High frequency of potential entrapment gaps in beds in an acute hospital

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Abstract

Objective: dimensional guidelines for bedrails have been developed to minimise the risk of patient entrapment within the bed. We examined whether bedrails in a large Irish teaching hospital complied with these standards.

Design and setting: survey of 60 accessible beds in six hospital wards.

Methods: a specialised cone and cylinder tool that mimics the size and weight of a small adult neck and head was used to determine gaps in the four zones most associated with entrapment.

Results: the number of failures for each zone was 15 beds for zone 1 (any space between the perimeters of the rail); 42 beds for zone 2 (the space under the rail); 41 beds for zone 3 (the space between the inside surface of the bedrail and the mattress) and 13 beds for zone 4 (the space between the mattress and rail at the end of the rail). Failures were more common with hydraulic adjusted than with electric profiling beds. Mattresses that were the wrong size (usually too narrow) or too soft and bedrails that were loose or were poorly maintained accounted for many failures.

Conclusion: many beds used in our hospital did not comply with dimensional standards to minimise entrapment risks. This emphasises the need for careful selection of patients for whom bedrails are to be used as well as the need for monitoring and maintenance of bed systems.

Keywords: bedrails, mattresses, restraints, hospital beds, equipment maintenance older people

Introduction

Bedrails are commonly used as safety devices to prevent people falling from bed. However, although the risk for any individual is extremely low, people can and have become trapped or strangled in almost all of the spaces that can exist within bedrails or between mattress, rails and head- or foot-boards, and many such cases have been recorded by regulatory authorities [1–4].

In the USA, dimensional guidelines for bedrails, based on anthropometric data regarding the size and weight of a small adult human head and neck, to minimise bedrail entrapment were issued by the Food and Drug Administration (FDA) in 2006 [5]. In 2010, the International Electrotechnical Committee (IEC) and the International Organization for Standardization (ISO), international bodies which set safety standards for medical electrical equipment, agreed new dimensional guidelines for bed systems and these came into force in April 2013 [6]. These dimensions are also endorsed by the Medicines and Healthcare products Regulatory Agency (MHRA) [7], and death or severe harm as a result of entrapment of an
adult in bedrails that do not comply with such guidance is defined as a ‘never event’ in England [8].

Bed systems built to modern standards should greatly reduce the risk of entrapment. However, deaths and injuries have continued to be reported, albeit, probably, at a lower level [9, 10], and it is inevitable that older bed frames will continue to be widely used for some time. In this study, we examined whether bedrails and bed systems in a large Irish teaching hospital were compliant with modern standards and the reasons for any shortcomings.

Methods

The four zones within the bed system which account for 80% of reported entrapment incidents and for which the FDA provide dimensional guidance were assessed (Figure 1). Zone 1 is any open space between the perimeters of the rail; zone 2 is the space under the rail or between the rail supports; zone 3 is the space between the inside surface of the bedrail and the mattress and zone 4 is a gap between the mattress and rail at the end of the rail. Zones 1–3 pose a risk of head entrapment, and gaps should be <120 mm (the 5th percentile adult female head breadth) and zone 4 a risk of neck entrapment and gaps should be <60 mm (the 5th percentile adult female neck breadth). A specialised cone and cylinder tool was used in accordance with the recommendations of the FDA and the British Health and Safety Executive [5, 11].

The figure also shows additional potential entrapment zones: although the FDA did not provide explicit advice regarding these zones, the new IEC standards do [6]. Zone 5, the gap between the head board and end of side rail, should be <60 mm, while zone 6, the gap between the foot board and end of side rail, should be <60 mm or >318 mm (the 95th percentile adult chest depth); zone 7, the gap between split side rails should also be <60 mm or >318 mm.

Following a training session with the cone and cylinder device, Fleiss kappa for inter-rater agreement between the examiners was excellent at 0.90. Assessors working in pairs then examined bed systems in a large Irish teaching hospital to determine the potential for patient entrapment. The study was carried out in six wards taking acute admissions. Only beds which were unoccupied during the testing period and had bedrails attached were considered for inclusion. Beds with alternating pressure mattresses were excluded. Bed type [hydraulic adjustable (HA) or electric profiling (EP)] and manufacturer and mattress type and manufacturer were noted. Only beds where all test zones on all accessible sides passed received an overall pass.

Results

Sixty of 145 beds on the selected wards were examined. In some cases, it was only possible to assess one side of the bed to avoid interfering with a patient sitting in a chair beside the bed; thus, 91 of 290 sides were examined. Of the 60 beds, 22 were EP and 38 were HA beds. There were 10 different bed types, 10 different mattress types and 20 different bed-mattress combinations (please see Supplementary data available in Age and Ageing online, Appendix). Intrinsic rails were present in 18 (81.8%) of the EP beds and 10 (26.3%) of the HA beds.

Only 5 (8.3%) beds, all EP beds, received an overall pass; 10 (16.6%) beds, all HA beds with non-original rails, failed all zones. The number of failures for each zone was: 15 beds [3 (13.6%) EP and 12 (31.6%) HA beds] for zone 1; 42 beds [7 (31.8%) EP and 35 (92.1%) HA beds] for zone 2; 41 beds [10 (45.5%) EP and 31 HA (81.6%) beds] for zone 3; and 13 beds [3 (16.3%) EP and 10 (26.3%) HA beds] for zone 4. Median (range) zone failures (on one or both sides) 1 (0–3) for EP beds were and 3 (1–4) for HA beds.

