) when death occurred within 200 days. The proportion who died using the same broad method for their self-harm and suicide by the end of the overall follow-up period was 54% (95% CI 49–59) (not shown on figure).

3.2.2. Specific methods used for self-harm and for suicide

We also investigated the continuity of specific methods of harm used in the last non-fatal episode and suicide, within all individuals who died by suicide, by examining the proportion who used a particular method for both their last self-harm and for suicide. Overall, one third of the individuals who died by suicide (121/378, 32%) used the same type of method for their death as at their last self-harm, though this varied widely by particular method used. For example, of those who used hanging/asphyxiation in their self-harm prior to their subsequent suicide, 8/10 (80%) also died by hanging/asphyxiation, 104/254 (41%) who used self-poisoning prior to suicide also died by self-poisoning, and 3/87 (3%) who used cutting prior to suicide also died by cutting (Table 3).

3.2.3. Substances used for self-poisoning

We investigated substances used by the 128 individuals who died by self-poisoning, and determined the proportion who took the same type of substance in their last non-fatal overdose as they used for their suicide. Three classes of substances were considered: analgesics, antidepressants or tranquillisers, and other substances. We found some consistency in use of substances in self-harm and suicide. Death by analgesic self-poisoning was more common in those using analgesics for non-fatal self-poisoning (7/27, 25.9%) than other methods (7/101, 6.9%; Fisher exact, $P=0.011$); death by self-poisoning with antidepressants or tranquillisers was more common in those using antidepressants or tranquillisers for non-fatal self-poisoning (15/36, 41.7%) than other methods (22/92, 23.9%; $\chi^2=3.97$, $P=0.046$); and death by self-poisoning with substances other than analgesics, antidepressants and tranquillisers was more common in those using the same broad group of substance for non-fatal self-poisoning (31/41, 75.6%) than other methods (46/87, 52.9%; $\chi^2=6.01$, $P=0.014$).

Table 2

Cox proportional hazards models^a for time to (a) all suicides (b) suicide by self-poisoning and (c) suicide by self-injury, from the last episode of self-harm, associated with method of last non-fatal self-harm, for the study sample 2000–2007 followed up to the end of 2010.

Method of non-fatal self-harm	N	(a) All methods of suicide			(b) Suicide by self-poisoning			(c) Suicide by self-injury		
		Hazard ratio			Hazard ratio			Hazard ratio		
		n (%)	(95% CI)	P	n (%)	(95% CI)	P	n (%)	(95% CI)	P
	30,202	378 (1.25)			128 (0.42)			250 (0.83)		
Self-poisoning alone	24,624	254 (1.03)	1 (Reference)		104 (0.20)	1 (Reference)		150 (0.61)	1 (Reference)	
Cutting	4453	87 (1.95)	1.79 (1.62–1.98)	<0.001	20 (0.45)	1.08 (0.67–1.75)	0.739	67 (1.50)	2.29 (1.67–3.13)	<0.001
Hanging/asphyxiation	304	10 (3.29)	2.65 (2.36–2.97)	<0.001	0 (0.0)	Note ^c	–	10 (3.29)	4.15 (3.11–5.54)	<0.001
CO/other gas	118	8 (6.78)	5.02 (2.33–10.86)	<0.001	1 (0.85)	2.08 (0.29–14.88)	0.465	7 (5.93)	6.70 (1.70–26.49)	0.007
Traffic-related	88	5 (5.68)	4.41 (2.93–6.63)	<0.001	1 (1.14)	2.81 (0.39–20.27)	0.305	4 (4.55)	5.65 (2.40–13.32)	<0.001
All other self-injuries ^b	615	14 (2.28)	1.88 (1.01–3.50)	0.045	2 (0.33)	0.55 (0.14–2.22)	0.401	12 (1.95)	2.55 (0.93–6.99)	0.067

^a Cox survival analyses adjusted for clustering by centre, and controlling for gender, age, unemployment/sickness/disability status, and psychiatric treatment for outcomes (a) and (c), and unadjusted for outcome (b).

^b All other self-injuries include drowning, jumping from a height, firearms/fire-related, unknown self-injury, and all other self-injuries.

