

REVIEW ARTICLE

## Systematic review of resource utilization in the hospital management of deliberate self-harm

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### ABSTRACT

**Background.** Deliberate self-harm (DSH) is a significant public health problem, representing a major burden in terms of morbidity to the individual and health-service utilization. While clinical guidelines suggest good practice for the short-term hospital management of DSH, there remains considerable variability in the way that services are provided.

**Method.** A systematic review of the literature was undertaken to examine the current evidence on hospital resource use and costs involved in the short-term hospital management of adults following DSH and to elucidate the factors that influence these differences, in terms of clinical characteristics and service provision.

**Results.** Twenty-one papers reporting on 17 studies met the inclusion criteria for review. Clinical characteristics associated with an increase in resource use included overdose with tricyclic antidepressants (TCAs) compared with selective serotonin re-uptake inhibitors (SSRIs) (weighted ratio 2.6:1) and co-ingestion of alcohol with SSRIs. Variations in service provision, including medical admissions policy and provision of a specialist liaison service, affected resource utilization independently of the clinical needs of patients.

**Conclusions.** Overdoses of TCAs incur substantially greater hospital costs than overdoses of SSRIs. Variations in the medical seriousness of DSH, and in the structure of service provision, affect the resources used in its short-term hospital management, with little evidence about the impact these differences have on clinical outcome. Research is needed to evaluate the impact of different styles of service provision on outcome, and to incorporate these factors into the trial design of future cost-effectiveness studies of interventions following DSH.

### INTRODUCTION

Deliberate self-harm (DSH) is a significant public health problem. One estimate is that approximately 170 000 people a year present to hospital in the UK following an episode (Kapur *et al.* 1999*b*). From a societal perspective, this represents a major burden in terms of morbidity to the individual, health-service utilization and

life years lost. Although clinical guidelines have been produced suggesting good practice for the short-term management of DSH (Royal College of Psychiatrists, 1994, 2004; NICE, 2004), there remains considerable variability in the way that services are provided within and between different health systems (Hultén *et al.* 2000; Kapur *et al.* 2002*a*; Bennewith *et al.* 2004), and there is no evidence as to which service model is most effective.

There has been much clinical and epidemiological research into the risk factors associated

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with DSH in different countries (Platt *et al.* 1992; Schmidtke *et al.* 1996). Less research has focused on either the economic aspects or the resource burden associated with DSH (Byford *et al.* 2001, 2003). As DSH is a behaviour associated with most mental illnesses, it is difficult to determine resource use directly attributable to it, rather than that due to an underlying psychiatric condition, or other cause. Determining these costs has implications for evaluating the cost-effectiveness of interventions aimed at the secondary prevention of DSH.

In the UK the majority of DSH patients who present to health services attend the emergency department of their local hospital, while 15% of medically less serious DSH episodes are managed in primary care alone (Jick *et al.* 2004). Although there are major differences in the structure of health provision between countries, the role of the emergency department is a reasonably constant component, making international comparisons of the immediate hospital management more valid than across more disparate service structures (e.g. primary care). In addition, the resources involved in this immediate management can be attributed more directly to DSH, rather than to any underlying cause.

This study was designed to estimate hospital resource use of patients following DSH. The specific aims were:

- (1) to review the current evidence on hospital resource use and costs involved in the short-term management of adults following DSH;
- (2) to examine the factors that influence differences in hospital resource use, in terms of clinical characteristics (demand factors) and service provision (supply factors).

## METHOD

A systematic review of the literature on hospital resource use by DSH patients was undertaken. Studies were included if they fulfilled the following criteria:

- (1) Reported primary data in adult populations (90% >16 years). Economic modelling and population-based studies not reporting primary data were excluded.

- (2) Reported detailed hospital resource use in the short-term management of patients presenting following an episode of DSH.

Cost-effectiveness analyses were included if they met these criteria. Where a study was reported in more than one article, data were abstracted from each of the papers if they were examining different aspects of resource use, otherwise from the most recent report. Bibliographies of eligible papers were checked for possible relevant studies. Where there were uncertainties about the data, authors were approached for clarification. Because of the paucity of evidence, there were no quality exclusion criteria, although quality was assessed. Studies examining resource use before or after an episode of DSH but not involving the immediate management of the index episode (see criterion 2 above) fell outside the remit of this review.

## Search strategy

Electronic searches of Medline (1966–2004), EMBASE (1980–2004), PsycINFO (1872–2004) and Biological Abstracts (1985–2004), Web of Science (1981–2004) and CINAHL (1982–2004) were carried out using subject headings and free text terms: ‘attempted suicide’, ‘self-injurious behaviour’, ‘overdose’, ‘deliberate self-harm’, ‘suicidal behaviour’, ‘parasuicide’, ‘drug overdose’, combined with terms for ‘costs’, ‘cost analysis’, ‘evaluation’, ‘cost-effectiveness’, ‘service utilization’, ‘resource use’.

Included papers were checked for additional references not found electronically. We reviewed screened papers independently and any disagreements on inclusion discussed and resolved (see Fig. 1).

## Data abstraction

Data were abstracted from each paper using a structured pro forma, and summarized in table form. A simple 10-point check-list was developed to score studies on the key elements for a simple economic evaluation (Drummond *et al.* 1997). This allowed the design of studies to be scored out of a maximum of 15 points (Table 1).

