Clinicians are confused by conflicting guidelines about the use of head-of-bed elevation to prevent aspiration and pressure ulcers in critically ill patients. Research-based information in support of guidelines for head-of-bed elevation to prevent either condition is limited. However, positioning of the head of the bed has been studied more extensively for the prevention of aspiration than for the prevention of pressure ulcers, especially in critically ill patients. More research on pressure ulcers has been conducted in healthy persons or residents of nursing homes than in critically ill patients. Thus, the optimal elevation for the head of the bed to balance the risks for aspiration and pressure ulcers in critically ill patients who are receiving mechanical ventilation and tube feedings is unknown. Currently available information provides some indications of how to position patients; however, randomized controlled trials where both outcomes are evaluated simultaneously at various head-of-bed positions are needed. (Critical Care Nurse. 2013;33[3]:53-67)

Guidelines for head-of-bed (HOB) elevation to prevent aspiration and pressure ulcers are in conflict. As indicated in Table 1, several expert sources recommend a 45° HOB elevation (unless medically contraindicated) to prevent aspiration while others recommend an HOB elevation between 30° and 45° (again, unless medically contraindicated). In contrast, pressure ulcer guidelines call for raising the HOB no more than 30° to avoid excessive pressure on the sacral region. Although the recommendations overlap, a 45° HOB elevation is generally favored to prevent aspiration in critically ill patients who are receiving mechanical ventilation and tube feedings. Because aspiration is a threat to oxygenation, some authors caution that aspiration is a greater and more immediate concern than are pressure ulcers in critically ill patients. Clearly, the conflicting guidelines regarding aspiration and pressure ulcers are problematic for critical care clinicians who strive to prevent the suffering and increased costs associated with both conditions.
Aspiration of gastric contents is a primary route of bacterial entry into the lungs and is an important factor in the development of ventilator-associated pneumonia (VAP). VAP is the most common nosocomial infection in critically ill patients and is an important cause of prolonged hospitalization and mortality. For example, a review of 89 observational and randomized trials regarding VAP showed that VAP developed in between 10% and 20% of patients receiving more than 48 hours of mechanical ventilation, and critically ill patients in whom VAP develops appear to be twice as likely to die as similar patients without VAP. Further, patients in whom VAP develops may incur at least $10 019 in additional hospital costs. Because VAP prevention is partially predicated on the prevention of aspiration, it is understandable why guidelines for both aspiration and VAP include an elevated HOB position. The Centers for Medicare and Medicaid Services (CMS) is considering adding VAP to the list of “never events”; if this happens, punitive reimbursement policies could follow.

Pressure ulcers are also associated with adverse outcomes and increased hospital costs. Fatalities from septicemia associated with untreated pressure ulcers are occasionally reported. However, a pressure ulcer is often a marker for coexisting illness and other risk factors for mortality. Among all hospitalized patients, prevalence rates of acquired pressure ulcers are highest in patients in

**Table 1** Summary of guidelines for head-of-bed elevation

<table>
<thead>
<tr>
<th>Guidelines to prevent aspiration/pneumonia</th>
<th>Guidelines to prevent pressure ulcers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevate head of bed to 45º, unless contraindicated</td>
<td>Raise head of bed no more than 30º (and preferably less)</td>
</tr>
<tr>
<td>• Canadian clinical practice guidelines for nutrition support in mechanically ventilated, critically ill adult patients. <em>Journal of Parenteral and Enteral Nutrition</em>, 2003</td>
<td></td>
</tr>
<tr>
<td>Elevate head of bed from 30º to 45º, unless contraindicated</td>
<td></td>
</tr>
<tr>
<td>• American Gastroenterological Association technical review on tube feeding for enteral nutrition. <em>Gastroenterology</em>, 1995</td>
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</table>

**Aspiration of gastric contents is a primary route of bacterial entry into the lungs and is an important factor in the development of ventilator-associated pneumonia (VAP). VAP is the most common nosocomial infection in critically ill patients and is an important cause of prolonged hospitalization and mortality. For example, a review of 89 observational and randomized trials regarding VAP showed that VAP developed in between 10% and 20% of patients receiving more than 48 hours of mechanical ventilation, and critically ill patients in whom VAP develops appear to be twice as likely to die as similar patients without VAP. Further, patients in whom VAP develops may incur at least $10 019 in additional hospital costs. Because VAP prevention is partially predicated on the prevention of aspiration, it is understandable why guidelines for both aspiration and VAP include an elevated HOB position. The Centers for Medicare and Medicaid Services (CMS) is considering adding VAP to the list of “never events”; if this happens, punitive reimbursement policies could follow.**

