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Assessing the incidence of bed falls and harms following the introduction of a 'floor bed' in a high-risk, long-term care facility: a prospective cross-over evaluation.

Executive Summary

Falls, in particular bed falls, represent a major safety issue in rehabilitation and long-term care settings. Evaluating a new intervention systematically, can illustrate the potential benefit and guide implementation.

Methods

A prospective cross-over evaluation to compare fall outcomes in high risk individuals when using a low bed (Phase One) and a floor bed (Phase Two). Participants were drawn from dependent residents in three skilled nursing facilities, which form part of the Masonic Villages of Pennsylvania Organization. Metrics included; risk profile; recent fall history; the number and severity of falls; use of safety features (low height and safety mats). Fall data for Phases One and Two were compared using the Student's t-test. Informal feedback was sought from staff as to the clinical utility and ease of use of the beds.

Results

Twenty participants completed both Phase One (12 weeks) and Phase Two (between 9 and 12 weeks).

Phase One: Fifteen of the 20 residents reported falls. One individual fell just once, while 14 fell repeatedly (2-6 times), giving a total of 58 (mean 2.9) separate falls. Of these, almost half (n=26, 45%) were from the bed. This included injurious falls with one resident hospitalized with bruising and a second resident admitted for investigations into leg pain. Three additional residents incurred injuries after bed falls on four occasions: bruising (n=1), abrasions (n=3). In all bed-related injuries, except one, the bed was in the higher position without a safety mat.

Phase Two: Thirteen residents 'fell' at least once (n=7), while 6 fell multiple times. A total of 26 falls were reported of which six (23%) were classified as 'falls from the bed'. In 5 of these 6 incidents the bed was lowered to the floor with a safety mat. Three residents made a lateral transfer (roll/crawl) onto the padded mat and one resident exited the bed on two occasions using the non-mat side. In all cases, no injuries were reported.

In comparison, the mean fall rate (all falls and bed falls) was significantly lower in Phase Two compared to Phase One ($p<0.05$). Staff evaluation was positive, with the Empresa Floor Bed considered to lessen the risk of fall injury and offering a preferred mode of action i.e. vertical lift compared to the standard bed with 'travelling' scissor lift.

Discussion

Phase Two bed falls reduced by more than three quarters to just 6 (77%) incidents and no injuries. The clinical utility of the Empresa Floor Bed within this resident population was established. The floor bed and safety mat can translate unintentional bed exit into a lower-risk lateral transfer or roll, rather than an injurious fall from height. This has implications for statutory reporting, quality metrics and client satisfaction. As with any intervention, clinical assessment is needed to assess a resident's suitability for a floor bed.

Conclusion

The Empresa Floor Bed, when used within a comprehensive fall prevention protocol, may help to reduce falls and injuries in a high-risk population.

Background

Falls are common in the older population (fig. 1).ⁱ and so represent a major safety issue in rehabilitation and long-term care settings. It is estimated that 50% of the 1.6 million residents in nursing facilities will fall each year and one third will fall repeatedlyⁱⁱ: a single fall doubling the chance of a recurrence.ⁱⁱⁱ Furthermore, 10% of fallers will suffer serious injury, including 65,000 hip fractures each year.^{iv}

It is clear that falls represent a significant risk of physical injury and, while the economic impact is well documented, and in excess of US\$50 billion per annum^v, there are also psychological and emotional repercussions for the individual, their family and caregivers (Table 1). Individuals who fall, or have a fear of falling, may lose confidence and independence, leading to mental and physical decline, which, in turn, may further increase their risk.^{vi vii}