## RESULTS

Twenty-one papers reporting on 17 studies met the inclusion criteria for the review (Table 2).

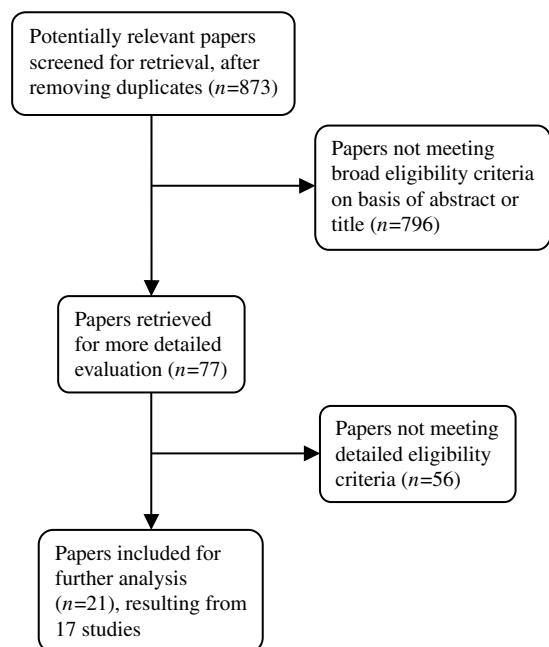


FIG. 1. Summary of results of search for relevant papers on resource use following deliberate self-harm (DSH).

Nine papers (D'Mello *et al.* 1995; Revicki *et al.* 1997; Stoner *et al.* 1997; Palmer *et al.* 1998; Kapur *et al.* 1999a, 2001; Bosch *et al.* 2000; Ramchandani *et al.* 2000; Whyte *et al.* 2003) compared resource use in the hospital management of a single episode of deliberate self-poisoning (DSP) with different classes of antidepressant drugs, primarily selective serotonin re-uptake inhibitors (SSRIs) and tricyclic antidepressants (TCAs) (see Table 2).

Eight papers (Robicsek *et al.* 1993; Yeo, 1993; Runeson & Wasserman, 1994; Waller *et al.* 1994; Gunnell *et al.* 1996; Whyte *et al.* 1997; Kapur *et al.* 1999b, 2002b) reported studies of consecutive DSH presentations at one or more hospital sites, including the cost per episode of DSH, differences in resource use between centres, or the resource use of DSH patients compared with that of patients presenting with other forms of injury (see Table 2).

Two papers reported studies that examined the effect of variation in hospital service provision on resource use. One study from the USA in 1974 evaluated the effect of managing patients on a new respiratory care unit compared with its historical control (Piper & Griner, 1974). A recent UK paper (Kapur *et al.* 2003)

presented a secondary analysis of data from an earlier UK study (Kapur *et al.* 2002b) to examine what impact the structure of hospital services had on resource use in the management of DSH (see Table 2).

Finally, two studies stand alone (Table 3). One from the USA examined the different patient characteristics and relative resource use of patients presenting with accidental paracetamol poisoning compared with paracetamol used in DSH (Schiodt *et al.* 1997). The second calculated resource utilization of DSH patients admitted to an intensive therapy unit (ITU) in Sri Lanka over a 5-year period (Gunawardana & Abeywardana, 1997).

Given the variability of resources used and how these were costed and recorded between studies (see Table 2), as well as the differences in health-care systems and the time over which the studies were conducted, it would be meaningless to combine the results in a traditional form of meta-analysis. Results are therefore presented below in a descriptive synthesis, the studies grouped in the following categories: first the studies reporting on overdoses with antidepressant medication; then those studies that calculated resource use for samples of consecutive DSH populations; the impact of epidemiological differences in methods of DSH; the effect of different service structures and unit costs; and finally those studies that compare DSH patient resource use with other forms of injury and poisoning.

#### Studies examining resource use following overdose with antidepressant medication

It was possible to aggregate the findings from seven of the nine papers examining resource use resulting from antidepressant overdose (D'Mello *et al.* 1995; Revicki *et al.* 1997; Stoner *et al.* 1997; Palmer *et al.* 1998; Kapur *et al.* 1999a, 2001; Ramchandani *et al.* 2000). This showed that the unweighted average cost of TCA overdose was 2.7 times (range 2.01–4.26) that of managing an overdose of an SSRI. Adjusting the ratio of average TCA : SSRI costs for relative sample size gave a weighted average ratio of 2.6 : 1.