Pressure ulcers are also associated with adverse outcomes and increased hospital costs. Fatalities from septicemia associated with untreated pressure ulcers are occasionally reported. However, a pressure ulcer is often a marker for coexisting illness and other risk factors for mortality. Among all hospitalized patients, prevalence rates of acquired pressure ulcers are highest in patients in
intensive care units (ICUs). In 2009, approximately 1 in 10 patients in adult ICUs in the United States had a pressure ulcer develop. Facility-acquired pressure ulcer rates were 8.8% in general cardiac care units, 9.4% in medical ICUs, 10.3% in general ICUs, and 10.4% in surgical ICUs; about 65% to 75% of the ulcers were more severe than stage I. The cost of treating pressure ulcers, especially stage III and IV ulcers, is substantial. The mean cost of care for an acute care patient with a stage III or IV pressure ulcer is reported by the CMS to be $43,180. In 2006, the CMS added stage III and IV pressure ulcers to the list of “never events.” Beginning in 2008, the CMS refused to pay for the care of a hospital-acquired pressure ulcer in stages III and IV unless it was determined to have been unavoidable. One component of the pressure ulcer guidelines issued by the National Pressure Ulcer Advisory Panel is a low HOB elevation (preferably <30°).

Pathophysiology of Aspiration

Aspiration is defined as the inhalation of oropharyngeal secretions or gastric contents into the airways beyond the vocal cords. Consequences of pulmonary aspiration depend on the volume and chemical composition of the aspirated material as well as on the presence or absence of infectious agents and the patient’s underlying condition. The associated lung injury is characterized by pulmonary inflammation, capillary leakage, and oxidative damage. Variable outcomes are possible, ranging from mild pneumonitis to acute respiratory distress and death. Risk factors for pulmonary aspiration include conditions that depress the level of consciousness, a decreased gag reflex, tracheal intubation, presence of a gastric tube, and a full stomach. Critically ill patients undergoing mechanical ventilation who are receiving tube feedings are at especially high risk for the aspiration of regurgitated gastric contents. Reports of witnessed macroaspirations in critically ill patients range from less than 1% to 11.7%; far more common are clinically silent, small-volume aspirations. For example, McClave et al reported a 22.1% mean frequency of clinically silent microaspirations per patient (range, 0%-94%) in a group of 40 adult critically ill, tube-fed patients receiving mechanical ventilation.

Pathophysiology of Pressure Ulcers

The National Pressure Ulcer Advisory Panel has defined a pressure ulcer as localized injury of the skin and/or underlying tissue, usually over a bony prominence, as a result of pressure or pressure in combination with shearing force. Oxygen delivery to the skin is compromised when it is exposed to a pressure greater than the capillary closing pressure; if sustained, tissue necrosis results. An elevated HOB position results in an increased interface pressure between the sacrum and the bed’s surface; in addition, potential for injury of skin in the sacral region is increased when the HOB is elevated sufficiently to cause the patient to slide downward. The bony prominence most affected by pressure ulcers is the sacrum. For patients turned on their sides at regular intervals, damage of skin over the trochanters may occur (although it is unlikely when patients are turned to an angle ≤30°). Healing rates of pressure ulcers vary considerably and are dependent on comorbid conditions, clinical interventions, and severity of the ulcer.

Purpose

In this article, we review guidelines for HOB elevation to prevent aspiration and pressure ulcers, as well as the limited research-based information in support of the guidelines. Table 2 lists studies relevant to HOB elevation and aspiration (as well as aspiration-related conditions), and Table 3 lists studies relevant to HOB elevation and pressure ulcers.

