

MENTAL HEALTH

The epidemiology and prevention of suicide by hanging: a systematic review

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Background Hanging is one of the most commonly used methods for suicide worldwide. In England and a number of other countries, its incidence has increased over the last 30 years. This review summarizes the published literature on suicide by hanging. The focus is on its epidemiology in England and on identifying potential means of prevention.

Methods We searched Medline (1966–2003), Embase (1980–2003), CINAHL (1982–2003) and PsycINFO (1967–2003). As considerable research on suicides occurring in prisons and psychiatric hospitals in England and Wales has been carried out by the National Confidential Inquiry into Suicide and Homicide (Manchester) and the Prison Service's Safer Custody Group, we obtained additional information from these sources.

Results Only a small proportion (around 10%) of hanging suicides occur in the controlled environments of hospitals, prisons, and police custody; the remainder occur in the community. The most commonly used ligatures (rope, belts, flex) and ligature points (beams, banisters, hooks, door knobs, and trees) are widely available; thus prevention strategies focused around restriction of access to means of hanging are of limited value. Around 50% of hanging suicides are not fully suspended—ligature points below head level are commonly used. Case fatality following attempted suicide by hanging is around 70%; the majority (80–90%) of those who reach hospital alive survive.

Conclusion Strategies to reduce suicide by hanging should focus on the prevention of suicide in controlled environments, the emergency management of 'near-hanging' and on the primary prevention of suicide in general. More research is required to better understand the recent rise in popularity of this method.

Keywords Suicide, systematic review, hanging, suicide prevention

Hanging is a frequently used method of suicide in many countries.¹ In England, there are around 2000 hanging suicides per year and it is the most commonly used suicide method. Its popularity as a means of suicide dates back to medieval times at least, when it accounted for around half of all suicides.² The last 30 years have seen an increase in hanging suicides, particularly amongst young males, in Australia,³ New Zealand,⁴ and elsewhere. In England, suicide by hanging has increased markedly in males aged <65 years (Figure 1).^{5,6} There have also been increases amongst young (aged <45 years) females

but rates in older females have been declining since the mid-1980s (Figure 2). Amongst older (>75 years) females in England and Wales, deaths by suffocation using a plastic bag account for around a third of suicides coded as due to hanging, strangulation, or suffocation using the International Classification of Diseases (ICD). In all other age/sex groups hanging accounts for 80–90% of deaths in these categories.

Hanging is a particularly lethal method of suicide with an estimated fatality rate of over 70%.^{7–9} In contrast to overdose there is little opportunity to change one's mind as death generally occurs rapidly after suspension. The usual cause of death is asphyxia as, unlike judicial hanging, the height of the drop is generally insufficient to cause spinal cord injury.

National suicide prevention strategies in England¹⁰ and internationally¹¹ place emphasis on restricting access to commonly used methods of suicide as a means of reducing suicide rates. Most commentators agree that this approach is generally not possible for hanging suicides as the ligature points and ligatures

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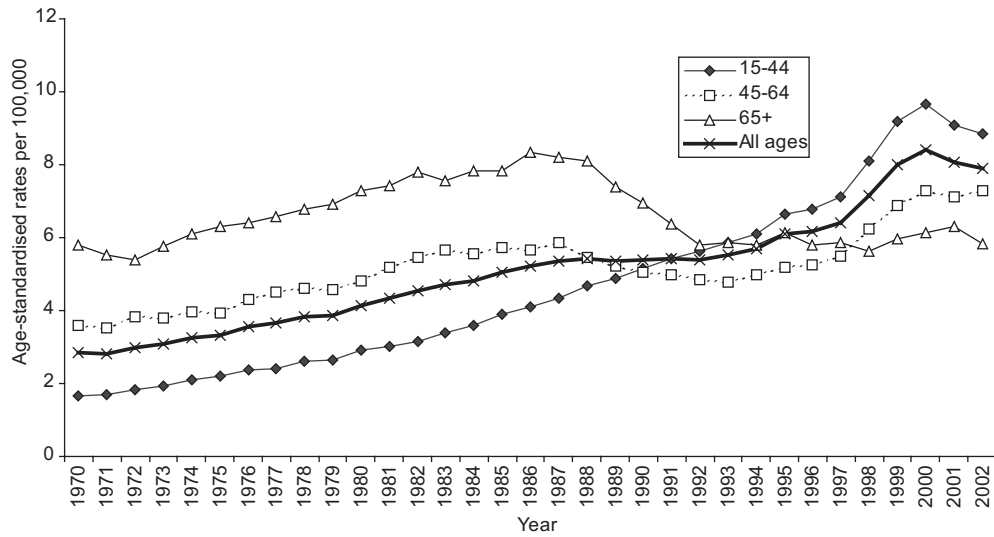


Figure 1 Age-standardized rates for deaths by hanging (suicide and undetermined; E953.0-953.9; E983.0-983.9) in England and Wales for males aged 15 and over, 1968–2002 (3-year moving averages)

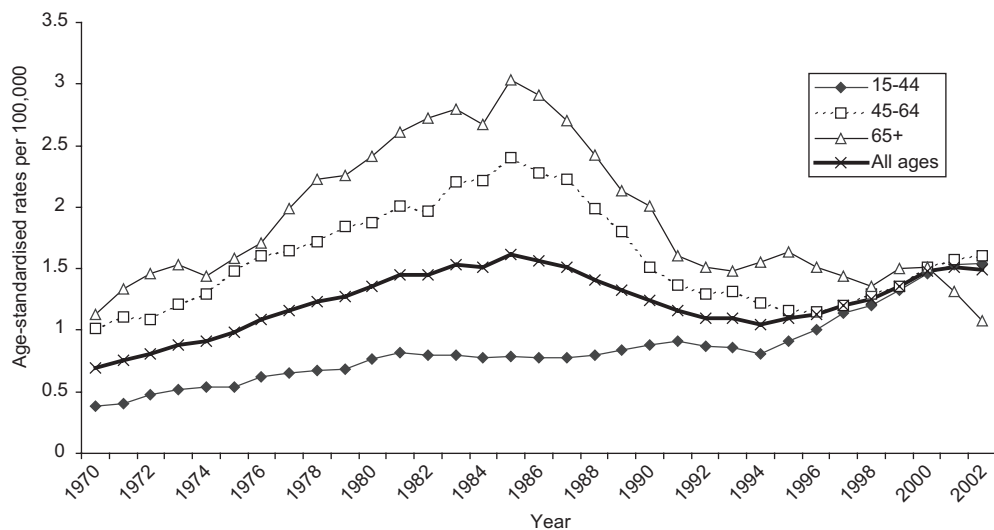


Figure 2 Age-standardized rates for deaths by hanging (suicide and undetermined E953.0-953.9; E983.0-983.9) in England and Wales for females aged 15 and over, 1968–2002 (3-year moving averages)

commonly used are universally available. An exception to this is suicide in institutional settings—police custody, prisons and hospitals.⁴ Such deaths, however, comprise only around 10% of all hanging suicides.^{12–14}

This review summarizes the published literature on suicide by hanging. The focus is on its epidemiology in England and in identifying potential means of prevention. We divide the published studies into those concerned with suicides in (i) the general population and (ii) institutional settings. These are considered separately because the opportunities for prevention depend upon the setting. We also review aspects of the emergency medical management of near-hanging victims who reach hospital alive.