The management of venlafaxine overdose was studied separately in one study (Whyte *et al.* 2003). This found that because of its pro-convulsive potential in overdose (Sinclair *et al.*

Table 1. *Criteria used to rate studies*

		Rating score	
1. Statement of study perspective	Clear statement of study perspective	2	
	Partial statement or perspective implied	1	
	No mention of study perspective	0	
2. Study population defined	(a) Is it clear what percentage of total DSH presentations the sample represents?	1/0	
	(b) Is it clear if this is an index or a prevalence study?	1/0	
	(c) Is information on co-ingestants given?	1/0	
3. (a) Sources of resource use given	Full breakdown of both data origin and units used	2	
	Partial breakdown: either origin of data or units used	1	
	No information given on origin of data or units used	0	
3. (b) Sources of costs given	Full breakdown of both data origin and units used	2	
	Partial breakdown: either origin of data or units used	1	
	No information given on origin of data or units used	0	
4. Analysis of costs	(a) Used appropriate methods to analyse skewed data	Full: log transformation, parametric bootstrap, etc.	2
		Partial: Means/medians and ranges given, or non-parametric tests used	1
		None: Means and s.d.s given no mention of skewed data	0
	(b) Year of costings given	N.A.: No assumptions made around means, or no costs given	N.A.
		Yes: Year and currency given	1
		No: Costs used but year not given	0
	(c) Discounting	N.A.: No costs used	N.A.
		Yes: Attempt to discount costs to a particular year and methods given	1
		No: Study recruitment over one year and no mention of discounting	0
	5. Sensitivity analysis	N.A.: Study completed within 1 year, or no costs used	N.A.
Yes: Testing of assumptions and variation in resource use stated		2	
Partial: Some attempt to test the assumptions/variation in resource use		1	
No attempts to test assumptions in the model used		0	
	N.A.: Either no costs given or no inferences made around mean	N.A.	
		Maximum score = 15	

DSH, Deliberate self-harm.

1998), management of complications required more time in ITU and hospital than for overdoses with SSRIs. This study excluded overdose with dothiepin from the reference TCA group, which, because of its significant depression of respiratory function in overdose (Buckley *et al.* 1994), is likely to lessen the difference between the groups.

#### *Effect of co-ingestants on resource utilization*

One major factor affecting the relative difference in resources required to manage DSP with any class of antidepressant medication is whether the effect of co-ingestants was considered. Four reports gave specific information on the percentage of patients who consumed pro-convulsive or respiratory depressant drugs or alcohol, in addition to the primary antidepressant compound (Stoner *et al.* 1997; Palmer *et al.* 1998; Bosch *et al.* 2000; Whyte *et al.* 2003). However, the studies by Bosch *et al.* (2000) and Whyte *et al.* (2003) gave insufficient

detail as to the effect of these additional compounds on resource use. The other two studies specifically compared the effect on resource use of co-ingestion of alcohol with antidepressant overdose (Stoner *et al.* 1997; Palmer *et al.* 1998). In the study by Stoner *et al.* (1997), 43/171 (25%) of the TCA group and 16/49 (33%) of the SSRI group also ingested alcohol ( $z=1.115$ ,  $p=0.26$ ). This increased the mean resource use compared to antidepressant alone by 10.4% in the TCA group (from \$606 to \$670) and 61% (from \$252 to \$407) in the SSRI group. In the other study (Palmer *et al.* 1998), 60/542 (11%) of the TCA group and 15/80 (19%) of the fluoxetine group ( $z=1.05$ ,  $p=0.30$ ) also ingested alcohol, decreasing the mean resource use by 39% in the TCA group (from \$5764 to \$1269) but increasing it by 55% in the fluoxetine group (from \$1269 to \$1973) when compared to antidepressant alone. No explanation is given for why co-ingestion of alcohol with TCAs reduces the resources required for management; the