Evidence to Support HOB Elevation to Prevent Aspiration

Much of the supportive evidence for a semirecumbent position to prevent aspiration was gathered several decades ago in studies with relatively small sample sizes. In randomized trials of critically ill patients, investigators compared the effect of a supine (0° HOB elevated position) versus a 45° HOB elevated position on aspiration by adding a radioactive substance to gastric contents and subsequently scanning bronchial secretions for radioactivity. This method for testing for aspiration is highly reliable and demonstrates the extent to which HOB elevation is associated with aspiration. In another frequently cited and credible study, researchers assessed for microbiologically confirmed pneumonia when patients were flat in bed versus at a 45° HOB elevation. Because of ethical concerns, it would be not be possible today to assign critically ill patients to a supine position to study aspiration.
<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Design</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torres et al.(^{30}) <em>Annals of Internal Medicine</em>, 1992</td>
<td>19 patients with nasogastric tubes undergoing mechanical ventilation Mean age, 60 y</td>
<td>Randomized 2-period cross-over study</td>
<td>Aspiration of gastric contents</td>
</tr>
<tr>
<td>Orozco-Levi et al.(^{31}) <em>American Journal of Respiratory and Critical Care Medicine</em>, 1995</td>
<td>15 patients with nasogastric tubes undergoing mechanical ventilation Mean age, 56 y</td>
<td>Randomized 2-period cross-over study</td>
<td>Aspiration of gastric contents&lt;br&gt;Gastroesophageal reflux (GER)</td>
</tr>
<tr>
<td>Ibanez et al.(^{32}) <em>Journal of Parenteral and Enteral Nutrition</em>, 1992</td>
<td>70 orotracheally intubated patients&lt;br&gt;50 received enteral nutrition while gastric contents labeled with technetium Tc 99m&lt;br&gt;20 had nasogastric tubes removed after instillation of technetium Tc 99m</td>
<td>Randomized 2-group study</td>
<td>GER</td>
</tr>
<tr>
<td>Drakulovic et al.(^{33}) <em>Lancet</em>, 1999</td>
<td>86 critically ill patients receiving mechanical ventilation&lt;br&gt;47 supine, 39 semirecumbent&lt;br&gt;Enteral feedings used in 56%-60% of patients&lt;br&gt;Mean age, 65 y</td>
<td>Randomized 2-group study</td>
<td>Microbiologically confirmed nosocomial pneumonia</td>
</tr>
<tr>
<td>Metheny et al.(^{34}) <em>Critical Care Medicine</em>, 2006</td>
<td>360 critically ill tube-fed patients undergoing mechanical ventilation Mean age, 52 y</td>
<td>Prospective descriptive study</td>
<td>Aspiration of gastric contents&lt;br&gt;Pneumonia</td>
</tr>
<tr>
<td>Method</td>
<td>Results</td>
<td>Conclusions</td>
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<tr>
<td>Randomly assigned to supine (0°) or 45° HOB elevation during period 1 and other position during period 2</td>
<td>Mean radioactive counts higher in bronchial samples obtained with patient supine vs semirecumbent (4154 cpm vs 954 cpm, respectively, ( P &lt; .04 )). Aspiration increased over time while patient supine (2592 cpm at 300 min vs 298 cpm at 30 min, ( P = .01 )). Same microorganisms isolated from stomach, pharynx, and bronchial samples in 68% of studies when patients supine, as compared with 32% when patients semirecumbent.</td>
<td>45° HOB elevation associated with less aspiration than supine position. Risk for aspiration increases over time when patient is supine.</td>
<td></td>
</tr>
<tr>
<td>Random assignment to supine (0°) or semirecumbent (45° HOB elevation) position</td>
<td>Radioactivity of pharyngeal secretions higher with patients supine from hours 1-4. ( P &lt; .05 ); however, no difference noted at 5 hours. Radioactivity in bronchial secretions higher at 5 hours in supine patients compared with baseline (( P &lt; .05 )) and semirecumbency (( P &lt; .01 )). Results of microbiological cultures showed a sequence of colonization from the stomach to the pharynx in 6 patients (4 of them supine), and from the pharynx to the bronchi in 2 others (one supine and one semirecumbent).</td>
<td>GER is a frequent feature in patients with nasogastric tubes. GER occurs irrespective of body position in patients undergoing mechanical ventilation. A semirecumbent position lessens aspiration, but does not completely prevent it.</td>
<td></td>
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<tr>
<td>Patients assigned to supine (0° HOB elevation) or semirecumbent group (45° HOB elevation)</td>
<td>In the 50 patients with nasogastric tubes, incidence of GER higher in supine patients (81%, 21/26) than in semirecumbent patients (67%, 16/24), ( P = .26 ). In the 20 patients without nasogastric tubes, GER was also more frequent in supine position (50%, 6/12) than in the semirecumbent position (12%, 1/8), ( P = .16 ). Overall, GER more frequent in patients with nasogastric tubes than in those without (74% vs 35%, ( P &lt; .001 )).</td>
<td>Incidence of GER is high in patients with orotracheal intubation and nasogastric tubes. Semirecumbency does not prevent GER, although GER tends to occur less often in semirecumbent patients.</td>
<td></td>
</tr>
<tr>
<td>Random assignment to supine (0°) or semirecumbent (45° HOB elevation) position</td>
<td>Microbiologically confirmed pneumonia occurred less often in the semirecumbent group than in the supine group (2/39 [5%] vs 11/47 [23%], respectively, ( P = .02 )). Highest risk for nosocomial pneumonia occurred in patients receiving tube feedings in the supine position. No adverse effects of the semirecumbent position were found; investigators emphasized use of protective measures to prevent pressure ulcers.</td>
<td>45° HOB elevation reduces frequency of pneumonia, especially in tube-fed patients.</td>
<td></td>
</tr>
<tr>
<td>Correctness of assigned body position checked daily</td>
<td>At least 1 aspiration event identified in 89% of participants. Patients with mean HOB elevation &lt;30° (n = 226) had higher percentage of aspiration than did the 134 patients with mean HOB ≥30° (35% vs 25%, ( P &lt; .001 )). Mean HOB elevation &lt;30° found significantly more often in patients with pneumonia than in those without (( P = .02 )). Higher percentage of pepsin-positive secretions found in patients with pneumonia than in those without (42% vs 21%, ( P &lt; .001 )). Other significant risk factors were decreased level of consciousness, vomiting, and GER.</td>
<td>Microaspiration common in critically ill, tube-fed patients receiving mechanical ventilation. Frequent aspiration significantly increases risk for pneumonia. HOB elevation &lt;30° is a significant risk factor for aspiration and pneumonia.</td>
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Continued
Nonetheless, results from these studies are helpful in current practice because they clearly show that a 45° HOB elevation is superior to a “flat in bed” position in preventing aspiration. Recommendations in guidelines to prevent aspiration are largely based on these trials.