^c Hanging/asphyxiation also included in 'all other self-injuries' as the number of suicides by self-poisoning was zero for this category.

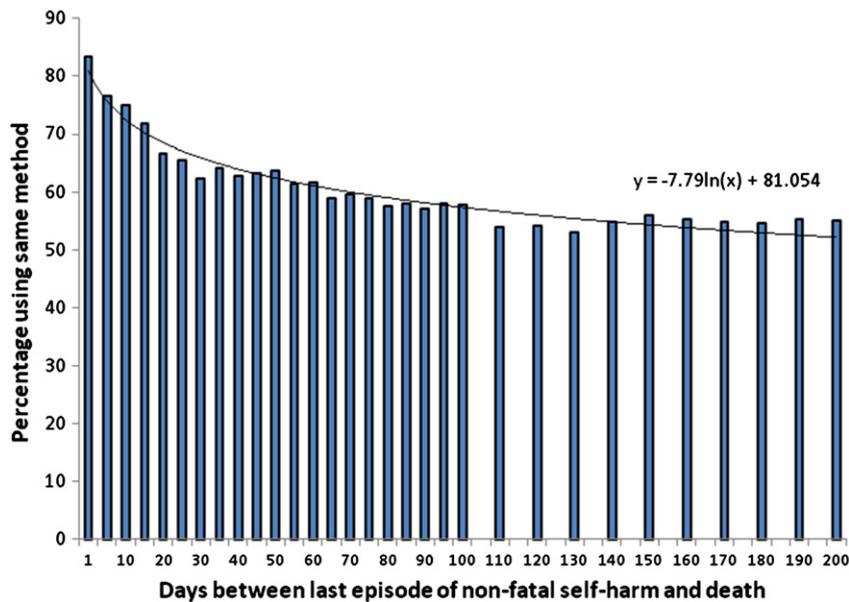


Fig. 1. Use of the same method (either self-poisoning or self-injury), and time between the last episode of non-fatal self-harm and death, in individuals who died by suicide ($n = 378$).

3.3. Changes in methods used in the last two episodes of self-harm and in suicide, in individuals with repeat episodes

For this analysis, method of self-harm was categorised into 3 groups: self-poisoning only, cutting, and all other self-injuries. Methods used in the two most recent self-harm episodes, in all individuals with two or more episodes, were used to generate nine possible method sequences, e.g. [cutting, self-poisoning] (see Method). Associations of these method sequences with suicide were investigated using Cox survival models for three outcomes: (a) all suicides (b) suicide involving self-poisoning and (c) suicide involving self-injury (Table 4). There were no significant associations at the $P < 0.006$ (Bonferroni corrected) level between method sequences used at the last two episodes of self-harm, and risk of suicide overall, suicide by self-poisoning, and suicide by self-injury. Thus all possible combinations of methods of

self-harm in the last two non-fatal episodes showed similar risks of subsequent suicide by any method.

4. Discussion

We have explored relationships between methods used in prior non-fatal self-harm and method of subsequent suicide in individuals who presented to emergency departments in six hospitals in three centres in England between 2000 and 2007. One novel aspect was that we examined risk of suicide associated with methods used in the most recent episode of self-harm (where individuals repeated self-harm), rather than the first episode in the study period. We also examined risks of suicide associated with changes in methods between the most recent self-harm and the suicide, and between episodes of repeated self-harm.

4.1. Risk of suicide by last method of self-harm

Our findings for risk of suicide (all methods combined) according to method of last self-harm were similar to those of other studies based on index non-fatal method, e.g. (Chen et al., 2011; Christiansen and Jensen, 2007; Runeson et al., 2010), where self-injury, relative to self-poisoning, predicted an increased risk of suicide. However, we found that cutting or stabbing also incurred a greater (2-fold) risk of suicide than self-poisoning. A similar association, that just failed to reach significance due to low numbers, was found in a single-centre study including only individuals who received a psychosocial assessment (Cooper et al., 2005). In Chen et al.'s (2011) study, cutting was included with self-poisoning in the reference category, so comparison with our finding regarding cutting is not possible. Other register-based studies which included only patients admitted to hospital (Christiansen and Jensen, 2007; Runeson et al., 2010), found no significant association of cutting or stabbing with suicide. Our study included all

Table 3

Method used at the last episode of non-fatal self-harm and at eventual suicide in individuals who died by suicide.