Methods

Literature search strategy

We searched Medline for the years 1966–2003, Embase 1980–2003, CINAHL 1982–2003 and PsycINFO 1967–2003, using the following search strategy to identify relevant papers: suicide as a mesh heading and text word combined with the following text words: hanging, asphyxia (also as a key word), and strangulation. We limited the search to English language papers.

From the 734 papers identified using this strategy we selected those which focused on hanging as a method of suicide or where the abstract suggested that the paper would include

details concerning hanging suicides. We identified additional relevant papers from the reference lists of retrieved literature.

For our summary of data on ligature points and ligatures used for hanging we excluded small case series (<50 cases) and general reviews of the epidemiology of suicide in countries where hanging was mentioned but there was no specific focus on this method. In addition we excluded papers dealing specifically with asphyxia from plastic bags/self-strangulation. We included data presented in an MD thesis examining a large case series of hanging suicides, through personal contact with its author.¹³ We excluded papers that only described the pathological features of hanging suicides.^{15,16}

Sources of suicide data for England & Wales

As considerable research on suicides occurring in prisons and psychiatric hospitals in England and Wales has been carried out by the National Confidential Inquiry into Suicide and Homicide (Manchester) and the Prison Service's Safer Custody Group, we obtained additional information from these sources. We used Office for National Statistics (ONS) mortality statistics to investigate secular trends in the use of hanging.

Results

General population studies

We identified fifteen studies based on population samples and describing the characteristics of individuals and the methods they used for suicide by hanging (Appendix 1). The place of death in approximately three-quarters of the cases was the person's home. Deaths in custody or hospital accounted for ~10% of deaths and the remainder occurred in public places. A range of different ligatures were used—most commonly rope, belts, and electric flex. The main ligature points were rafters and beams, banisters, hooks, door knobs, and trees.

In studies reporting the position of the deceased, generally around half of the victims or fewer were found freely suspended with both their feet off the ground.^{9,12,17,18} In one Australian series 8% of the 261 cases studied were found kneeling and 8% sitting.¹² A forensic analysis by Khokhlov investigated tensions on the noose of a ligature exerted by different postures.¹⁹ He found that in the standing posture (with both feet on the ground) the ligature supports 65% of body weight; 54–74% in the kneeling position; 17–32% when sitting; and 18% when recumbent. Thus asphyxiation may be achieved without complete suspension.

Suicide by hanging whilst in custody

Suicides in custody have generated considerable concern in many countries.²⁰ In 1999/2000 there were 172 prison suicide deaths in England and Wales, 159 (92%) of which were by hanging or self-strangulation.²¹ Over this 2-year period these constituted 3.9% (159/4061) of national suicides by hanging.²² Hanging accounts for a similarly high proportion of deaths in custody in the USA, Australia, Canada, and Holland.^{23–29} The number of deaths by suicide in police custody in England and Wales is much lower than those in prisons. Between 1999/2000 and 2002/2003 deaths by hanging in police custody have averaged two a year. [Home Office: www.homeoffice.gov.uk/rds/pdfs/deaths2000.pdf; www.homeoffice.gov.uk/docs/deaths2001.pdf;

www.homeoffice.gov.uk/docs/death_in_custody.pdf; www.homeoffice.gov.uk/docs2/deathpolcustody2002_2003.pdf (Accessed December 23, 2003)].

Suicide by hanging in prisons

In England and Wales, cell window bars are the suspension point used in nearly half of prison suicides (48%)^{21,30} Other points of suspension are the bed (11%), cell fittings such as lights, pipes, cupboards, sinks or toilets (13%), or the cell door (5%).²¹ Suggestions for prevention have included changes to cell window frame design,³⁰ the removal of bars,²¹ or the covering of bars with Plexiglas.³¹ Other recommendations for the removal of suspension points have been the installation of recessed lighting or lighting that collapses under strain,^{28,31} and the removal of clothes hooks and bunk beds, replacing the latter with concrete sleeping benches.^{31,32} It has been suggested that in areas where 'at risk' prisoners are kept, all potential ligature points should be removed. These include prison health care centres, where one in six prison suicides in England and Wales occur.²¹

In 1989 Atlas suggested a wide range of changes to cell design which involved removing all possible means of suicide,³³ but it is only recently that 'safer cells', designed to be ligature-free, have been piloted in prisons in England and Wales (see Appendix 2). There are now 3000 'safer cells' out of a total of 47 000 cells in the correctional and prison services. In designing these the Safer Custody Group have sought to strike a balance between the need for removal of ligature points and the construction of a humane environment. Specific criteria have been laid down for furniture and sanitary ware so that ligatures cannot be attached.³⁴ (John Doohan, Safer Custody Group, HM Prisons, personal communication) Bars in 'safer cells' are covered with transparent polycarbonate sheeting and a ventilator inserted. Lights are recessed, pipes covered, and the bed base is fixed. Garment hanging space is constructed so that the rail is collapsible or a shelf lip is provided for hanging garments using cardboard hangers. Shelving is fitted flush against walls, button water controls are used on washbasins instead of taps and a button flush is used on toilets. Toilet seats, a potential ligature point, are not used but the pedestal is covered with an acrylic resin.³⁴ Recently, fixed plugs on washbasins have been removed as it was found that these could be used as a ligature point. Individual cells are tested with a fishing line and if the line snags behind shelves or pipes, gaps are filled with an anti-pick mastic. (John Doohan, Safer Custody Group, HM Prisons, personal communication)

A recently published evaluation of 'safer cells' in six prisons in England and Wales identified that five suicides by hanging or self-strangulation have taken place in these cells.³⁴ The ligature point used in the prison where the three cases of hanging took place was the upper hinge of the cell door—the design of these has subsequently been changed. A system is in place to develop and disseminate information on appropriate modifications when new ligature points are identified and used.