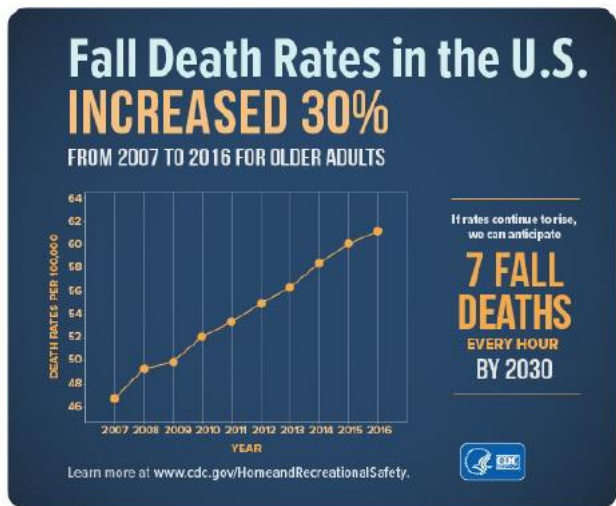


Figure 1

The solution is undoubtedly complex, and has led to the development of multi-disciplinary fall-prevention programmes^{viii} including; risk assessment tools; education; technological interventions such as bed-exit alarms, slip mats, hip protectors, anti-slip socks, arm bands and video surveillance^{ix}; adapted environments with enhanced room and floor lighting, grab rails; vitamins, supplements and, arguably less effective overall, mixed messaging: *'try to be as independent as possible, but don't do anything in your room without calling for assistance'*.^x

Bed falls

Bed falls are a particular problem and, not surprisingly, more common at night,^{xi} with 'sundowning' (night-time confusion), minimal lighting and less supervision playing a significant part in raising the risk. There is also an increased risk of injury when falling from bed to floor. In a laboratory study, Bowers et al^{xii}, determined the risk of serious head injury from a feet-first fall, with the bed at nursing height (97.5 cm), to be in the region of 25%; this risk increased to 40% if side rails were added. The authors conclude that beds should be placed at their lowest position when the patient is unsupervised, side rails should be discontinued and a floor mat provided beside the bed. When this approach was evaluated in acute elderly care over a four-year period, 28.3% fewer falls occurred from the lower height of the bed with significantly fewer falls associated with harm ($p=0.006$).^{xiii}

The question: would a floor-level bed offer similar benefits within a long-term care environment?

Table 1: Impact of falls

Residents	Facility
Reduced quality of life	Increased paperwork for staff.
Increased fear of falling and restriction of activities.	Increased levels of care required for fallers.
Decreased ability to function.	Poor survey results.
Serious injuries.	Lawsuits.
Increased risk of death.	High insurance premiums.

Methodology

Aim

As part of the continual quality improvement programme, senior leadership at Masonic Villages of Pennsylvania elected to systematically evaluate the clinical utility of an ultra-low bed ('floor' bed).

Objectives

Key objectives were to identify residents at high risk of falls and compare the incidence and severity of fall incidents associated with unintentional bed exit when allocated either a low bed or a floor bed. The use of associated safety features (bed height and safety mat) was also investigated.

Population

The Masonic Villages of Pennsylvania Organization has five residential communities across Pennsylvania, USA, which provide a continuum of care from active retirement living through personal care, memory care and nursing services. The target population were dependent residents living within three of the group's skilled nursing facilities.

Residents are risk assessed at least quarterly as part of their care plan and re-evaluation process. This routine audit data, using a range of weighted metrics (fig. 2), was used to identify those at greatest risk of falling.

Weighted metrics

- Level of consciousness
- History of falls (last 3 months)
- Ambulation / Elimination status
- Vision status
- Gait and balance
- Orthostatic changes
- Medications
- Predisposing diseases
- Equipment issues

Figure 2

Inclusion criteria

- History of falls in the last 3-months and/or a high risk of falling in the future
- Suitable for a floor bed (clinical opinion)

Exclusion criteria

- Residents who were considered unlikely to remain in the facility for a 6-month evaluation period.
- Residents who were considered unsuitable for an ultra-low bed, specifically those who were likely to try to rise from the floor, stand and walk and be physically unable to do so.

Attrition

Where residents were lost to follow up (e.g., died, transferred) a replacement was identified.

Equipment

Two types of powered, articulating, beds were used during the evaluation.

Phase One: UltraBed® XT (Joerns Healthcare) - standard care

The bed offers a sleep surface height range of a low of 7" (178 mm) to 30" (762 cm). The bed has a scissor-action (fig.3) to raise-lower the mattress platform, this requires castor travel during height adjustment. The backrest and knee-break can be adjusted for comfort. This and similar beds are the standard of care across all three participant facilities.