Method	Number using method in last non-fatal self-harm	Number (%) using same method for suicide
Self-poisoning	254	104 (41%)
Cutting	87	3 (3%)
Hanging/asphyxiation	10	8 (80%)
CO/other gas	8	2 (25%)
Jumping before moving object ^a	5	1 (20%)
Jumping from height	3	0 (0%)
Other self-injury (including drowning, firearms/fire-related, other/unknown)	11	3 (18%)
Total	378	121 (32%)

^a This method of suicide was equated to traffic-related non-fatal self-harm.

Table 4

Cox proportional hazards models for time to (a) all suicides, (b) suicide by self-poisoning (c) and suicide by self-injury, from the last episode of self-harm, associated with history of methods used in the penultimate and last episodes of non-fatal self-harm, in all individuals with repeat episodes of non-fatal self-harm during the study period 2000 to 2007.

Method of non-fatal self-harm [penultimate, last]	N	(a) All suicides (n = 129)		(b) Suicide by self-poisoning (n = 54)			(c) Suicide by self-injury (n = 75)			
		Hazard ratio		Hazard ratio			Hazard ratio			
		(95% CI)	P	(95% CI)	P	(95% CI)	P			
		n (%)		n (%)		n (%)				
[SP, SP]	4851	75 (1.5)	1 (Reference)	35 (0.7)	1 (Reference)	40 (0.8)	1 (Reference)			
[SP, cutting]	419	9 (2.1)	1.39 (0.70–2.79)	0.341	3 (0.7)	1.00 (0.31–3.26)	0.995	6 (1.4)	1.74 (0.74–4.11)	0.204
[SP, other SI]	331	2 (0.6)	0.40 (0.10–1.63)	0.201	1 (0.3)	0.43 (0.06–3.13)	0.404	1 (0.3)	0.38 (0.05–2.73)	0.333
[cutting, SP]	462	11 (2.4)	1.56 (0.83–2.93)	0.171	5 (1.1)	1.52 (0.59–3.87)	0.383	6 (1.3)	1.59 (0.67–3.75)	0.290
[cutting, cutting]	494	13 (2.6)	1.71 (0.95–3.07)	0.076	4 (0.8)	1.12 (0.40–3.16)	0.825	9 (1.8)	2.22 (1.08–4.57)	0.031
[cutting, other SI]	98	3 (3.1)	2.11 (0.66–6.68)	0.206	0 (0.0)	0	0.971	3 (3.1)	3.94 (1.22–12.75)	0.022
[other SI, SP]	330	12 (3.6)	2.36 (1.29–4.35)	0.006	5 (1.5)	2.12 (0.83–5.40)	0.117	7 (2.1)	2.58 (1.16–5.76)	0.021
[other SI, cutting]	119	2 (1.7)	1.12 (0.27–4.55)	0.880	1 (0.8)	1.19 (0.16–8.66)	0.866	1 (0.8)	1.05 (0.15–7.65)	0.860
[other SI, other SI]	96	2 (2.1)	1.40 (0.34–5.70)	0.639	0 (0.0)	0	0.971	2 (2.1)	2.63 (0.64–10.88)	0.182

SP, self-poisoning only; Other SI, self-injury other than cutting; cutting: self-injury by cutting or stabbing.

individuals who presented to the emergency department with self-harm, including those not admitted, and those who did not wait for, or who refused, or were not offered psychosocial assessment—many of these would be individuals who used self-cutting. Thus variation in sample composition is probably the reason for this difference. Our finding is important because individuals who self-harm by cutting are often deemed to be at low risk of suicide and are less likely to be referred for psychosocial assessment (Bennewith et al., 2005; Kapur et al., 2008; Lilley et al., 2008).