Table 2. Summary of antidepressant overdose studies

Authors (date, place)	Quality rating (%)	Study details	Episode (patient) number	Summary of resource use
D'Mello <i>et al.</i> (1995, USA)	20	Retrospective audit of 200 consecutive DSH presentations following drug overdose between 1/1/1991 and 31/12/1993. Inclusion criteria; intentional OD using antidepressant; available cost data. 12% of sample included. M:F 1:2.5	23 patients TCA = 14 SSRI = 6 (+ 3 Trazodone)	<b>Hospital costs, mean (s.d.)</b> TCA \$22923 (27629) SSRI \$5379 (2362) <b>TCA : SSRI costs = 4:26 : 1</b>
Stoner <i>et al.</i> (1997, USA)	40	Retrospective audit of all patients admitted following DSP, with antidepressants listed as one of three main substances used, between 1/8/1987 and 31/12/1995. M:F 1:1.3. Differential resource use with co-ingestants given (see text)	262 patients TCA = 171 HA = 40 SSRI = 49 (+ 2 MAOI)	<b>Hospital costs, mean</b> TCA (based on 68% of cases) \$635 HA (based on 75% of cases) \$451 SSRI (based on 90% of cases) \$252 <b>TCA : SSRI costs = 2:5 : 1</b>
Revicki <i>et al.</i> (1997, USA)	80	Prospective, multi-centre study of DSP with single antidepressant (TCA or fluoxetine) between 10/1990 and 03/1993. Inclusion criteria; ingestion of single antidepressant drug, laboratory confirmation of OD, retrievable hospital bills. M:F 1:1.16. Of 622 eligible patients (TCA = 542, fluoxetine = 80), 136 (21%) fulfilled inclusion criteria	136 patients	<b>Hospital costs, mean (s.d.)</b> TCA ( <i>n</i> = 121) \$5764 (821) Fluoxetine ( <i>n</i> = 15) \$1269 (382) <b>TCA : SSRI costs = 2:15 : 1</b>
Palmer <i>et al.</i> (1998, USA)	80	Paper based on Revicki <i>et al.</i> (1997) study above. Reports an additional 75 patients (15 fluoxetine + alcohol OD, 60 TCA + alcohol OD). Laboratory confirmation of OD, costs taken from billing data	75 patients	<b>Hospital costs, mean (s.d.)</b> TCA + alcohol \$3529 (423) Fluoxetine + alcohol \$1973 (588) <b>TCA : SSRI costs = 1:79 : 1</b>
Kapur <i>et al.</i> (1999a, UK)	71	Retrospective audit of all DSP presentations (>16 years) due to TCA or SSRI OD to four teaching hospitals over a 4/52 period in 11/1994. Subgroup (12%) of patients reported in Kapur <i>et al.</i> (1999b). M:F 1:1.04. Past DSH in 37%. Costs divided into ED assessment, IP days, ITU days, psychiatric assessment	57 episodes	<b>Hospital costs, mean (no ranges)</b> TCA ( <i>n</i> = 29) £584 SSRI ( <i>n</i> = 28) £213 <b>TCA : SSRI costs = 2:74 : 1</b>
Bosch <i>et al.</i> (2000, Netherlands)	55	Retrospective case review of all admissions to ITU following DSP with single antidepressant drug from 01/1994 to 12/1998. 33.3% of all ODs admitted to ITU. M:F 1:2.9. Data unclear in places. Effects of co-ingestants on length of stay and procedures required are unclear	86 patients	<b>Length of hospital stay, days</b> TCA ( <i>n</i> = 65) 3.1 SSRIs ( <i>n</i> = 20) 2.3 <b>TCA : SSRI (ITU days) = 1:3 : 1</b>
Ramchandani <i>et al.</i> (2000, UK)	64	Retrospective audit of 1165 episodes of DSH presenting to hospital in 1996. 19% used single antidepressant in OD. No toxicological confirmation. M:F 1:1.6. Average cost of TCA and SSRI adjusted for younger mean age of SSRI group (31.9 v. 37.4 years)	220 episodes	<b>Hospital costs, mean</b> TCA ( <i>n</i> = 151) £598 SSRI ( <i>n</i> = 69) £298 Difference (95% CI) £300 (152–447) <b>TCA : SSRI costs = 2:01 : 1</b>
Kapur <i>et al.</i> (2001, UK)	86	Prospective consecutive DSP presentations to three teaching hospitals and three DGH between 1/11/1998 and 31/3/1999 due to TCA or SSRI OD. M:F 1:1.3. 12.5% of all DSP reported in Kapur <i>et al.</i> (2002b). Past DSH in 33%. Costs divided into ED assessment, IP days, ITU days, psychiatric assessment	223 episodes	<b>Hospital costs, mean (s.d.)</b> TCA ( <i>n</i> = 124) £634 (911.5) SSRI ( <i>n</i> = 99) £173 (127) Difference (95% CI) £461 (303–617)* <b>TCA : SSRI costs = 3:66 : 1</b>
Whyte <i>et al.</i> (2003, Australia)	55	Prospective cohort of all first admissions following DSP with single agent antidepressant drug from 11/1994 to 04/2000 (15.5% of all DSP admissions). M:F 1:1.25. Dothiepin ( <i>n</i> = 82) excluded from TCA analysis due to high OR for seizures v. other TCAs (adjusted OR = 8.9, <i>p</i> = 0.005). Effects of co-ingested pro-convulsive drugs unclear	538 patients TCA = 254 VLF = 51 SSRI = 233	<b>Time in hospital, hours (range)</b> TCA 23.2 (2.8–282) VLF 18.5 (0.8–330.2) SSRI 15.3 (2–185.5) <b>ITU admission required</b> TCA ( <i>n</i> = 172) 45.9% VLF ( <i>n</i> = 51) 29.4% SSRI ( <i>n</i> = 233) 7.3% <b>TCA : SSRI (hospital days) = 1:5 : 1</b>

DSH, Deliberate self-harm; DSP, deliberate self-poisoning; OD, overdose; M:F, male:female ratio; TCA, tricyclic antidepressant; SSRI, selective serotonin re-uptake inhibitor; HA, heterocyclic antidepressants; VLF, venlafaxine; ED, emergency department; IP, inpatient; ITU, intensive therapy unit; OR, odds ratio; CI, confidence interval; DGH, district general hospital.

\* Difference calculated using non-parametric bootstrap.