Figure 3: UltraCare® XT

Phase Two: Empresa® (Accora Ltd).

An ultra-low 'floor' bed (fig.4) with a minimum height of 3.9" (100 mm) rising to 31.5" (800 mm). In addition to comfort adjustments, the *Empresa* includes BodyMove® autoregression on the mattress platform to reduce shear and friction over areas supporting body weight and vulnerable to pressure injury.

Both beds have user-accessible functionality to promote independence and have safety features, such as movement locks, to prevent unintentional manoeuvres.



Figure 4: Empresa® Floor Bed

Design

A prospective cross-over study.

Fall risk, prevalence and injury data are routinely collected across the Masonic Village of Pennsylvania sites, this audit data formed the basis for selecting a convenience sample of high-risk residents and for reporting outcomes across Phases One and Two. No personal or identifiable data was collected from the residents and outcome data was collated from the established electronic charting system. Given that this was an observational study, with no deviation from usual care, it was not considered to require approval from an Institutional Review Board.

- *Phase One: Standard bed*

Eligible high-risk residents were identified and observed over a 3-month period to determine a baseline level of falls and fall-related injury.

- *Phase Two: Floor bed*

Residents switched to the *Empresa* floor bed and monitored for a further 3 months. This cross-over component did not have a 'wash out' period as both beds offered a very similar sleep environment. 20 *Empresa* floor beds and floor mats were provided; in-service training was provided by the company prior to allocation.

Analysis

At the end of the evaluation period, data were extracted, anonymised and analysed using Numbers® (Apple Inc.). As a small pilot observational study, an *a priori* sample size was not calculated and so reporting is limited to descriptive outcome data and a comparison of the mean fall rate (Student's t-test^{xiv}). A period prevalence and incidence rate per 1,000 bed days was calculated for falls occurring during Phase One and Two.

Results

A total of 25 residents were considered eligible to participate in the evaluation. Three were excluded due to transfer (n=1) or death (n=2) during Phase One. A further two residents were late entrants and had only completed two and four weeks in Phase Two at the time of reporting; these were excluded from analysis.

The 20 remaining participants completed Phase One of the evaluation (12 weeks, 1,680 bed days) plus between 9 and 12 weeks (1,610 bed days) in Phase Two.

Results (continued)

- *Fall Risk*

All participants were considered to be at a high risk of falling based upon formal risk assessment (fig. 5), with a mean risk score of 16.6 (range 10 - 22). Confusion and incontinence were the dominant risk factors, with 75% (n=15) having fallen in the past three months.

- *Fall Rate & Injury*

Phase One: Fifteen of the 20 residents fell during the preliminary evaluation. One individual fell just once, while 14 fell repeatedly (range 2-6 incidents), giving a total of 58 separate falls (period prevalence^{xv} of 290%) (fig 6).

Of these, 26 (45%) fell from the bed (15.5 bed falls per 1,000 bed days). This included six injurious falls with one resident hospitalised with bruising and a second resident admitted for investigations into leg pain. A further three residents incurred injuries after falling on four occasions: bruising (n=1) and abrasions (n=3). In all cases of bed-related injury, except one, the bed was in a higher position with no safety mat in place.

Phase Two: Thirteen residents fell during Phase Two. Seven fell on a single occasion and six fell between 2 and 4 times.

The Total number of falls was 26 (period prevalence of 130%) of which almost one quarter (n=6, 23%) were classified as 'falls from the bed' (fig. 6). The incidence rate was 3.7 bed falls per 1,000 bed days.