When we investigated risk of suicide involving self-injury separately, we found that individuals who presented to the emergency department with relatively lethal methods of self-injury such as hanging, inhalation of CO gas, and traffic-related injury had 4 to 6-fold increased risks of suicide involving self-injury, compared to those who presented with self-poisoning. In contrast, risk of suicide by self-poisoning was similar regardless of the method used at the most recent episode of self-harm. These findings give us some insight into patterns by which individuals switched methods to those which were more likely to end in suicide. Only 19% (24/128) of those who died by self-poisoning had changed methods, mostly from cutting (n = 20) and a few from other self-injury (n = 4). In contrast, 60% (150/250) of those who died by self-injury had switched from self-poisoning. Both of these patterns indicate, perhaps, a shift from a less lethal non-fatal method to a more lethal method for suicide (cutting to poisoning, and poisoning to other self-injury) by the individuals involved. This has important implications for clinical practice. In addition to identification of those few individuals at high relative risk of suicide (i.e. those using self-injury), consideration needs to be given to the many more individuals who use self-poisoning at their last episode but then switch methods to die by self-injury. It is clear that suicide risk cannot be predicted on the basis of non-fatal method alone; other risk factors, underlying reasons and suicidal intent need to be explored in a comprehensive clinical assessment of all individuals (Hawton, 2000).

4.2. Use of same methods in non-fatal and fatal acts

We found that just over half (54%) of all individuals who died had used either self-poisoning or self-injury for both their last self-harm episode and for suicide. The proportion using the same broad method appeared to increase the shorter the time between non-fatal and fatal acts, with, for example, up to 80% doing so where there were only 1–2 days between self-harm episode and suicide, though differences were not statistically significant. This trend may be related to lack of planning or lack of access to alternative means, or ongoing access to a particular method, over a short space of time, increasing the likelihood of a repeat episode involving by the same method. The obvious clinical implications are that, following presentation to the ED for non-fatal self-harm, a patient's access to means should be investigated and restricted where possible. This may help to prevent further impulsive episode using the same method, especially in the short term. This is especially important where the method of injury was relatively lethal or the drug particularly toxic. A study of suicides in the US found that individuals prescribed with psychotropic medication were more likely to die by poisoning than those without prescriptions (Callanan and Davis, 2011), and individuals in France who died by self-poisoning were more likely to use their own prescriptions than other drugs not prescribed for them (Tournier et al., 2009). Thus following non-fatal self-poisoning, access to drugs should be controlled and/or less toxic drugs should be prescribed, if possible. These measures may not prevent change of method for a subsequent episode (Donovan et al., 1999) but they may help reduce the likelihood of a further, possibly fatal, episode involving the same method.

Prevention by restriction of access to means may be more difficult in the case of self-injury. Examination of detailed methods of harm used by the individuals who died by suicide in our study showed that (8/10, 80%) of individuals who used hanging or asphyxiation at their last self-harm prior to suicide, also died by hanging or asphyxiation. An explanation may be the high actual lethality of hanging/asphyxiation, as

well as the perceived lethality combined with serious intent of the individuals involved. To put this in context, in our study we found that hanging/asphyxiation was the most commonly used specific method of suicide (133/378, 35%), but a relatively rare method of non-fatal self-harm (304/30,202, 1%). Thus the clinical implication of our finding is that individuals who present to the ED having survived a hanging attempt are at high risk of death by the same method, and intensive follow-up care is indicated for these individuals (Hawton et al., 2008; Shenassa et al., 2003; Spicer and Miller, 2000). Our data showed a weaker relationship than previously reported (Runeson et al., 2010) between methods used for death and for previous self-harm (60–65% in Runeson's study vs. 32% in our study). A possible explanation for this is that Runeson's study was restricted to admitted self-harm patients only, whereas our sample included all self-harm presentations, as described above. Other comparisons of attempted and completed suicide have shown more differences in methods used for non-fatal and fatal acts, (Spicer and Miller, 2000), similar to our findings.