The most common forms of ligature used in prison suicides in England and Wales in 1999/2000 were bedding (56%) and shoe laces (13%).²¹ For this reason bedding made of fabric that is resistant to tearing is being piloted (John Doohan, Safer Custody Group, HM Prisons, personal communication). The replacement of shoe laces with Velcro fastening has been

recommended.²⁸ Modifying the availability of ligatures, particularly those utilizing clothing, is difficult to control while maintaining the dignity of the individual.

The World Health Organization (WHO) has issued guidelines for Prison Officers regarding the prevention of suicide.^{35,36} These guidelines include advice on commonly used ligatures and the need to minimize ligature points.

Suicide by hanging in police custody

In over half (52%, 38/73) the cases of suicide by hanging in police cells in England and Wales during the years 1990–1996, the hatch/bolt hole to the cell door was used as the ligature point. The door or door hinge were used in about one-quarter of the cases (26%).³⁷ All police forces have since been instructed to keep cell hatches closed when cells are occupied and some forces have introduced inspections to identify potential ligature points.³⁷ In addition a Home Office Circular published in 2002 provided guidance on changes that need to be introduced if police cells are to be ligature-free.

Shoe or boot-laces were used as the ligature in about one-third (32%) of the cases of death by hanging in police custody during 1990–1996. Clothing, or cord removed from clothing, was used in about one-quarter (24%) and one-fifth of the cases (20%), respectively. Bedding was used in only 15% of hangings. Some forces now use replacement clothing and blankets that will not tear.³⁷ The Home Office has recommended that items like shoelaces and belts that can be easily used as a ligature should always be removed.

Suicide by hanging in psychiatric inpatients

In the 4 years from April 1, 1996, there were 234 suicides on psychiatric wards in England and Wales—three-quarters of these (175/234) were caused by hanging. Such deaths accounted for around 3% of the 6554 suicides by hanging in England between 1997 and 2001.³⁸ Hanging makes a similar contribution to inpatient suicides in other countries.^{39,40}

In England and Wales, nearly one-third (23/74) of ward hangings between October 2001 and September 2003 were located in the toilet or bathroom. Recently it has become a legal requirement in England and Wales for all non-collapsible frames, such as bed, shower, and curtain rails to be removed from psychiatric wards (by March 2002).⁴¹ In the 2 years up to September 2003 a hook or handle (27%), part of the bed (20%), or door/wardrobe (17%) were the most common ligature points. These were used in nearly two-thirds of the suicides by hanging on psychiatric wards (Table 1).

The National Institute for Mental Health in England is developing guidance on conducting environmental audits of inpatient units to identify ligature points and so minimize the risk of hanging.⁴¹ Where it is not possible to remove structures identified as ligature points or where obstructions to the observation of patients have been identified and cannot be removed, it has been suggested that such wards should not be used for the admission of acutely ill patients.³⁸

The main ligatures used in suicides occurring on psychiatric wards in the 2 years up to September 2003 were: belts/dressing gown cords (50%), sheet or towel (13%), and shoe laces (9%) (see Table 2). It has been suggested that high-risk patients should be given or asked to wear clothes that do not need belts and shoes that do not have laces, though it is acknowledged that this would need to be sensitively discussed with such patients.³⁸

Table 1 Ligature points used in psychiatric inpatient ward suicides by hanging in England and Wales during the 2 years from October 2001 to September 2003

Ligature point	n (%) ^a
Hook or handle	19 (27.1)
Part of bed	14 (20.0)
Door/wardrobe	12 (17.1)
Shower fitting	6 (8.6)
Pipes	4 (5.7)
Window fitting	4 (5.7)
Bed curtain rail	2 (2.9)
Radiator fittings, including thermostat	2 (2.9)
Disabled toilet rail	1 (1.4)
Curtains	1 (1.4)
Light fixture	1 (1.4)
Wooden beam	1 (1.4)
Banister	1 (1.4)
Stopcock in ceiling	1 (1.4)
Telephone	1 (1.4)
Total	70 (100)

Source: The National Confidential Inquiry into Suicide and Homicide by People with Mental Illness (personal communication, Harriet Bickley; unpublished data).

^a Of the 74 returns, data on ligature points were missing for 4 suicides. Figures for 2003 are incomplete because of delays inherent in notification.

Medical management of cases of suicide by hanging

Case fatality following attempted suicide by hanging is high. One French study has estimated the case fatality as 79%.⁷ In an American case series 78% of the victims were declared dead at the scene of discovery.⁸ Aufderheide *et al.* describe a series of 306 cases of hanging in WI, USA, of whom 22% were referred to hospital and 64% of these survived.⁸ Higher mortality rates have been reported in other case series—around 3% of people who hanged themselves reached hospital alive in one case series from the USA⁹ whereas a more recent paper suggests case fatality is ~60%.⁴²

Those who reach hospital alive have a relatively high probability of survival.⁴³ In a recent Australian study, 68 (94%) of the 72 patients brought to A&E between 1995 and 2000 after 'near hanging' left hospital alive.⁴⁴ In a Canadian review of 17 cases the survival rate was 76%; four people suffered severe neurological and cognitive impairments and four mild to moderate impairments.⁴⁵ All four of those who died had required cardiopulmonary resuscitation at the scene of the hanging. In contrast to these relatively high levels of morbidity and mortality, a recent Australian case series ($n = 44$)⁴⁶ reported an 88% survival rate amongst those reaching hospital alive and a low incidence of persistent severe neurological impairment (5%). As in other studies, all those who died in this case series were pulseless when they were discovered.⁴⁶

Survival following attempted suicide by hanging is possible even if the victim has been suspended for >5 min. In one small case series 57% (4/7) survived after more than 5 min

Table 2 Ligatures used in psychiatric inpatient ward suicides by hanging in England and Wales during the 2 years from October 2001 to September 2003

Ligature	n (%) ^a
Belt, dressing gown cord	35 (50.0)
Sheet, towel, etc	9 (12.9)
Shoelaces	6 (8.6)
Item brought in specifically for the purpose e.g. rope	3 (4.3)
Tights	2 (2.9)
Bag strap/bag	1 (1.4)
Head scarf	1 (1.4)
Pyjama trousers	1 (1.4)
Shirt	1 (1.4)
Strapping	1 (1.4)
Curtain cord	1 (1.4)
Shower curtain	1 (1.4)
Telephone cord	1 (1.4)
TV aerial	1 (1.4)
Anorak cord	1 (1.4)
Bra	1 (1.4)
Metal coat hanger	1 (1.4)
Piece of cord	1 (1.4)
Shower lead	1 (1.4)
Cord from trousers	1 (1.4)
Total	70 (100)

Source: The National Confidential Inquiry into Suicide and Homicide by People with Mental Illness (personal communication, Harriet Bickley; unpublished data).