No randomized controlled trials were identified that compare aspiration while patients are at a 30° HOB elevation versus a 0° elevation, or a 30° elevation versus a 45° elevation. Thus, although a 30° HOB elevation is commonly recommended in practice settings, there is no direct evidence that it is as effective as a 45° elevation in reducing aspiration. However, as indicated in Table 2, several descriptive studies suggest that an HOB elevation of 30° or greater is associated with fewer adverse outcomes (aspiration and pneumonia) than is a lower HOB elevation. It must be noted that evidence garnered from descriptive studies is not as strong as evidence obtained from a controlled trial where patients are randomly assigned to differing HOB elevations. Further, the descriptive studies described in Table 2 have typically included HOB elevation

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Design</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metheny et al, 2010</td>
<td>474 critically ill, tube-fed patients receiving mechanical ventilation</td>
<td>Two-group quasi-experimental study</td>
<td>Aspiration of gastric contents</td>
</tr>
<tr>
<td>van Nieuwenhoven et al, 2006</td>
<td>221 critically ill patients receiving mechanical ventilation</td>
<td>Prospective multicenter randomized 2-group trial</td>
<td>Ventilator-associated pneumonia (VAP) Pressure ulcers</td>
</tr>
<tr>
<td>Keeley, 2007</td>
<td>30 critically ill patients receiving mechanical ventilation completed the study</td>
<td>Randomized controlled trial</td>
<td>VAP</td>
</tr>
</tbody>
</table>

Table 2 Continued
in context with multiple other variables, thus making it
difficult to determine the singular effect of HOB ele-
vation on outcomes.