Table 3. Summary of consecutive DSH presentation studies

Authors (date, place)	Quality rating (%)	Study details	Episode (patient) number	Summary of resource use	
Piper & Griner (1974, USA)	33	Retrospective case review of all presentations of DSP with psychotropic drugs between 1968 and 1972. New RCU opened 1970 and all eligible patients managed on that ward from then on. Historical control. M:F 1:1.6	119 admitted	<b>Mean hospital costs (range)</b> Pre RCU: \$1822 (\$194–\$8548) Post RCU: \$1804 (\$301–\$5788)	LOS shorter on RCU but costs higher 119 admitted to medical beds of 337 assessed in ED
Yeo (1993, UK)	57	Retrospective audit of consecutive DSH presentations (94% DSP) 6/1990–9/1990 to DGH ED. M:F 1:1.6. Past DSH in 63%. Analysis using episode not patient data	190 (178)	178 patients presented 190 times in 9/12	<b>Average cost per patient</b> £425 (no ranges given)
Robicsek <i>et al.</i> (1993, USA)	36	Prospective consecutive case series of all injuries presenting to hospital between 1/10/1989 and 30/9/1990. Data given separately for DSH (59% DSP, 26% lacerations, 7.5% firearms). M:F 1:0.72	375 patients (362 DSH, 13 suicides)	<b>Total hospital charges for DSH/suicide</b> ( <i>n</i> = 375): \$4570 per person <b>Total charges for assaults</b> ( <i>n</i> = 4874): \$1446 per person	DSH patients more likely to be admitted to medical bed or ITU from ED than assault or accident patients Resource use includes those who died during admission
Waller <i>et al.</i> (1994, USA)	29	Prospective presentations of violence/injury on 109 random sample of days between 3/1991 and 3/1992. Data given separately for DSH (59% DSP, 27% lacerations). M:F 1:1.75	22 patients	<b>Mean hospital cost (s.d.)</b> DSH group \$2639 (3565) Assault group £420 (1658) Unknown intent \$388 (1219)	Costs of managing DSH are higher than other forms of injury. Record of +ve blood alcohol higher with attempted suicide than other forms of violence
Runeson & Wasserman (1994, Sweden)	57	Prospective consecutive series of 100 DSH presentations (84% DSP) between 1/9/1991 and 31/12/1991. M:F 1:1.7. Past DSH in 53%. Follow-up to 3/52 post-discharge	97 patients	<b>Mean hospital costs – somatic Rx</b> SEK 20207 ( <i>n</i> = 55) <b>Mean hospital costs – follow-up</b> SEK 51604 ( <i>n</i> = 55)	Six left prior to assessment. 76 referred for aftercare of whom 62% had full compliance and 18% partial compliance
Gunnell <i>et al.</i> (1996 UK)	40	Retrospective analysis of routine information systems	5770 (5080)	<b>Median length of hospital stay</b> 1 day (no ranges given)	10% of admissions received additional psychiatric in-patient care
Schiodt <i>et al.</i> (1997, USA)	33	Retrospective case series of management of paracetamol toxicity between 1/1/1992 and 30/4/1995. DSP cases compared with accidental poisoning. M:F 1:2.8	50 patients	<b>Median hospital costs (range)</b> DSH group \$6899 (632–44 976) Accidental \$5897 (1019–81 558)	<b>Median hospital stay, days (range)</b> DSH group ( <i>n</i> = 50) 3 (1–23) Accidental ( <i>n</i> = 21) 4 (1–51)
Gunawardana & Abeywardana (1997, Sri Lanka)	38	Retrospective case-note series of all ITU admissions following DSP 1991–1995. M:F 2.3:1. 85% organophosphate poisoning. No details on resource use other than ITU procedures	292	<b>Mean length ITU stay</b> 6 days (range 1–32) 52% required mechanical ventilation	Opportunity cost estimated to be 114 other critically ill patients denied treatment due to resource use by DSP patients requiring ITU
Whyte <i>et al.</i> (1997, Australia)	40	Prospective descriptive evaluation of new Regional Toxicology Centre. All patients presenting 1987–1995, DSP patients presented separately. No data on gender, type of DSP or number of repeaters	584 (483)	<b>Median hospital stay, hours (range)</b> 16.2 (0.6–315.9)	96/584 (16.4%) require ITU admission. 520/584 (89%) received psychiatric assessment. Calculations on episodes not patients

Author (Year)	Study Design	Sample Size (n)	Cost per episode (£)	Cost of specialist assessment (£)
Kapur <i>et al.</i> (1999b, UK)	Retrospective audit of all DSP presentations (>16 years) to four teaching hospitals over a 4/52 period in 11/1994. M: F 1: 1.04. Past DSH in 41%. Analysis using episode not patient data	477 (458)	Manchester £217 (100) Nottingham £235 (165) Leicester £243 (111) Leeds £432 (101)	Manchester £138 (39) Nottingham £73 (88) Leicester £186 (82) Leeds £146 (68)
Kapur <i>et al.</i> (2002b, UK)	Prospective consecutive case series of DSP presentations to three teaching hospitals and three DGH between 1/11/1998 and 31/3/1999. M: F 1: 1.2. Past DSH in 39%	1778 (1306)	<b>Drug (n) mean cost (s.d.)</b> Paracetamol (436) £227.5 (217.5) Coproxamol (45) £323.4 (436.8) NSAID (217) £257.3 (388.8) Benzos (219) £22.1 (265.5) SSRI (99) £172.9 (127.2) TCA (124) £634.0 (911.5) Cocktail (310) £449.0 (1954.8)	<b>Mean cost per centre (s.d.)</b> All episodes (n = 1778) £333.2 (1026.7) DSH team (n = 888) £377.6 (1241.7) No DSH team (n = 890) £288.8 (751.3) Difference* £(7.8–198.3), p < 0.01
Kapur <i>et al.</i> (2003, UK)	Prospective consecutive case series of DSP presentations to three teaching hospitals and three DGH (part of earlier study by Kapur <i>et al.</i> 2002b)	1778 (1306)	<b>Mean cost per episode (s.d.)</b> £333.2 (1026.7) <b>Range (s.d.)</b> 227.9–422.2 (257.9–453.7)	Costs highest in centres with specialist services. Resource use increases with lethality of drug taken Variations in cost accounted for by service structure, not patient characteristics. Wide variation in resource use between centres

DSH, Deliberate self-harm; DSP, deliberate self-poisoning; OD, overdose; M: F, male: female ratio; TCA, tricyclic antidepressant; SSRI, selective serotonin re-uptake inhibitor; ED, Emergency Department; IP, in-patient; ITU, intensive therapy unit; RCU, Respiratory Care Unit; DGH, district general hospital; LOS, length of stay; SEK, Swedish kroner; NSAID, non-steroidal anti-inflammatory drug.