^a Of the 73 returns, data on ligatures were missing for 3 suicides, figures for 2003 incomplete because of delays inherent in notification.

suspension.⁴⁷ In another series three subjects, all with Glasgow coma scale (GCS) of 3, survived without memory defects.⁴⁸ In an Australian case series, 9 (64%) of the 14 patients with a GCS of 3 at the scene were discharged alive, although one was discharged to a nursing home with severe neurological disabilities. Seven of these patients were reported as having fixed dilated pupils at the scene and left hospital with no neurological sequelae.⁴⁶ Altogether, amongst the 42 people included in this series 5 (12%) died and 2 were left with severe neurological problems.

Immediate death following attempted suicide by hanging may occur in one of three ways:^{43,49}

- (i) Mechanical constriction of the neck structures (asphyxia; venous occlusion or arterial occlusion). Only 2 kg of pressure is needed to block the jugular veins, arterial occlusion requires 2.3–30.0 kg. About 15 kg of pressure is required to obstruct the trachea.
- (ii) Cardiac arrest, possibly facilitated by pressure on the carotid sinus and its effects on vasoactive centres.
- (iii) Injury of spinal cord and brain stem. Fractures of the cervical spine are, however, very rare in suicidal hanging⁴³ because the drop before tension on the noose is achieved is usually minimal.

Table 3 Treatment of non-judicial hanging and other strangulations (modified from: Iserson⁵¹)

Pre-hospital treatment:
<ul style="list-style-type: none"> • Stabilize neck, cut off ligature, do not cut knot (for possible medico-legal investigation) • ABCs <ul style="list-style-type: none"> — Ventilate if no/poor ventilation using facemask or bag-valve-mask (BVM) device — Give high-flow oxygen if breathing spontaneously, position patient to prevent aspiration ensuring neck stabilization throughout. — If necessary (failure to ventilate adequately using BVM) ventilate using laryngeal mask airway or intubate oro-tracheally with in-line cervical stabilization. — Circulation: commence chest compressions if no pulse • Start i.v. and draw baseline blood • Obtain history about patient's position, knot placement, drop and type of ligature
Emergency Department:
<ul style="list-style-type: none"> • Maintain cervical stabilization • Secure airway if necessary by intubating oro-tracheally with in-line cervical stabilization using rapid sequence induction. Beware of potential laryngeal injury (look for laryngeal crepitus) and be prepared to undertake surgical airway if required. • Maintain high-flow oxygen in all cases and continue ventilation throughout if required • Check for other self induced injuries (gun shot wounds, poisoning, laceration) • Support systemic physiology • X-ray and/or CT-scan of the neck to rule out bone injury and dislocation • Obtain photographs of external neck injuries • Look for raised intra-cranial pressure and treat if present • Admit patient for observation, even with normal neurological and pulmonary status

The most frequently reported causes of subsequent death amongst people who are brought to hospital alive following a suicide attempt by hanging are bronchopneumonia, pulmonary oedema and adult respiratory distress syndrome.^{45,50} In one series of 67 cases of hanging presenting to A&E, 8 (12%) developed pulmonary oedema, pneumomediastinum or pulmonary infiltrates. Rarer complications include hyperthermia, status epilepticus and oesophageal rupture.⁴³ Several signs indicating a poor prognosis have been identified. These include: pre-hospital cardiopulmonary arrest, need for intubation, and spontaneous respiratory rate of less than four breaths per minute.⁸ Admission to ITU is indicated for respiratory support and monitoring neurological and pulmonary complications. Endotracheal intubation is recommended for all patients with significantly impaired conscious level to avoid aspiration.⁴³

There are no authoritative evidence-based guidelines on the medical management of near-hanging. Table 3 highlights a number of aspects of the pre-hospital and emergency department treatment modified from a review published in 1984⁴⁹ to include suggestions from more recent reviews^{43,45} and comments from A&E specialists (see Acknowledgements). Some physicians have questioned the value of high levels of positive end-expiratory pressure (PEEP) because of the danger of worsening intracranial

hypertension.⁵¹ Krol and Wolfe, however, advocate endotracheal intubation and hyperventilation to decrease intracranial pressure and protect the airway from aspiration.⁴⁷

While bone injury or dislocation of the cervical spine is rare (<1%),⁴³ physicians recommend using precautionary measures (immobilization) until such an injury can be ruled out by X-ray and neck CT scan.^{43,49,52} Soft tissue films of the neck are useful to detect tracheo-laryngeal injury (indicated by difficulty in swallowing/hoarseness).⁴⁷ Adams suggests that, once stabilized, patients with neurological signs suggestive of cervical spine injury require CT or MRI scans;⁴³ although others⁴⁷ suggest these are not needed routinely. Patients with neurological signs consistent with a stroke should be investigated with a CT brain scan and Doppler ultrasound of the carotid arteries (Adams N, personal communication). Those involved in the initial management of cases of suicidal hanging should also bear in mind that the person may have taken a drug overdose or have some other injury.⁸

Of note, whilst existing guidelines for health care in prison give a detailed account of the emergency treatment of self-poisoning and overdose, they do not include advice on the management of hanging.³⁶

Discussion

Suicide by hanging has increased in England and Wales and a number of other countries over the last 30 years. Hanging is a highly lethal method of suicide in that around 70% of those who attempt suicide using this method die. It is to be noted that only half of those who die by hanging are found fully suspended with their feet above the ground. Ligature points

used by those in prisons and hospitals are often below head height. Most hanging deaths occur in the community—only around 10% occur in prisons and psychiatric hospitals.