Following a systematic review of 3 of the trials,33,36,37
described in Table 2, a European panel concluded that it
is uncertain whether a 45° HOB elevation is effective or
harmful in regard to pneumonia and pressure ulcers.45
One aspect considered in the panel’s deliberations was the
paucity of data to support the use of a 45° HOB elevation
for a sustained period.45 The authors questioned whether
a 45° HOB elevation for 24 hours a day might increase
the risk for thromboembolism, hemodynamic instability,
and pressure ulcers. Although these are reasonable con-
cerns, the 3 studies reviewed by the panel did not assess
for thromboembolism and hemodynamic instability and
only 1 referred to pressure ulcers as an outcome (noting
no difference at the end of 1 week between groups with
mean HOB elevations of 16° and 23°). Based on their
deliberations, the panel recommended an HOB elevation
of 20° to 45° for patients receiving mechanical ventilation.
Table 3  Studies related to head-of-bed (HOB) elevation and pressure ulcers

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Design</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| Peterson et al,38 Critical Care Medicine, 2008 | 15 healthy adults  
Age range, 23-54 y | Descriptive observational study | Peak sacral interface pressures |
Age range, 18-25 y | Comparative, quasi-experimental study with repeated measures | Body displacement  
Sacral interface pressure |
| Peterson et al,40 Journal of Advanced Nursing, 2010 | 15 healthy adults  
Age range, 23-54 y | Descriptive observational study | Interface pressures in the sacral, trochanteric, and buttock regions  
Effectiveness of turning in unloading pressure on at-risk tissues |
| Gray-Siracusa and Schrier,41 Journal of Nursing Care Quality, 2011 | Total 1199 critically ill patients (554 in “before” group and 645 in “after” group) | Two-group (before-after) comparison study | Rate of hospital-acquired pressure ulcers |
| Nanjo et al,42 Journal of Wound Ostomy Continence Nursing, 2011 | 30 adult critically ill patients  
Mean age, 68 y | Qualitative exploratory study | Relationships among etiologic factors, characteristics of pressure ulcers, and interventional nursing care |
### Method

| Interface pressure profiles of the sacral area obtained for the 0°, 10°, 20°, 30°, 45°, 60°, and 75° HOB elevated positions Measurements obtained using a thin pressure-sensing pad placed under the sacral region |

| Results |

| After repeated-measures analysis of variance, the HOB positions of 45°, 60°, and 75° all caused statistically significant increases in affected areas compared with the supine measurement (P<.001) With the same statistical test, the areas with >32 mm Hg interface pressure at the HOB positions of 45°, 60°, and 75° were all significantly different from all other HOB positions The 30° HOB elevation was different from the 10° and the 20° HOB elevation positions (P<.02) |

| Conclusions |

| Raising the HOB to ≥30° significantly increases the skin–support surface interface pressure, and a ≥45° HOB elevation significantly increases the area of skin exposed to a pressure >32 mm Hg |

| Subjects placed supine on standard hospital bed; HOB then raised to 30° according to 2 protocols: (1) supine for 10 minutes without leg elevation alternating with 10 minutes of side-lying, or (2) supine for 10 minutes with leg elevation at 10° alternating with side-lying every 10 minutes Difference over time between the top edge of the mattress and subjects’ acromion measured every 10 minutes Sacral interface pressure measured every 10 minutes using a pneumatic pressure sensor Body displacement and mean sacral interface pressures in both protocols compared by using repeated-measures analysis of variance |

| Mean body displacement in 30° elevated HOB position without leg elevation at the end of 2 hours was 29 cm, whereas with leg elevation it was 18 cm (P<.001) No significant differences in sacral interface pressures with or without leg elevation at baseline (7.3 mm Hg and 11.9 mm Hg, respectively) |

| Leg elevation at 10° in the 30° HOB elevated position is effective for reducing body displacement; it is not effective for reducing sacral interface pressures |

| Interface pressure profiles obtained from sacral, trochanteric, and buttock regions while patients were supine, followed by lateral turning with pillow or wedge support and subsequent HOB elevation to 30° Turning performed by an experienced intensive care unit nurse |

| Peak perisacral area interface pressures not significantly affected by lateral turning, but demonstrated a significant increase upon elevating the HOB to 30° (P<.05) 93% of participants had skin areas with interface pressures >32 mm Hg throughout all positions (mean [SD], 60 [54] cm²), termed “triple jeopardy area” The triple jeopardy area increased significantly with wedges as compared with pillows (mean [SD], 153 [99] cm² vs 48 [47] cm², P<.05) |