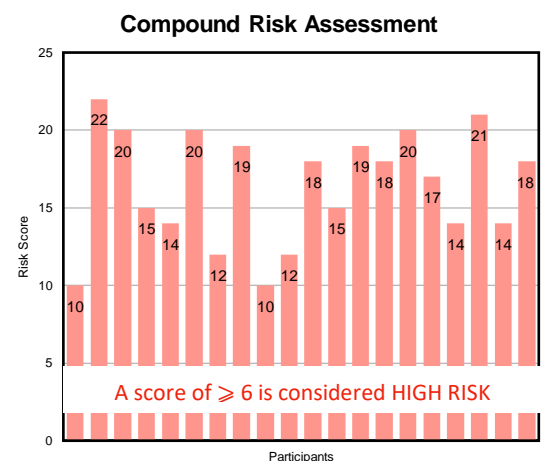


Figure 5

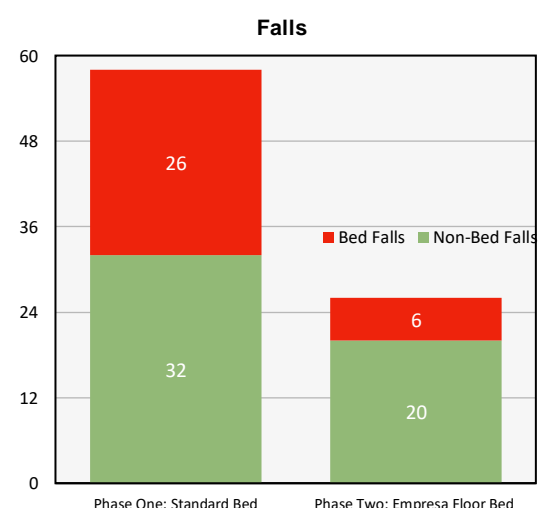


Figure 6

There were two injurious non-bed falls, with one resident referred to hospital for a CT Scan to investigate head pain after a fall in the room and one resident suffered bruising.

In the bed 'fall' group, residents may be considered to have made a lateral transfer (crawl or roll) in 3 of the 6 incidents. One resident exited the bed on two occasions using the non-mat side. In all cases, no injuries were reported.

Comparing mean results, the number of falls and bed falls in Phase Two were significantly lower than Phase One ($p < 0.05$).

- *Fall prevention protocol - bed height & safety mat*

During Phase One more than half of the 26 bed fall incidents were associated with the bed in a higher position ($n=14$; 54%) and in 19 incidents (73%) there was no safety mat in situ (fig 7). During Phase Two the bed was in the floor position with an adjacent safety mat in 5 out of 6 fall events.

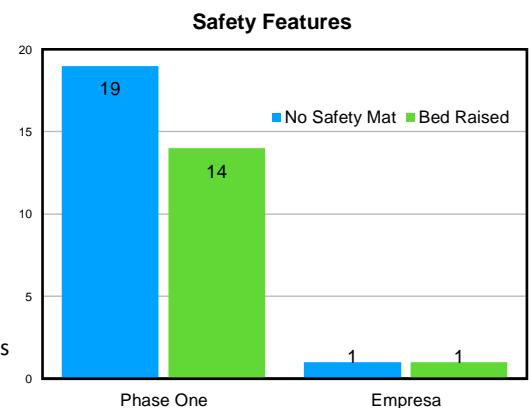


Figure 7

Discussion

Despite a culture of continual quality improvement and preventative care, Masonic Villages of Pennsylvania's skilled nursing facilities collectively report, on average, 140 falls each month; this reflects the complex needs of the residents. It is clear that not all falls can be prevented and to try to do so may severely restrict an individual's ability to make independent movement and choices. In ideal circumstances, the use of physical (e.g. side rails) and chemical (e.g. sedation) restraints are only recommended if holistic risk assessment considers it to be essential and where there is no alternative.^{xvi} Even then, a minimum level of intervention is desirable. However, the undeniably high economic and personal cost associated with fall injury means there is a continual drive to reduce both the number and severity of falls. This need, which reaches across all healthcare and social care settings, has led to the development of a growing range of technologies dedicated to alerting caregivers to a resident's position and movement. However, while many of these devices, such as bed exit alarms, proximity sensors and video surveillance, warn that an exit has occurred it comes too late to prevent injury. An alternative is to employ 'sitters' who can react and intervene to prevent a fall, but this is clearly cost-prohibitive for many providers and challenges privacy and dignity for the resident. Unfortunately, despite substantial investment in prevention, the supporting evidence is typically weak and inconclusive.^{xvii} Even the fundamental principle of risk assessment, used to identify those most likely to fall, comes under scrutiny, with some studies suggesting that risk assessment tools add to clinical workload but have no impact on outcome^{xviii} and may be no better than simple clinical reasoning.^{xix}

In the absence of hard evidence, an 'Action Research' approach is widely used in healthcare to investigate professional practice and service user's experience while introducing innovations; planning, actioning and evaluating new ideas; seeking to improve patient care and working collaboratively.^{xx} By evaluating concepts systematically, changing just one element at a time, outcomes can be mapped and efficacy estimated. It can also allow for tweaks to provide continual improvement over time and identify learning opportunities that emerge during implementation.