The controlled environments of prisons and psychiatric hospital do provide opportunities for reducing the incidence of hanging suicides. The fact that complete suspension is not required to successfully hang oneself needs to be understood and communicated to those reviewing potential ligature points in institutional settings. Table 4 summarizes possible approaches to prevention of hanging suicides in prisons and hospitals. In Britain, many of the recommendations for prisons are being introduced: all prisons screen for high-risk patients and identify those appropriate for a safer cell, trauma resuscitation training for prison nurses is being piloted and prisons provide emergency response kits in each wing or office for use by staff. Furthermore many of the staff carry personal issue cut-down knives to ensure they respond immediately in the event of a hanging (John Doohan, personal communication). The approaches to medical management of hanging suicide attempts (Table 3) might usefully be incorporated in guidelines for health care workers and prison staff.³⁶

In contrast to the situation in prisons and psychiatric hospitals, the ligatures and suspension points used by those who kill themselves by hanging in the community are universally available. Therefore approaches to prevention based around limiting access to ligature and suspension points or reducing the lethality of suicide attempts by hanging are unlikely to be successful.⁵³

Improved pre-hospital and acute medical management of victims may have some impact on the current death toll as around 20% of those who die from hanging are found alive.

Table 4 Summary of approaches to preventing suicide by hanging in prisons and hospitals

Prisons

- A system for identifying at risk prisoners needs to be in place to identify those who would most appropriately be accommodated in 'safer (ligature-free) cells'.
- As it is possible to remove all ligature points but more difficult to remove all ligatures, monitoring of at risk prisoners even in 'safer cells' is important in order to prevent self-strangulation.
- Where new ligature points are identified it is important to develop and introduce modifications quickly to avoid 'copy cat suicides.'
- Before the more widespread use of 'safer cells' is likely the following issues need addressing: (i) to avoid stigma there should be more 'safer cells' than the number needed to accommodate all prisoners identified as high-risk; (ii) if 'safer cells' are not to be used for reward or punishment they need to be no better or no worse than other cells; (iii) both single and double 'safer cells' need to be constructed; and (iv) if the results of piloting new larger ventilation units are positive, then these need to be introduced to all 'safer cells' where ventilation is a problem as this has been found to adversely affect prisoner mood.
- The development and introduction of safer bedding would limit acts of self-strangulation.
- Prison staff should be trained in the resuscitation and emergency management of attempted suicide by hanging
- Prisons should provide readily available emergency treatment response kits at suitable sites around the prison. Staff should carry 'cut-down' knives to ensure they can respond immediately in the event of a hanging.

In hospitals

- As ligature points used in psychiatric hospitals are similar to those commonly used in prisons (hooks, handles, beds, wardrobe doors), some of the changes made to fixtures and fittings in prisons could be introduced in hospital wards.
- Inspection of wards for potential ligature points should be done and where these ligature points or obstructions to the appropriate observation of patients are identified and cannot be removed, such wards should not be used for high-risk patients.
- Hospital staff should be made aware that fatal hangings often occur from ligature points below head level.
- Since a belt/dressing gown cord or shoelaces are among the most commonly used ligatures on psychiatric wards, consideration could be given to changes in clothing for patients identified as high-risk so these cannot be used as ligatures.
- Hospital staff should be trained in the resuscitation and emergency management of attempted suicide by hanging.

In the absence of randomized trials, consensus guidelines on the management of hanging should be drawn up and made available to ambulance and A&E staff. Prison and hospital staff should be trained in the emergency medical management of individuals who have hung themselves.

There are two main limitations of our review. First, we did not search the grey literature or non-English language papers and so may have excluded some relevant studies. We feel this is unlikely to influence our main findings as, unlike systematic reviews of treatment effectiveness or disease risk factors, descriptive studies of suicide by hanging and its management are less likely to be subject to publication bias. Second, the treatment guidelines (Table 3) are based on expert opinion and evidence from non-randomized studies. We did not identify any randomized trials of the management of suicide by hanging—this is most likely to reflect the relative rarity with which survivors of hanging are encountered in clinical practice.

A range of different factors lie behind the choice of a particular method of suicide.⁵⁴ Socio-cultural acceptability appears to be an important factor.⁵³ It has been argued that the previously low rates of suicide by hanging in the UK and other countries was due to the stigma associated with the use of this method in judicial executions.^{1,55} Recent increase in the cases of hanging may in part be due to substitution from other methods, such as gassing, which have become less lethal.^{56,57} The most fruitful approach to tackling the rise in hanging suicides may therefore be through population-based initiatives to reduce the popularity of this method. This may be achieved through working with the

media to reduce the portrayal of fictional suicides by hanging and the reporting of hanging suicides. Qualitative studies are required to better understand explanations for choice of method. Until a greater understanding of these issues is available, preventive approaches to hanging suicides may be better focused more broadly on the primary and secondary prevention of factors associated with suicide risk.⁵⁸

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KEY MESSAGES

- Hanging is a commonly used method of suicide worldwide and in Britain and some other countries its incidence is increasing.
- The most commonly used ligatures (ropes, belts, flex) and ligature points (beams, banisters, hooks, door knobs, and trees) are widely available, limiting attempts at prevention focused around restriction of access to means, except in institutional settings.
- Only a small proportion of suicides by hanging (around 10%) occur within the controlled environments of hospitals and prisons.
- Around 50% of hanging suicides are not fully suspended—ligature points below head level are commonly used. Relatively minimal neck pressure is required to cause death by hanging.
- Whilst case fatality following attempted suicide by hanging is high (around 70%) survival is possible, even after 5 min suspension. The main causes of death amongst those reaching hospital alive are bronchopneumonia, pulmonary oedema and adult respiratory distress syndrome.

References

- 1 Farmer R, Rohde J. Effect of availability and acceptability of lethal instruments on suicide mortality. An analysis of some international data. *Acta Psychiatr Scand* 1980;**62**:436–46.
- 2 Seabourne A, Seabourne G. Suicide or accident—self-killing in medieval England: series of 198 cases from the Eyre records. *Br J Psychiatry* 2001;**178**:42–47.
- 3 Wilkinson D, Gunnell D. Comparison of trends in method-specific suicide rates in Australia and England & Wales, 1968–97. *Aust NZ J Public Health* 2000;**24**:153–57.
- 4 Beautrais AL. Methods of youth suicide in New Zealand: trends and implications for prevention. *Aust NZ J Psychiatry* 2000;**34**:413–19.
- 5 Middleton N, Gunnell D. Trends in suicide in England and Wales. *Br J Psychiatry* 2000;**176**:595.
- 6 Brock A, Griffiths C. Trends in suicide by method in England and Wales, 1979 to 2001. *Health Stat Q* 2003;**20**:7–18.
- 7 Simounet C, Bourgeois M. Suicides and attempted suicides by hanging. *Ann Med Psychol* 1992;**150**:481–85.
- 8 Aufderheide TP, Aprahamian C, Mateer JR *et al*. Emergency airway management in hanging victims. *Ann Emerg Med* 1994;**24**:879–84.