\* Difference calculated using non-parametric bootstrap.

assumption has to be that these overdoses were medically less serious, possibly with lower doses of TCAs or alcohol ingested. What is clear from both studies is the relative increase in resources required to manage SSRI overdoses when combined with alcohol than when taken alone.

### Studies investigating consecutive DSH presentations

Five studies investigated consecutive DSH presentations at one or more sites (Yeo, 1993; Runeson & Wasserman, 1994; Gunnell *et al.* 1996; Kapur *et al.* 1999b, 2002b). In the study by Yeo (1993), resource utilization was aggregated from emergency department assessment, medical/surgical in-patient days, ITU days and psychiatric assessment. This format was used as a template for the later UK studies (Kapur *et al.* 1999b, 2002b).

### Characteristics of patient samples

All five studies had a similar male to female ratio (mean 1:1.3, range 1.04–1.70), and the mean age was 33.3 years (range 30.9–38.0 years). The prevalence of prior DSH based on aggregating data from four of these studies (Yeo, 1993; Runeson & Wasserman, 1994; Kapur *et al.* 1999b, 2002b) was 41.0% (1026/2500; range in individual studies 38.6–53.4%). Rates within one multi-centre study (Kapur *et al.* 2002b) varied from 29% to 50% between sites. Self-discharge rates were available in three studies, and were 6.2% in the Swedish study (Runeson & Wasserman, 1994), 6.8% in an earlier UK study (Yeo, 1993), and 17.6% in the more recent UK study (Kapur *et al.* 2002b).

### Resource utilization

*Emergency department assessment and hospital admission.* All patients received some form of emergency department assessment, following which hospital admission occurred on average in 45.5% of cases (1154/2536; range 83.0–37.9%) across the four clinical studies. The proportion of patients admitted to hospital in the UK decreased from 83% in 1990 (Yeo, 1993), to 66% in 1992 (Gunnell *et al.* 1996), 57% in 1996 (Kapur *et al.* 1999b) and 37.9% in 1999 (Kapur *et al.* 2002b). For those patients who were admitted, the mean length of hospital stay was 1.8 days (2074 days admission for 1154 persons). This compares with a median hospital

length of stay of 1 day found in two studies (Yeo 1993; Gunnell *et al.* 1996), illustrating the significant right skew in length of hospital stay arising from long stays by a small number of people.

*Management on the ITU.* Management on the ITU occurred in less than 2% of patients (Yeo, 1993; Kapur *et al.* 1999*b*), making up 5.7% of in-patient days of those admitted to hospital, although this varied from 2.6% in the UK studies (Yeo, 1993; Kapur *et al.* 1999*b*) to 23.3% in the Swedish study (Runeson & Wasserman, 1994). From the data available it is not possible to say whether this was due to differences in management protocols between the two countries, or whether the medical severity of the acts of DSH in the two populations differed (Michel *et al.* 2000). Days on ITU in the UK studies account for between 8% (Yeo, 1993; Kapur *et al.* 1999*b*) and 21% (Kapur *et al.* 2002*b*) of the total cost.

*Psychosocial assessment.* The proportion of patients referred for a specialist psychosocial assessment showed significant variation between studies, as well as within studies at different sites. Overall, 47.4% (1203/2536; range in individual studies 42.9–90%) were referred for a specialist psychosocial assessment. In multi-centre studies, rates varied between 39% and 74% between sites. There were also significant differences in who provided these assessments and the service structure in which they were based. In the earlier studies (Yeo, 1993; Runeson & Wasserman, 1994) psychosocial assessments were carried out by the duty psychiatrist; more recent studies have identified a range of mental health professionals carrying out assessments as part of a specialist service in some centres while the previous provision continues in others. In none of the studies did authors attempt to estimate the cost of delivery of a specialist DSH service, and they either incorporated the costs into the ward unit costs (Runeson & Wasserman, 1994) or approximated them as being equal to a psychiatric outpatient appointment (Yeo, 1993; Kapur *et al.* 1999*a*).

*Follow-up arrangements.* Admission to a psychiatric in-patient facility as aftercare occurred

in 9.7% of cases (587/6057; range in individual studies 5.8–10.0%) in the three studies giving details (Yeo, 1993; Runeson & Wasserman, 1994; Gunnell *et al.* 1996), with a further 29.6% (85/287; range 22.6–42%) referred for outpatient psychiatric follow-up (Yeo, 1993; Runeson & Wasserman, 1994). In two recent UK studies (Kapur *et al.* 1999*b*, 2002*b*) an average of 35% of patients were referred for 'specialist' follow-up (791/2255; range 32–45%), which included both in- and out-patient psychiatric care.