In this evaluation, the potential benefit of using a 'floor' bed to reduce both the number and severity of injuries attributed to bed falls was demonstrated. The total number of falls reported during Phase Two (n=26) was almost half (45%) that reported in Phase One, while the number of bed falls fell by more than three quarters to just 6 (77%). Similarly, the period prevalence rate (all falls per phase/participants x 100) fell in Phase Two to 130% from 290% and the incidence of bed falls per 1,000 bed days from 15.5 to 3.7 falls. *Note prevalence will be higher than 100% when multiple falls per resident are counted.*

The number of injuries when using the *Empresa* Floor Bed were zero compared to two hospitalisations plus residents with cuts and bruising after falling from the standard bed in Phase One; these incidents will have an economic cost, which has not been calculated at this time.

These results, while credible, have to be viewed in context of the study design. There is a possibility that the results were confounded by unidentified and uncontrolled variables, such as changes in resident or clinician behaviour over time. In particular, there may have been a greater diligence in utilising the ultra-low position (and safety mats) due to the novelty effect of the floor bed and possible Hawthorne effect. The latter reflecting a tendency in some individuals to alter their behaviour in response to their awareness of being observed.^{xxi} There is also a possibility that unintentional bed exit was underreported during Phase Two where staff had naturally made the distinction between a fall and a roll to the mat. In addition to reducing falls and injuries this evaluation also identified learning opportunities that might otherwise have been missed. As with all interventions, clinical assessment is needed to determine an individual's suitability. Although a floor bed has been shown to be an important asset in the risk reduction portfolio, like any intervention, it may not be suitable for everyone.

Residents who are considered likely to rise from the floor bed and attempt to walk without physical strength and stability may not be ideal candidates; clinical assessment is required in order to balance the risk-benefit. However, for dependent residents who will make a deliberate move to exit the bed, or simply migrate to a position where a fall is inevitable, an ultra-low bed may be an ideal solution.

In the framework of quality metrics, there may be an opportunity to declassify 'falls' where they can be defined as a lateral transfer (roll or crawl) onto a safety surface, rather than by descent to the floor. This may have a positive impact on statutory

reporting, reduce staff administration that takes time away from resident care and improve resident and family confidence. From the resident's perspective, a low bed and safety mat does not only lower the risk of bumps, cuts and more serious musculoskeletal injury, as shown in this evaluation, but may also reduce anxiety by lessening the fear of falling and so have an positive impact on quality of life: this would need to be investigated from the resident's perspective.

The cause of falls is, without doubt, multifactorial and therefore it is logical to conclude that the solution will also be multi-dimensional of which the bed, albeit important, is just one part. It will be interesting to review the fall data in one year to see if these positive trends are sustained.

Conclusion

The Masonic Villages Organization, as a high-quality care provider, is continuously seeking ways to mitigate the risk of falls, while providing an environment encourages independence, positive emotional wellbeing and functional mobility. The introduction of the *Empresa* Floor Bed was associated with a significant reduction in the number of falls from the bed and, importantly, the severity of injury. As a result of this evaluation, and positive staff feedback, the *Empresa* Floor Bed was adopted as the preferred bed for residents at high risk of bed falls.

Headlines

- **All participants were at high risk of falling; 75% had fallen recently**
- ***Empresa* was associated with a significant reduction in the number of falls overall**
- ***Empresa* was associated with a significant reduction in falls from the bed**
- **There were no injuries in the *Empresa* Floor bed group**
- **Staff rated the bed highly for resident care and ease of use**

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