- ⁹ Luke JL, Reay DT, Eisele JW, Bonnell HJ. Correlation of circumstances with pathological findings in asphyxial deaths by hanging: a prospective study of 61 cases from Seattle, WA. *J Forensic Sci* 1985;**30**: 1140–47.
- ¹⁰ Department of Health. *National suicide prevention strategy for England*. London: Department of Health, 2002.
- ¹¹ Taylor SJ, Kingdom D, Jenkins R. How are nations trying to prevent suicide? An analysis of national suicide prevention strategies. *Acta Psychiatr Scand* 1997;**95**:457–63.
- ¹² Cooke CT, Cadden GA, Margolius KA. Death by hanging in Western Australia. *Pathology* 1995;**27**:268–72.
- ¹³ Nowers M. *Violent Suicide: Pathways to Prevention*. MD Thesis, University of Bristol, 2001.
- ¹⁴ Luke JL. Asphyxial deaths by hanging in New York City, 1964–1965. *J Forensic Sci* 1967;**12**:359–69.
- ¹⁵ Green H, James RA, Gilbert JD, Byard RW. Fractures of the hyoid bone and laryngeal cartilages in suicidal hanging. *J Clin Forensic Med* 2000;**7**:123–26.
- ¹⁶ Betz P, Eisenmenger W. Frequency of throat-skeleton fractures in hanging. *Am J Forensic Med Pathol* 1996;**17**:191–93.
- ¹⁷ Davison A, Marshall TK. Hanging in Northern Ireland—a survey. *Med Sci Law* 1986;**26**:23–28.
- ¹⁸ Simonsen J. Patho-anatomic findings in neck structures in asphyxiation due to hanging: a survey of 80 cases. *Forensic Sci Int* 1988;**38**:83–91.
- ¹⁹ Khokhlov VD. Calculation of tension exerted on a ligature in incomplete hanging. *Forensic Sci Int* 2001;**123**:172–77.
- ²⁰ Wortley R. Self-Harm. In: Wortley R (Ed). *Situational Prison Control*. Cambridge: Cambridge University Press, 2002, pp. 136–54.
- ²¹ Shaw J, Appleby L, Baker D. *Safer Prisons: A National Study of Prison Studies 1999–2000 by the National Confidential Inquiry into Suicides and Homicides by People with Mental Illness*, 2003.
- ²² Office of National Statistics. *Twentieth Century Mortality*. London: Stationery Office, 2004.
- ²³ Novick LF, Remmlinger E. A Study of 128 Deaths in New York City Correctional Facilities (1971–1976). *Med Care* 1978;**16**:749–56.
- ²⁴ McKee GR. Lethal vs. non-lethal suicide attempts in jail. *Psychol Rep* 1998;**82**:611–14.
- ²⁵ DuRand CJ, Burtka GJ, Federman EJ, Haycox JA, Smith JW. A quarter century of suicide in a major urban jail: implications for community psychiatry. *Am J Psychiatry* 1995;**152**:1077–80.
- ²⁶ Copeland AR. Fatal suicidal hangings among prisoners in jail. *Med Sci Law* 1989;**29**:341–45.
- ²⁷ McDonald D, Thomson NJ. Australian deaths in custody, 1980–1989. 2. Causes. *Med J Aust* 1993;**159**:581–85.
- ²⁸ Green C, Kendall K, Andre G, Looman T, Polvi N. A study of 133 suicides among Canadian federal prisoners. *Med Sci Law* 1993;**33**:121–27.
- ²⁹ Kerkhof AJFM, Bernasco W. Suicidal Behaviour in Jails and Prisons in the Netherlands: incidence, characteristics, and prevention. *Suicide Life Threat Behav* 1990;**20**:123–37.
- ³⁰ Dooley E. Prison Suicide in England and Wales 1972–87. *Br J Psychiatry* 1990;**156**:40–45.
- ³¹ Jordan FB, Schmeckpeper K, Strobe M. Jail suicides by hanging. An epidemiological review and recommendations for prevention. *Am J Forensic Med Pathol* 1987;**8**:27–31.
- ³² Lanphear BP. Deaths in custody in Shelby County, Tennessee, January 1970–July 1985. *Am J Forensic Med Pathol* 1987;**8**:299–301.
- ³³ Atlas R. Reducing the opportunity for inmate suicide: a design guide. *Psychiatr Q* 1989;**60**:161–71.
- ³⁴ Burrows T, Brock AP, Hulley S, Smith C, Summers L. *Safer Cells Evaluation: Full Report*. The Jill Dando Institute of Crime Science, University College London, 2003.
- ³⁵ *Preventing Suicide A Resource for Prison Officers*. Geneva: World Health Organisation, 2000, pp. 1–13.
- ³⁶ WHO Collaborating Centre for Research and Training for Mental Health Institute of Psychiatry. *Mental Health Primary Care in Prisons—adapted for prisons and young offenders*. Institution for the WHO Guide to Mental Health in Primary Care. London: Royal Society of Medicine Press Ltd, 2002.
- ³⁷ Leigh A, Johnson G, Ingram A. Deaths in police custody: learning the lessons. Policy Research Series paper 26. Available at: <http://www.homeoffice.gov.uk/rds/prgpdfs/lprs26.pdf> (Accessed 23 December, 2003)
- ³⁸ Appleby L, Shaw J, Sherratt J, Amos T, Robinson J, McDonnell R. *Safety First: Five-year report of the National Confidential Enquiry into Suicide and Homicide by People with mental illness*. London: Department of Health, 2001.
- ³⁹ Sundqvist-Stensman UB. Suicides in close connection with psychiatric care: An analysis of 57 cases in a Swedish county. *Acta Psychiatr Scand* 1987;**76**:15–20.
- ⁴⁰ Proulx F, Lesage AD, Grunberg F. One hundred in-patient suicides. *Br J Psychiatry* 1997;**171**:247–50.
- ⁴¹ National Institute for Mental Health in England. *The National Suicide Prevention Strategy for England: Annual Report of Progress 2003*. National Institute for Mental Health in England. Leeds, 2003.
- ⁴² Spicer RS, Miller TR. Suicide acts in 8 States: Incidence and case fatality rates by demographics and method. *Am J Public Health* 2004;**90**:1885–91.
- ⁴³ Adams N. Near hanging. *Emerg Med* 1999;**11**:17–21.
- ⁴⁴ Davidson JA. Presentation of near-hanging to an emergency department in the Northern Territory. *Emerg Med* 2003;**15**:28–31.
- ⁴⁵ Kaki A, Crosby ET, Lui ACP. Airway and respiratory management following non-lethal hanging. *Can J Anaesth* 1997;**44**:445–450.
- ⁴⁶ Penney DJ, Stewart AHL, Parr MJA. Prognostic outcome indicators following hanging injuries. *Resuscitation* 2002;**54**:27–29.
- ⁴⁷ Vander Krol L, Wolfe R. The emergency department management of near-hanging victims. *J Emerg Med* 2003;**12**:285–92.
- ⁴⁸ Bautz P, Knottenbelt JD. Successful resuscitation from suicidal hanging: report of three cases. *Injury* 1994;**25**:111–12.
- ⁴⁹ Iserson KV. Strangulation: a review of ligature, manual, and postural neck compression injuries. *Ann Emerg Med* 1984;**13**:179–85.
- ⁵⁰ Fischman CM, Goldstein MS, Gardner LB. Suicidal hanging: an association with the Adult Respiratory Distress Syndrome. *Chest* 1977;**71**:225–27.
- ⁵¹ Sternbach G, Bresler MJ. Near-fatal suicidal hanging. *J Emerg Med* 1989;**7**:513–16.
- ⁵² Howell MA, Guly HR. Near hanging presenting to an accident and emergency department. *J Accid Emerg Med* 1996;**13**:135–36.
- ⁵³ Cantor CH, Baume PJH. Access to methods of suicide: what impact? *Aust NZ J Psychiatry* 1998;**32**:8–14.
- ⁵⁴ Clarke RV, Lester D. *Explaining Choice of Method. Suicide: Closing the Exits*. New York: Springer-Verlag, 1989, pp. 85–95.
- ⁵⁵ Pounder DJ. Why are the British hanging themselves? *Am J Forensic Med Pathol* 1993;**14**:135–40.
- ⁵⁶ Amos T, Appleby L, Kiernan K. Changes in rates of suicide by car exhaust asphyxiation in England and Wales. *Psychol Med* 2001;**31**: 935–39.
- ⁵⁷ Gunnell D, Middleton N, Frankel S. Method availability and the prevention of suicide—a reanalysis of secular trends in England and Wales 1950–1975. *Soc Psychiatry Psychiatr Epidemiol* 2000;**35**:437–43.
- ⁵⁸ Gunnell D, Frankel S. Prevention of suicide: aspirations and evidence. *BMJ* 1994;**308**:1227–33.
- ⁵⁹ De Leo D, Evans R, Neulinger K. Hanging, firearm, and non-domestic gas suicides among males: a comparative study. *Aust NZ J Psychiatry* 2002;**36**:183–89.