| Standard turning by experienced intensive care unit nurses does not reliably unload all areas of high skin-bed interface pressures Support materials for maintaining lateral turned positions can influence tissue unloading and triple jeopardy areas, and need to be further evaluated to improve care Further study is needed to establish how to achieve optimal positioning to eliminate areas that remain at risk |

| Analysis of quarterly hospital-acquired pressure ulcer rates before and after shows no significant difference (P=.11) Before pressure ulcer bundle, quarterly survey results for hospital-acquired pressure ulcer rates were as follows: quarter 1 = 5.7%; quarter 2 = 0%; quarter 3 = 5.2%, and quarter 4 = 0% After implementation of pressure ulcer bundle, quarterly hospital-acquired pressure ulcer rates remained <1% through the year |

| Pressure ulcer bundle reduced the incidence of pressure ulcers but difference was not statistically significant |

| Determined rate of hospital-acquired pressure ulcers during year before implementation of bundle intervention Implemented 7-item pressure ulcer bundle; portions pertaining to HOB elevation included (1) elevating HOB to 45° for all patients receiving mechanical ventilation, and (2) maintaining HOB at 30° or less for patients who are not receiving mechanical ventilation, who are at lower risk Determined rate of hospital-acquired pressure ulcers during year following implementation of pressure ulcer bundle |

| Analysis of quarterly hospital-acquired pressure ulcer sites before and after shows no significant difference (P=.11) Before pressure ulcer bundle, quarterly survey results for hospital-acquired pressure ulcer rates were as follows: quarter 1 = 5.7%; quarter 2 = 0%; quarter 3 = 5.2%, and quarter 4 = 0% After implementation of pressure ulcer bundle, quarterly hospital-acquired pressure ulcer rates remained <1% through the year |

| Pressure ulcer bundle reduced the incidence of pressure ulcers but difference was not statistically significant |

| Details of 30 individual pressure ulcers described by sketching pressure ulcer photographs Characteristics of pressure ulcers divided into 4 categories: (1) location, (2) shape, (3) type of skin lesion, and (4) periwound skin After identification of pressure ulcer characteristics, in-depth review of medical records to evaluate the pressure ulcers’ development process Semistructured interviews with 5 nurses who cared for patients in study; topics included position and positioning methods, criteria for deciding how to position a particular patient, and typical interventions to prevent pressure ulcers |

| Pressure ulcer sites: Upper sacrum (n=5) Lower sacrum (n=14) Coccyx (n=8) Ischium (n=1) Heel/ankle (n=2) Possible etiological factors for specific pressure ulcer divided into 4 categories: (1) occurrence of pressure ulcer risk episodes, (2) failure of peripheral circulation, (3) periods of critical immobility, and (4) position change techniques inducing skin deformation |

| Frequently repeated position changes, such as lateral tilt and repeated HOB elevation, may cause deformation of the sacral skin and possibly play a role in development of pressure ulcers |
Evidence to Support a Low HOB Elevation to Prevent Pressure Ulcers

Overall, less research is available about the effect of HOB elevation on pressure ulcer development than on aspiration; further, relatively few studies have been conducted in a critical care setting. Three of the studies described in Table 3 were conducted with healthy persons and show that interface pressure between the skin and bed surface is increased as the HOB angle is increased.

One of the studies also suggests that sliding down in bed is more likely at a 30° HOB angle than when the bed is flat. No randomized controlled trials were identified that compared the effect of various HOB elevations on development of pressure ulcers. However, 1 group of investigators compared pressure ulcer outcomes before and after the implementation of a pressure ulcer bundle (1 component of which was manipulation of the HOB angle) in a critical care setting. A trend toward reduction in pressure ulcer rates was noted, although statistical significance was not achieved. Two other studies described in Table 3 are examples of projects that demonstrate the benefit of pressure-relieving surfaces in preventing pressure ulcers.

Compliance With Guidelines in Critical Care Settings

Aspiration Guidelines

Among contraindications to an elevated HOB position are recent lumbar spine injury, hemodynamic instability, trauma of the pelvic region, and severe sacral pressure ulcers. Even when there are no contraindications to an elevated HOB position, it is not consistently applied. (See the study by van Nieuwenhoven et al in Table 2.) A variety of strategies have been studied in regard to increasing use of an elevated HOB position. For example, Helman et al implemented a standardized order for placing patients in a 45° HOB elevated position, along with an educational program for nurses and physicians; however, compliance with the order was achieved in less than one-third of the observations.