### Methods of DSH

The method of DSH, and its associated medical complications, was a key factor in resource utilization. Violent methods, such as firearm injuries, were responsible for a significant right skew in costs of management because of increased length of in-patient stay, use of ITU and high in-patient mortality rates (67%) in the studies that included them (Robicsek *et al.* 1993; Waller *et al.* 1994). No specific details were given on resources required in other forms of self-injury, particularly carbon monoxide poisoning or hanging. To a lesser extent, the choice of substance used in DSP and the co-ingestion of alcohol or other respiratory depressant drugs also result in significant differences in resource use. In Sri Lanka, where DSP with organophosphates is common, 85% of ITU admissions were accounted for by organophosphate poisoning (Gunawardana & Abeywardana, 1997). In this review, in the high-income countries, TCAs and overdose 'cocktails' of psychotropic drugs resulted in highest use of costly medical resources such as in-patient days and ITU (Stoner *et al.* 1997; Palmer *et al.* 1998; Kapur *et al.* 1999*a*, 2001, 2002*b*; Ramchandani *et al.* 2000).

### Resource utilization factors

Resource utilization was affected by the threshold for admission from the emergency department to a medical bed. The two studies that evaluated this at a service level (Piper & Griner, 1974; Whyte *et al.* 1997) suggested that an integrated admissions policy reduced medical complications and therefore resource use. In the more recent and methodologically robust Australian study (Whyte *et al.* 1997), all patients were admitted to a centralized Regional Unit

with high rates of psychosocial assessment (89%). In this study a centralized multi-disciplinary assessment service resulted in a reduction in length of hospital stay, especially in complicated co-morbid cases, and, despite the slightly higher unit costs, resulted in an overall cost saving.

Results of the two multi-centre urban studies conducted in the UK (Kapur, 1999*b*, 2003) suggest that several factors independent of patient characteristics affected whether or not patients were subsequently referred for specialist assessment. These included admission policies in different sites, time of day at which the patient presented and, in those hospitals without a specialist assessment team, the proximity of the local psychiatric service. In these studies, those who received a specialist assessment were less likely to repeat DSH in the short term compared with those who did not (9.8% v. 17.9%,  $p < 0.005$ ).

Patients receiving a specialist psychosocial assessment were also more likely to be referred for specialist follow-up. However, other than the Swedish study, which recorded compliance rates of 62% in the follow-up period, and the small percentage (9.7%) admitted to in-patient psychiatric care (Runeson & Wasserman, 1994), there was no further evidence on whether patients referred for follow-up attended.

### Costs

In three studies the difference in unit costs in different sites were investigated (Runeson & Wasserman, 1994; Kapur *et al.* 1999*b*, 2002*b*). In each study university hospitals had greater unit costs than district general hospitals. More specialist resources and teams were likely to have been available in the university hospitals, which would also have had an impact on the pathways taken by patients through the different systems.

### Studies examining resource use following DSH compared with other forms of injury and poisoning

Three studies (Robicsek *et al.* 1993; Waller *et al.* 1994; Whyte *et al.* 1997) investigated the resource utilization of DSH patients compared with other groups.

The two studies based in the USA (Robicsek *et al.* 1993; Waller *et al.* 1994) examined

differences in service utilization between patients presenting following DSH and those who were victims of assault and/or accidental injury. In both studies 59% of the DSH patient sample had self-poisoned, 26% presented with lacerations and, in the larger of the two studies (Robicsek *et al.* 1993), based on 375 DSH patients (13 of whom died), 7.5% (28/375) used firearms. This represents a major difference from the DSH populations in Europe. Both reports included some details of the concurrent use of alcohol: Waller *et al.* (1994) reported positive breath alcohol tests on 8/15 patients for whom there were data; and Robicsek reported that 52% (62/117) of the breath alcohol tests reached the legal limit for intoxication. Neither gave any detail as to what impact this might have had on the resources required to manage the episodes, nor details of any psychosocial assessment or disposal data. Both studies used billing data to estimate the costs of treatment, and although the actual costs involved differed considerably between the studies (see Table 2), in both cases the average cost of managing a DSH episode was at least twice that of an assault episode.

### DISCUSSION

From the studies identified in this review there appear to be three main interdependent factors that affect resource use from the supply side: threshold for admission to a medical bed; availability of a specialized liaison or on-site psychiatric service, and provision of care by a university hospital. From the demand side, the medical seriousness of DSH has a significant impact on length of hospital stay. To a lesser extent, patient characteristics recognized as risk factors for further suicidal behaviour also appear to have some impact on the management plan.

This review has not included the wider costs involved in the longer-term management following DSH (Byford *et al.* 2003), or specifically addressed the question of cost-effectiveness. There is as yet no conclusive evidence of the effectiveness of specific interventions targeted at the prevention of DSH (Hawton *et al.* 1998; Tyrer *et al.* 2003), no evidence of the impact of different methods of service delivery on clinical outcomes, and no consensus as to which costs

can be attributed directly to the management of DSH, and how much is due to underlying problems, which would still be accrued if DSH had not occurred. Consequently, examining the factors affecting resource use in DSH, as presented in this review, helps to clarify some of these important considerations. This approach to the development and evaluation of complex interventions is proposed by the Medical Research Council, to clearly define the parameters to be measured prior to undertaking further randomized controlled trials (Campbell *et al.* 2000).