⁶⁰ Kosky RJ, Dundas P. Death by hanging: implications for prevention of an important method of youth suicide. *Aust NZ J Psychiatry* 2000; **34**:836–41.

⁶¹ Morild I. Fractures of neck structures in suicidal hanging. *Med Sci Law* 1996; **36**:80–84.

⁶² Elfawal MA, Awad OA. Deaths from hanging in the eastern province of Saudi Arabia. *Med Sci Law* 1994; **34**:307–12.

⁶³ James R, Silcocks P. Suicidal hanging in Cardiff—a 15-year retrospective study. *Forensic Sci Int* 1992; **56**:167–75.

⁶⁴ Guarner J, Hanzlick R. Suicide by hanging. A review of 56 cases. *Am J Forensic Med Pathol* 1987; **8**:23–26.

⁶⁵ Bowen DA. Hanging—a review. *Forensic Sci Int* 1982; **20**:247–49.

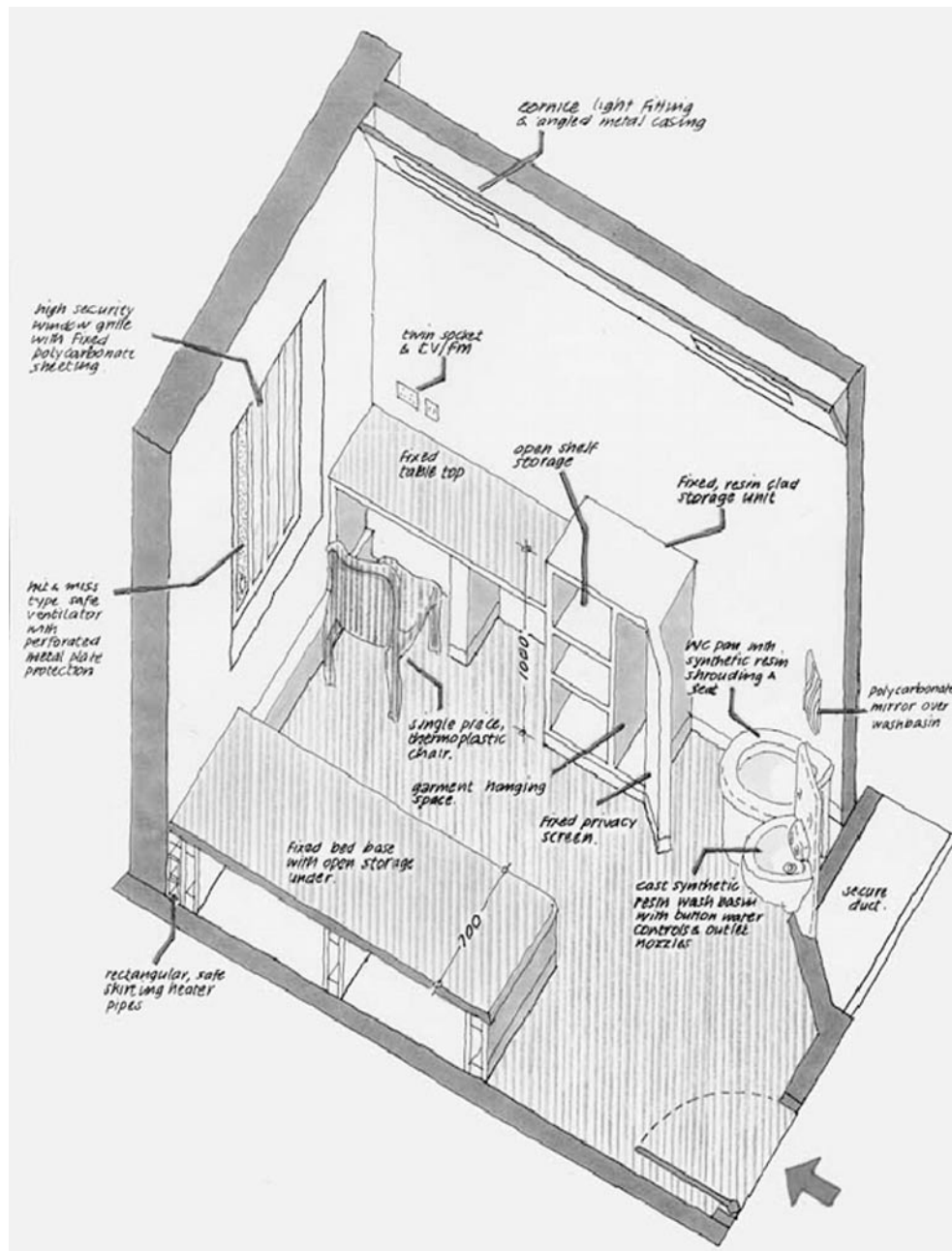
⁶⁶ Sen Gupta BK. Studies on 101 cases of death due to hanging. *J Indian Med Assoc* 1965; **45**:135–40.