4.3. Do changes in methods in repeat non-fatal episodes harm predict suicide?

We found no evidence for a specific sequence of self-poisoning or cutting or other self-injury in the last two episodes of self-harm that incurred more risk for suicide than two consecutive episodes of self-poisoning. This is an interesting finding because we expected to find a progression in methods and lethality which predicted suicide (such as cutting, followed by self-poisoning, followed by suicide using self-injury). However, we found no patterns that predicted suicide, perhaps because (i) our categories were insufficiently detailed, or (ii) the individuals involved had inaccurate expectations of lethality, or (iii) other factors were involved, or (iv) there was no progression in suicide intent.

4.4. Strengths and limitations

Our cohort included a large number of self-harm patients from three mainly urban centres in England who were followed up for sufficient time (median 5.3 years) to enable an accurate estimation of the short to medium-term risk of suicide. However, our sample did not include individuals who did not present to hospital following self-harm, or episodes for individuals included in the study but which resulted in presentation to hospitals outside the study. There was a small inconsistency in sampling for our dataset, in that in Manchester during the period 1st January 2000 to 31st August 2002 information was collected only on assessed episodes; the proportion of non-assessed episodes was estimated at 30% (Bergen et al., 2010). This would have had only a minor impact on the findings of the current study.

Our analysis of method changes in repeated non-fatal self-harm lacked a measure of suicidal intent, and assuming method of self-harm to be a proxy measure of lethality may have been insufficient to detect patterns which predicted suicide. For instance, a repeat episode of self-poisoning may have involved double the number of tablets indicating an increase in suicidal intent, but we had no measure of this.

Timing between repeat episodes may also have been important to consider.

Data recorded for the 'traffic-related' category of non-fatal self-injury included intentional motor vehicle accidents, as well as actions such as running out onto the road, or in front of a train, in order to cause self-harm. However, for suicide these categories were coded separately as 'jumping or lying before moving object', and 'other self-injury'—which included motor vehicle crashes. This inconsistency was unavoidable and may have had a small impact on our determination of proportions using the same method (Table 3).

5. Conclusions

Method of most recent self-harm is of some use in identifying individuals at high risk of suicide, i.e. those who use relatively lethal methods such as hanging. These individuals should be given intensive aftercare. However, self-cutting also incurs greater risk of eventual suicide than self-poisoning. This is an important finding with implications for emergency department staff, as patients who present with self-cutting are less likely to receive a psychosocial assessment than those who self-poisoned. Many other individuals also switch methods from cutting or poisoning to die by injury or they repeat poisoning. Our finding reinforces the guidance from the National Institute for Clinical Excellence that all self-harm patients should receive a psychosocial assessment (National Collaborating Centre for Mental Health, 2004). In-depth assessment of all contributing risk factors, including discussion of suicidal thoughts or plans, in addition to non-fatal methods previously used, is an essential component of management of self-harm in the hospital setting.

Role of funding source

We acknowledge financial support from the Department of Health under the NHS R&D Programme (DH/DSH2008). The Department of Health had no role in study design, the collection, analysis and interpretation of data, the writing of the report, and the decision to submit the paper for publication. The views and opinions expressed herein do not necessarily reflect those of the Department of Health.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

The authors from Oxford thank Deborah Casey, Elizabeth Bale and Anna Shepherd and members of the general hospital psychiatric services for their assistance with data collection. The authors from Manchester thank the clinicians completing assessment forms and the research team for their data collection, Elizabeth Murphy, Iain Donaldson, Maria Healey and Stella Dickson. The author from Derby thanks Carol Stalker and the clinicians, clerical and administrative staff in the Emergency Department and Mental Health Liaison Team. KH is a National Institute for Health Research Senior Investigator.