Nurses who participated in that study reported the following concerns:

- Increased probability of patient sliding down in bed
- More difficulty in turning patient from side to side
- Greater pressure exerted on patient’s sacral area
- Greater discomfort and interference with sleep

Even a 30° HOB-elevated position is not consistently used in some critical care settings. In 2003, Grap et al used a lift sheet to reposition patients reduces shear pressure and lowers risk for pressure ulcers.
reported that the mean backrest elevation in a population of 170 critically ill patients was 19.2º. Although an elevated HOB position is especially warranted in tube-fed patients, there was no difference in backrest elevation between patients being fed and not being fed. In a 2005 study of 66 critically ill patients monitored during 275 patient days, investigators found that backrest elevations were less than 30º 72% of the time. More encouraging findings were reported in a later study conducted in a thoracic ICU; mean compliance with an HOB elevated position greater than 30º changed from 65% in 2007 to 99% in 2009; associated with this increased compliance was a significant decrease in the incidence of VAP.

HOB elevation is related to acuity level. For example, Evans found a significant negative correlation \( r^2 = -0.17 \) between scores on the Acute Physiology and Chronic Health Evaluation II and HOB elevation in 113 critically ill patients. Evans also reported that patients receiving mechanical ventilation had a lower mean HOB elevation than did self-ventilating patients (19º vs 32º). In a study of 100 patients in a thoracic cardiovascular ICU, investigators found that patients with a mean arterial blood pressure of 64 mm Hg or less had a lower mean backrest elevation (17º) than did patients with a higher arterial pressure (24º). In a study of 438 patients, investigators reported that mean HOB elevations were lower in intubated patients (23º) than in nonintubated patients (33º, \( P < .001 \)).

Delivery of standard nursing care often calls for temporary lowering of the HOB elevation. For example, because it is difficult to turn patients when the bed’s backrest is elevated, nurses usually lower the bed to 0º (in some instances, they may even put the bed in reverse Trendelenberg position while turning patients and pulling them up in bed). There are reports of nurses forgetting to elevate the backrest after completing the turning procedure (sometimes for a period up to 1 hour). Medical procedures (such as insertions of central catheters) can cause temporary interruptions in the desired HOB elevation. Transitory physiological conditions such as hemodynamic instability or low cerebral perfusion pressure also may mandate lowering of the HOB elevation.

Another possible reason for noncompliance with an elevated HOB position is difficulty in making accurate visual estimates of an HOB angle. For example, Hiner et al asked 175 clinicians to estimate a simulated HOB angle of 30º; the angle was perceived accurately by 50% of 89 nurses and 53% of 39 physicians; a higher percentage (86%) of 21 respiratory therapists identified the angle accurately. These findings are significant because some hospital beds do not have built-in electronic devices to determine the bed’s angle.

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### Method

| Subjects divided into 3 groups according to type of pressure-relieving surface: (1) alternating air \( n = 20 \); (2) static air \( n = 20 \); and (3) water mattress \( n = 17 \) | Pressures recorded from sacrum and heel in the dorsal recumbent position; same measurements made while patient positioned at a 45º HOB elevation | Sacral and heel pressures tested for each surface, at each HOB position, using a repeated-measures design |

### Results

| Mean pressure with alternating air mattress was 30 mm Hg; it was 23.3 mm Hg with the water mattress and 25 mm Hg with the static air mattress \( P < .01 \) | The 45º HOB elevated position (regardless of pressure-relieving surface) produced significantly more sacral pressure at an average of 32.9 mm Hg, as compared with recumbent position average (25.1 mm Hg; \( P < .01 \)) | Heel pressures showed no differences across mattress type and position Pressure ulcers developed in 8 patients (5 on alternating air, 2 on water, and 1 on static air surface); \( \chi^2 \) analysis not significant |

### Conclusions

Findings suggest that alternating air overlays should be avoided. Investigators emphasized importance of periodically repositioning patients who require a prolonged HOB elevation to reduce the incidence of sacral pressure ulcers.

Elevating the HOB decreases risk for aspiration but increases risk for pressure ulcers.