Two recurring issues accounted for many of the failures, especially in zones 2 and 3: mattresses were the wrong size (usually too narrow) or their perimeters were too compressible; and bedrails were loose or were poorly maintained with bent or worn components which allowed significant lateral movement.

Discussion

This study in a large teaching hospital in Ireland shows a very high frequency of potential entrapment spaces in the bed systems in use. Only one similar study using the same testing device has, to our knowledge, been performed, and that was a student project that has not been published in the peer-reviewed literature [12]. Our results are comparable with that study which found that three-quarter of beds in various

Figure 1. Bed entrapment zones. Zones are explained in the text.
health care institutions in Vancouver in 2007 failed dimensional testing. Mattresses of the wrong size (too short or too narrow) or structure (too soft) were significant factors in both studies; poor maintenance of bedrail fittings, especially for extrinsic rails, was an additional factor in our study. EP beds are increasingly common in hospitals and most have purpose-built, permanently attached rails. Such beds were less likely to have gaps, especially in zones 1–3, in this study. About one-third of the beds examined in this study were EP beds, and this is broadly consistent with the bed mix in the hospital as a whole. This rate is much lower than the average of 81% in a UK survey of 18 hospitals, although the rates in individual hospitals in that survey ranged from 34 to 100% [13].

The Vancouver report noted that most failures related to older beds and that most beds manufactured after 2002 passed all four zones [12]. This is of course dependent on use of an appropriate mattress and adequate bed maintenance. Also, failures of bed manufacturers to comply with the dimensional standards have been reported [14]. We do not have precise data on the date of manufacture of the beds examined in this study, but examination of the websites of the relevant manufacturers showed that the bed models that passed all zones—and only those beds models—that had explicit declarations of compliance with the IEC-60601-2-52 standards. This supports the suggestion that newer bed systems will be safer, while leaving the problem of older ‘legacy’ beds.

On-going monitoring and maintenance of bedrails would avoid some of the problems identified in this study and should occur in all health care institutions. (Our results have been reported to local management and to national authorities and have resulted in improved local monitoring and maintenance of bed systems.) Other problems are less easily solved. It seems inevitable that there will be a multitude of bed types and of bed-mattress combinations in large acute hospitals. Replacing older bed stock is desirable but costly and is inevitably a long-term process although it is essential that compliance with dimensional guidelines is an important factor in bed procurement decision-making. Accessories are available in some cases that can be used to ‘retrofit’ older beds to eliminate gaps, although may also be labour-intensive and expensive [15].

It is important that staff should be aware of the potential for entrapment, and Healey and Tremil [16] have noted that only 46% of trust policies in England and Wales included specific guidance on avoiding bedrail entrapment gaps. Actually measuring gaps would be a very time consuming approach in everyday care and, given that serious injury or death from entrapment in hospital beds is extremely rare, would seem a poor use of relatively limited resources. However, intermittent surveys, as in the current study, may be helpful to identify and rectify important problems with bed systems. ( Routinely measuring gaps may be more useful in residential care settings, which is where most entrapment episodes have occurred and where the long-term relationship between a resident and their bed system may indeed make measurement a more practical option.)

Ensuring that bedrails are only used when appropriate will at least limit the number of patients for whom one need have particular concern regarding entrapment. If bedrails are to be used, the appropriateness of the bed, rail and mattress combination for that particular patient should be considered.

Key points

- Modern dimensional guidelines for beds and bedrails should greatly reduce the risk of injury and death from entrapment.
- In this study of 60 beds in an acute hospital, only five (8.3%) beds satisfied all of the dimensional standards.
- Potential entrapment gaps were more common with older beds and with hydraulic adjusted than with EP beds.
- Patients for whom bedrails are to be used should be carefully selected.
- There is a need for monitoring and maintenance of bed systems.

Supplementary data

Supplementary data mentioned in the text are available to subscribers in *Age and Aging* online.

References

Public and patient research priorities for orthostatic hypotension

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Abstract

With a rapidly expanding older population and increased survival of older people with chronic disease, we can expect to see increasing numbers of people with orthostatic hypotension (OH). Unfortunately the evidence base for people with OH, with particular relevance to older people, has not kept up and has resulted in a real lack of progress and little good evidence. There are several areas of research that could potentially benefit patients but establishing which ones are priority areas requires public and patient involvement (PPI). This process includes people/patients in the research team to maximise the relevance, success and translation of the research. This brief report describes the early involvement of older people in prioritising the research question, methods to improve adherence during a trial and the preferred methods to disseminate research output. The individuals’ priority was to research non-pharmacological treatment strategies and to improve the education of patients about their condition. Education was felt to be the best strategy to promote adherence during a trial, with change in symptoms and quality of life felt to be the most important outcome measures as opposed to blood pressure. This report offers guidance for academics that are undertaking OH-related research and how they can improve its relevance and increase its translation into clinical practice.

Keywords: orthostatic hypotension, patient adherence, patient education, older people