References

- Beck, A.T., Beck, R., Kovacs, M., 1975. Classification of suicidal behaviors: I. Quantifying intent and medical lethality. *The American Journal of Psychiatry* 132, 285–287.
- Beghi, M., Rosenbaum, J.F., 2010. Risk factors for fatal and nonfatal repetition of suicide attempt: a critical appraisal. *Current Opinion in Psychiatry* 23, 349–355.
- Bennewith, O., Peters, T.J., Hawton, K., House, A., Gunnell, D., 2005. Factors associated with the non-assessment of self-harm patients attending an

- Accident and Emergency Department: results of a national study. *Journal of Affective Disorders* 89, 91–97.
- Bergen, H., Hawton, K., Waters, K., Cooper, J., Kapur, N., 2010. Epidemiology and trends in non-fatal self-harm in three centres in England, 2000 to 2007. *The British Journal of Psychiatry* 197, 493–498.
- Brown, G.K., Henriques, G.R., Sosdjan, D., Beck, A.T., 2004. Suicide intent and accurate expectations of lethality: predictors of medical lethality of suicide attempts. *Journal of Consulting and Clinical Psychology* 72, 1170–1174.
- Callanan, V.J., Davis, M.S., 2011. Gender differences in suicide methods. *Social Psychiatry and Psychiatric Epidemiology* 1–13.
- Chen, V.C.H., Tan, H.K.L., Chen, C.Y., Chen, T.H.H., Liao, L.R., Lee, C.T.C., Dewey, M., Stewart, R., Prince, M., Cheng, A.T.A., 2011. Mortality and suicide after self-harm: community cohort study in Taiwan. *The British Journal of Psychiatry* 198, 31–36.
- Christiansen, E., Jensen, B.F., 2007. Risk repetition of suicide attempt, suicide or all deaths after an episode of attempted suicide: a register-based survival analysis. *The Australian and New Zealand Journal of Psychiatry* 41, 257–265.
- Chuang, H.L., Huang, W.C., 2004. A multinomial logit analysis of methods used by persons who completed suicide. *Suicide & Life-Threatening Behavior* 34, 298–310.
- Cooper, J., Kapur, N., Webb, R., Lawlor, M., Guthrie, E., Mackway-Jones, K., Appleby, L., 2005. Suicide after deliberate self-harm: a 4-year cohort study. *The American Journal of Psychiatry* 162, 297–303.
- Cooper, J., Kapur, N., Mackway-Jones, K., 2007. A comparison between clinicians' assessment and the Manchester self-harm rule: a cohort study. *Emergency Medicine Journal* 24, 720–721.
- Corporation, Stata, 2007. *Stata Statistical Software: Release 10*. Stata Corporation, College Station, TX.
- Donovan, S., Kelleher, M.J., Lambourn, J., Foster, T., 1999. The occurrence of suicide following the prescription of antidepressant drugs. *Archives of Suicide Research* 5, 181–192.
- Harriss, L., Hawton, K., 2005. Suicidal intent in deliberate self-harm and the risk of suicide: the predictive power of the Suicide Intent Scale. *Journal of Affective Disorders* 86, 225–233.
- Hawton, K., 2000. General hospital management of suicide attempters. In: Hawton, K., Van Heeringen, K. (Eds.), *The International Handbook of Suicide and Attempted Suicide*. Wiley, Chichester, pp. 519–537.
- Hawton, K., Harriss, L., Hall, S., Simkin, S., Bale, E., Bond, A., 2003a. Deliberate self-harm in Oxford, 1990–2000: a time of change in patient characteristics. *Psychological Medicine* 33, 987–996.
- Hawton, K., Zahl, D., Weatherall, R., 2003b. Suicide following deliberate self-harm: long-term follow-up of patients who presented to a general hospital. *The British Journal of Psychiatry* 182, 537–542.
- Hawton, K., Bergen, H., Casey, D., Simkin, S., Palmer, B., Cooper, J., Kapur, N., Horrocks, J., House, A., Lilley, R., Noble, R., Owens, D., 2007. Self-harm in England: a tale of three cities. Multicentre study of self-harm. *Social Psychiatry and Psychiatric Epidemiology* 42, 513–521.
- Hawton, K., Bergen, H., Casey, D., Simkin, S., 2008. Non-fatal hanging: general hospital presentations over a 28-year period and case control study. *The British Journal of Psychiatry* 193, 503–504.