It was not appropriate to carry out a formal meta-analysis on these results (Egger *et al.* 1998), particularly as management occurred in different populations across varied health systems. The mixed quality of the studies and lack of consistency in how resource use is recorded and described also limits the confidence that can be attached to the conclusions drawn. In addition, some factors described were investigated in only one study. This highlights the need for good quality multi-centre studies to incorporate economic aspects and the impact of service structure into trial protocols. The checklist used to rate studies in this review, based on key principles for simple economic evaluations that are well documented in the literature (Drummond *et al.* 1997; Cooper, 2000), provides a basis on which to conduct such future evaluations.

Variation in service delivery appears to be a significant factor affecting resource utilization (Hultén *et al.* 2000; Kapur *et al.* 2003). A recent study (Bennewith *et al.* 2004) showed that the variability remains as broad as ever. The data from this review suggest that alterations in one part of the system (e.g. policy on medical admission, or the presence of a specialist DSH service) are interdependent with other aspects of resource utilization. While there is some evidence that those who receive a psychosocial assessment have reduced rates of repetition in the short term (Crawford & Wessely, 1998; Kapur *et al.* 2003), it is not known what effect different pathways through services might have on outcome, or whether this may account for the variability seen across different health systems.

A consistent finding across the studies reviewed was the high cost of medical management

on ITU, which, although occurring in relatively few patients, accounted for a disproportionately large cost burden. Second to this in cost, but more prevalent, was the resources required for in-patient management on a medical or surgical ward. DSH is one of the top five reasons for admission to hospital emergency departments in men and women (NHS Centre for Reviews and Dissemination, 1998). Although the majority of patients were admitted for an average of 1 day, the large and increasing number of patients presenting to hospital following an episode of DSH means this has significant resource implications.

One of the limitations of all the studies reviewed is that the costs of providing assessments following DSH were based on reference unit costs for an out-patient appointment. There are no reference costs available for specialist DSH services. Given current resource limitations in terms of trained staff and financial provision within most mental health-care systems, an estimation of the cost and opportunity cost of providing these services is an essential component in any consideration of the cost-effectiveness of interventions aimed at the secondary prevention of DSH, and attempts to define reference costs for these services are sorely needed.

Emergency department resource use was costed using unit costs and in some studies additional treatment procedures were recorded separately (Yeo, 1993; Runeson & Wasserman, 1994). However, there is little research evidence to support the clinical impression that DSH patients are often burdensome in terms of the staff time required for their management. The decrease in percentage of patients admitted to medical beds over the past two decades as a result of changing policies is highlighted by this review. During the same time period DSH rates have risen significantly (Hawton *et al.* 1997; O'Loughlin & Sherwood, 2005). This association may be an ecological fallacy, but as with other epidemiological trends relating to suicidal behaviour it warrants further investigation.

In terms of DSP with psychotropic drugs, which remains the most common method of DSH in Europe (Michel *et al.* 2000), one of the most consistent findings of this review is that resource use is more than 2.5 times greater in the management of poisoning with TCAs than

with SSRIs. In the prevention of suicide, the lethality of available methods for suicidal behaviour is a key factor in the likelihood of suicide following DSH (Gunnell & Lewis, 2005). While there is no substantial evidence of a significant causal link between SSRIs and the provocation of suicidal behaviour (Gunnell *et al.* 2005; Martinez *et al.* 2005), recent concerns about the possibility of such an association may alter prescribing behaviour (Martin *et al.* 2006) and may result in a return to prescribing of TCAs, with a consequent potential increase in the number of fatalities as well as resources required in the short-term management of DSH.

Combinations of psychotropic drugs and co-ingestion of alcohol also have a significant impact on resource utilization. With the increased availability and relative reduction in price of alcohol in the UK this is likely to become an increasingly important factor (Academy of Medical Sciences, 2004). The wide use of firearms for DSH and suicide in the USA (Kellermann *et al.* 1992) and pesticide use in Sri Lanka (Gunawardana & Abeywardana, 1997) highlights the importance of national epidemiological patterns of DSH in estimating resource use in the hospital management of DSH.

## CONCLUSIONS

There is some evidence that not only the method and medical seriousness of DSH but also variations in service provision affect the resources used in its short-term hospital management. However, there is little evidence for the impact that different models of care may have on clinical outcome or longer-term resource utilization, and further research is needed to address this question using prospective studies well designed for this purpose. Given the current variation in service provision to patients following an episode of DSH, understanding the impact of these differences may have significant implications for clinical care, as well as the evaluation of cost-effectiveness of any specific interventions in this patient group. The findings of this review also highlight the significant differences in medical care required following overdose with TCAs compared with SSRIs, which should be considered in making prescribing decisions, together with the likelihood of co-ingestion of alcohol. Further research is also needed to evaluate the

impact of DSP with psychotropic drugs combined with alcohol, as recent legislation increasing the availability of alcohol in the UK is likely to make this an increasing problem.

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## DECLARATION OF INTEREST

None.

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