Appendix 1 Studies of suicide by hanging—general population samples

Author	Setting and sample size	Location	Ligature point, ligature, and degree of suspension
De Leo (2002) ⁵⁹	Queensland, Australia 1994–1996; n = 401; 100% males; mean age 36	73% occurred in place of residence	
Nowers (2001) ¹³	Bristol, UK 1974–1994; n = 412; 83% male; all ages	73% at home; 14% public places; 9% hospital or on leave from hospital; 2% in custody	Ligature points: window of room; door handle; window of toilet; atticrafters (home); tree in hospital grounds Ligatures include: scarf; shoelaces; electric flex; wire cable; electric cable
Kosky and Dundas (2000) ⁶⁰	Queensland, Australia 1995–1996 n = 137; 87% male; ages <25	57% home; 34% public place; 3% prison; 1% police cells; 1% hospital	
Morild (1996) ⁶¹	Bergen, Norway 1988–1993; n = 80; 73% male; mean age 38.7		51% completely suspended (both feet off ground)
Cooke CT (1995) ¹²	Perth, Australia 1988–1992; n = 280 (series includes 19 non-suicides); males 88%; numbers peak in 20–24 year old males	71% in around home (28% in a room; 13% carport or veranda; 21% shed or garage; 8% garden; 1% basement); 4% in custody (police and jail); 6% in a medical setting, including nursing home and hostel	Ligature points: rafter of a roof, ceiling, or verandah 47%; tree (16%); door or door frame (9%); cell bar (4%); shower rail or rose (4%); stair rail (2%); curtain rail (1%); ceiling hook (1%); manhole (1%) Ligature: rope (59%) Degree of suspension: only 41% completely suspended—both feet off the ground; 8% kneeling; 8% sitting; 1% lying
Elfawal and Awad (1994) ⁶²	Eastern Province, Saudi Arabia 1988–1992; n = 61 (59 suicides); 80% male	95% at home, (53 indoors and 5 outdoors) 5% place of work	Ligature: 41 (67%) plastic clothes line; 14 (23%) cotton cloth; leather strap (1); silk cloth (1); rubber hose (1); electric cable (3) Degree of suspension: 48 (79%) complete suspension, 13 (21%) partial
Simounet & Bourgeois (1992) ⁷	Bordeaux, France 1988; n = 86 (including one accident)—68 deaths and 18 (21%) survivors; 76% male		
James and Silcocks (1992) ⁶³	Cardiff, UK; n = 84; 92% male		Main ligatures: rope, wire, chain, flex, belts, and various soft ligatures
Simonsen (1988) ¹⁸	Odense, Denmark; n = 82 (77 suicides); 48 (59%) male; mean age 53 (males), 52 (female)		Ligatures: packing twine or electric cord 46 (58%); rope 20 (25%); linen 5 (6%); belt 5 (6%); other 4 (5%) Degree of suspension: 38% completely suspended (both feet off ground)
Guarner and Hanzlick (1987) ⁶⁴	Georgia, USA 1979–1984; n = 56; 90% male; ages 12–88	43% at home; 27% jail; 9% wooded areas; 7% hotels; 5% health care facilities; 4% work 5% other	Ligatures; 50% ropes and belts; 50% sheets, electric cords, shirts, towels, linen, clothes hanger
Davison and Marshall (1986) ¹⁷	N Ireland, UK 1979–1983; n = 105	71% at home; 10% in the open; 7% in hospital	Ligature point: rafter, joist, or beam (44%); nails, hooks, and brackets (13%); banister (9%); trees (9%) Ligatures: rope (51%); electric flex (8%); belts (8%); baler twine (7%); washing line (6%) Degree of suspension: feet touching ground in 53%
Luke JL <i>et al.</i> (1985) ⁹	King County, Washington 1981–1984; n = 61 (2 auto-erotic); 84% male; mean age 41		Ligature: Rope or clothes line (52%); leather belt (13%); Soft belt or tie (11%); sheet or cloth (10%) Degree of suspension; 33% completely suspended; Chair or other initial elevating device present in 73%

Appendix 1 continued

Author	Setting and sample size	Location	Ligature point, ligature, and degree of suspension
Bowen DA (1982) ⁶⁵	North West London, UK 1956–1980; n = 201 (95% suicidal)	'Almost always at home'	Ligature points: banisters, door knobs, clothes hooks on doors
Luke JL (1967) ¹⁴	Manhattan, New York 1964–1965; n = 106 suicide; 85% males (series includes 2 accidents)	79% at home; 8% hospital patients; 7% work; 2% at friend; 4% police/prison	Ligature: rope, often clothesline (46%); belt (14%); electric cords (7%); neckties (7%); sheets (7%); string or twine (5%); others such as dog lead, undershirt, shirt sleeve, Venetian blind, elastic cord, scarf.
Sen Gupta (1965) ⁶⁶	Calcutta, India 1960–1964; n = 101 (deaths, all suicides); 72% male; age 14–75		Ligatures: sari (n = 20); dhoti (n = 20); rope (n = 41); napkin (n = 12); wrapper (n = 3); electric wire (n = 1); belt (n = 1); chadder (n = 1); lungi (n = 2)



Appendix 2 Safer Cell design (Personal Communication John Doohan, Safer Cells Group, Home Office)