- Held, T., Hawellek, B., Dickopf-Kaschenbach, K., Schneider-Axmann, T., Schmidtke, A., Möller, H.J., 1998. Violent and non-violent methods of parasuicide: what predicts the choice? *Fortschritte der Neurologie-Psychiatrie* 66, 505–511.
- Kapur, N., Murphy, E., Cooper, J., Bergen, H., Hawton, K., Simkin, S., Casey, D., Horrocks, J., Lilley, R., Noble, R., Owens, D., 2008. Psychosocial assessment following self-harm: results from the Multi-Centre Monitoring of Self-Harm Project. *Journal of Affective Disorders* 106, 285–293.
- Kim, M.H., Jung-Choi, K., Jun, H.J., Kawachi, I., 2010. Socioeconomic inequalities in suicidal ideation, parasuicides, and completed suicides in South Korea. *Social Science & Medicine* 70, 1254–1261.
- Lilley, R., Owens, D., Horrocks, J., House, A., Noble, R., Bergen, H., Hawton, K., Casey, D., Simkin, S., Murphy, E., Cooper, J., Kapur, N., 2008. Hospital care and repetition following self-harm: a multicentre comparison of self-poisoning and self-injury. *The British Journal of Psychiatry* 192, 440–445.
- Linsley, K.R., Schapira, K., Kelly, T.P., 2001. Open verdict v. suicide—importance to research. *The British Journal of Psychiatry* 178, 465–468.
- National Collaborating Centre for Mental Health, 2004. *Self-harm: the short-term physical and psychological management and secondary prevention of self-harm in primary and secondary care (full guideline)* Clinical Guideline, 16. National Institute for Clinical Excellence, London.
- Nordentoft, M., Branner, J., 2008. Gender differences in suicidal intent and choice of method among suicide attempters. *Crisis* 29, 209–212.
- Owens, D., Horrocks, J., House, A., 2002. Fatal and non-fatal repetition of self-harm. Systematic review. *The British Journal of Psychiatry* 181, 193–199.
- Runeson, B., Tidemalm, D., Dahlin, M., Lichtenstein, P., Långström, N., 2010. Method of attempted suicide as predictor of subsequent successful suicide: national long term cohort study. *BMJ* 341, 186.
- Sakinofsky, I., 2000. Repetition of suicidal behaviour. In: Hawton, K., Van Heeringen, K. (Eds.), *The International Handbook of Suicide and Attempted Suicide*. Wiley, Chichester, pp. 385–404.
- Shenassa, E.D., Catlin, S.N., Buka, S.L., 2003. Lethality of firearms relative to other suicide methods: a population based study. *Journal of Epidemiology and Community Health* 57, 120–124.
- Skogman, K., Alsén, M., Öjehagen, A., 2004. Sex differences in risk factors for suicide after attempted suicide—a follow-up study of 1052 suicide attempters. *Social Psychiatry and Psychiatric Epidemiology* 39, 113–120.
- Spicer, R.S., Miller, T.R., 2000. Suicide acts in 8 states: incidence and case fatality rates by demographics and method. *American Journal of Public Health* 90, 1885–1891.
- SPSS Inc, 2008. *SPSS for Windows Release 17.0.1*. SPSS Inc., Chicago.
- Stefansson, J., Nordström, P., Jokinen, J., 2010. Suicide intent scale in the prediction of suicide. *Journal of Affective Disorders* doi:10.1016/j.jad.2010.1011.1016.
- Tidemalm, D., Långström, N., Lichtenstein, P., Runeson, B., 2008. Risk of suicide after suicide attempt according to coexisting psychiatric disorder: Swedish cohort study with long term follow-up. *BMJ* 337, 1328–1331.
- Tournier, M., Grolleau, A., Cougnard, A., Molimard, M., Verdoux, H., 2009. Factors associated with choice of psychotropic drugs used for intentional drug overdose. *European Archives of Psychiatry and Clinical Neuroscience* 259, 86–91.
- Zahl, D., Hawton, K., 2004. Repetition of deliberate self-harm and subsequent suicide risk: long-term follow-up study in 11,583 patients. *The British Journal of Psychiatry* 185, 70–75.
- Zhang, J., Xu, H., 2007. Degree of suicide intent and the lethality of means employed: a study of Chinese Attempters. *Archives of Suicide Research* 11, 343–350.