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### Delivery of standard nursing care often calls for temporary lowering of the HOB elevation. For example, because it is difficult to turn patients when the bed’s backrest is elevated, nurses usually lower the bed to 0º (in some instances, they may even put the bed in reverse Trendelenberg position while turning patients and pulling them up in bed). There are reports of nurses forgetting to elevate the backrest after completing the turning procedure (sometimes for a period up to 1 hour). Medical procedures (such as insertions of central catheters) can cause temporary interruptions in the desired HOB elevation. Transitory physiological conditions such as hemodynamic instability or low cerebral perfusion pressure also may mandate lowering of the HOB elevation.

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### Elevating the HOB decreases risk for aspiration but increases risk for pressure ulcers.

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Pressure Ulcer Guidelines

No studies were located that measured adherence to a low (≤30°) HOB elevation to prevent pressure ulcers in critically ill patients. However, in a study involving 362 long-term care facilities in Missouri, researchers found that minimizing the HOB elevation to less than 30° was done by fewer than 20% of the facilities.

Conclusions

The optimal HOB elevation to balance the risks for aspiration and pressure ulcers is unknown. Thus, a need exists for randomized controlled trials where both outcomes (aspiration and pressure ulcers) are evaluated simultaneously at various HOB elevated positions, especially in a population of critically ill, tube-fed patients receiving mechanical ventilation. Some authors suggest that studies be conducted to compare the commonly recommended 30° to 45° HOB elevations to lower and more achievable levels (such as 10° to 30°). Until more research-based evidence is available, caregivers should consider guidelines from expert panels and ultimately make decisions about HOB elevation in the context of the patient’s overall condition. Given current information, the following recommendations may be helpful to critical care clinicians:

- Unless medically contraindicated, maintain an HOB elevation of 45° in patients who are receiving mechanical ventilation and tube feedings. If necessary for comfort, lower the HOB elevation to 30° periodically.
- For critically ill patients at less risk for aspiration (eg, patients who are not receiving mechanical ventilation), maintain an HOB elevation of at least 30° unless medically contraindicated.
- Use a pressure-relieving surface for all critically ill patients to reduce the skin-bed interface pressure associated with an elevated HOB position. Routinely assess the patient’s skin for signs of a developing pressure ulcer.
- To minimize shear pressure, use a lift sheet to reposition patients (instead of sliding the patient up in bed).

Financial Disclosures

None reported.

References


Facts

There are conflicting guidelines about the use of head-of-bed (HOB) elevation to prevent aspiration and pressure ulcers in critically ill patients.

- Although the recommendations overlap, a 45° HOB elevation is generally favored to prevent aspiration in critically ill patients who are receiving mechanical ventilation and tube feedings. Because aspiration is a threat to oxygenation, it may be a more immediate concern than are pressure ulcers in critically ill patients.
- Aspiration of gastric contents is a primary route of bacterial entry into the lungs and is an important factor in the development of ventilator-associated pneumonia.
- Pressure ulcers are also associated with adverse outcomes and increased hospital costs. A pressure ulcer is often a marker for coexisting illness and other risk factors for mortality.
- Results from early studies are helpful in current practice because they clearly show that a 45° HOB elevation is superior to a “flat in bed” position in preventing aspiration.
- No randomized controlled trials were identified that compare aspiration while patients are at a 30° HOB elevation versus a 0° elevation, or a 30° elevation versus a 45° elevation. Thus, although a 30° HOB elevation is commonly recommended in practice settings, there is no direct evidence that it is as effective as a 45° elevation in reducing aspiration.
- Contraindications to an elevated HOB position are recent lumbar spine injury, hemodynamic instability, trauma of the pelvic region, and severe sacral pressure ulcers. Even when there are no contraindications to an elevated HOB position, it is not consistently applied.

Conclusions

Until more research-based evidence is available, caregivers should consider guidelines from expert panels and ultimately make decisions about HOB elevation in the context of the patient’s overall condition. Given current information, the following recommendations may be helpful to critical care clinicians:

- Standard nursing care often calls for temporary lowering of the HOB elevation. For example, because it is difficult to turn patients when the bed’s backrest is elevated, nurses usually lower the bed to 0°. There are reports of nurses forgetting to elevate the backrest after completing the turning procedure. Medical procedures also can cause temporary interruptions in the desired HOB elevation. Transitory physiological conditions such as hemodynamic instability or low cerebral perfusion pressure also may mandate lowering of the HOB elevation.