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Backrest position in prevention of pressure ulcers and ventilator-associated pneumonia: Conflicting recommendations

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Abstract

Pressure ulcers and ventilator-associated pneumonia (VAP) are both common in acute and critical care settings and are considerable sources of morbidity, mortality, and health care costs. To prevent pressure ulcers, guidelines limit bed backrest elevation to less than 30 degrees, whereas recommendations to reduce VAP include use of backrest elevations of 30 degrees or more. Although a variety of risk factors beyond patient position have been identified for both pressure ulcers and VAP, this article will focus on summarizing the major evidence for each of these apparently conflicting positioning strategies and discuss implications for practice in managing mechanically ventilated patients with risk factors for both pressure ulcers and VAP.

Keywords

Backrest elevation; Guidelines; Pressure ulcers; Recommendations; Ventilator-associated pneumonia

Pressure ulcers are common in acute and critical care settings, with prevalence ranging from 7%¹ to 33%² and incidence ranging from 7%³ to 12.4%.⁴ Pressure ulcers are a considerable source of morbidity, mortality, and patient discomfort.^{3,5-7} An estimated 2.5 million pressure ulcers are treated each year in US acute care facilities alone,⁸ with the coccyx (31%) and sacrum (26%) being the most frequent sites.⁹ Higher backrest elevation increases tissue pressure and shear, which facilitates pressure ulcer formation.¹⁰ To limit this effect, in the sacral area especially, guidelines limit the backrest elevation to the lowest degree of elevation consistent with medical conditions¹¹ or to 30 degrees for an individual on bedrest^{12,13} (Table 1).

Ventilator-associated pneumonia (VAP) is also a common complication in the acute and critical care setting.^{14,15} VAP occurs in 10% to 65% of ventilated patients^{14,16} and is responsible for 90% of nosocomial infections,^{17,18} greatly adding to cost,^{14,15} mechanical ventilation time,^{14,15,19} intensive care unit (ICU) length of stay,^{14,15,19} hospital length of stay,^{15,19} and mortality.^{15,19-21} VAP has been attributed to aspiration of gastric contents followed by pulmonary bacterial colonization.^{22,23} Lower backrest elevation is associated with an increased incidence of VAP.²⁴⁻²⁶ Therefore, strategies to reduce VAP involve

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minimizing both supine position and low backrest elevation with a goal of maintaining backrest elevation at 30 degrees or higher (Table 1).²⁷⁻³¹

Because the risk for both pressure ulcers and VAP frequently coexist, the simultaneous management of these 2 common acute care risks has resulted in conflicting recommendations for backrest elevation (Table 1). This article will discuss the major evidence for each of these apparently conflicting management strategies in the acute care setting and present perspectives for clinicians to consider when managing patients at simultaneous risk for both.

Pressure Ulcers

Position Recommendation Evidence

A large number of risk factors for the development of pressure ulcers have been identified;³²⁻³⁴ however, the major risk factors are pressure, friction, and shearing forces.^{35,36} These same risk factors are also important in discussions of use of higher levels of backrest elevation.

Pressure—Use of higher backrest elevation may increase pressure, especially in the sacral, ischial, and trochanter areas because higher backrest elevation places greater weight in those areas. The greater pressure was thought to result in capillary bed occlusion and ischemia followed by tissue damage.³⁷⁻³⁹ Several early studies⁴⁰⁻⁴² found the average capillary closing pressure to be 32 mm Hg, and currently, capillary closing pressure of 32 mm Hg remains a commonly used threshold for tissue damage.^{37,43,44} However, more recent studies have questioned capillary closing pressure as the primary cause for pressure ulcers, showing that high pressures can be supported by soft tissues before blood flow is compromised.^{45,46}

Backrest elevation has been shown to change skin–surface interface pressures in the sacral area, although data are limited and conflicting. Some studies have shown that supine positioning and backrest elevation of 0 degrees result in lower sacral or buttock interface pressures.⁴⁷⁻⁵⁰ In early studies, Sideranko et al⁴⁸ found that sacral pressures were significantly lower in the supine position compared with the semi-Fowler position (45-degree backrest elevation) in 57 surgical ICU patients. Two studies by Allen et al,^{51,52} each with 10 healthy volunteers, demonstrated increased buttock interface pressures on backrest elevation from zero to 60 degrees but a slight decrease at the sacrum. However, Defloor⁵⁰ observed increased pressure between the 0- and 90-degree backrest elevation but not between 0 and 30 degrees or 60 degrees in 62 healthy volunteers. More recently, using full-body pressure mapping, Barnett and Shelton⁵³ described increased gluteal pressure from backrest elevation of 0 to 30 degrees and 45 degrees in mannequins and human subjects representing 4 average human body types. They demonstrated that with higher backrest elevation there is increased loading of the pelvic region producing elevated interface pressures in the gluteal, sacral, and coccygeal areas. In addition, Peterson et al,⁴⁷ also using pressure mapping, found the lowest sacral pressures with backrest elevation of 0 degrees and significantly greater pressures with 30-, 45-, 60-, and 75-degree backrest elevation in 14 healthy volunteers. In contrast, studies have also shown higher interface pressures in lower backrest elevation positions. Whittemore et al⁴⁹ demonstrated increased pressure with the 0-degree position compared with the 45-degree backrest elevation position in healthy subjects, whereas Rondorf-Klym and Langemo⁵⁴ observed higher interface pressures in the backrest elevation 0-degree position when compared with the Fowler and semi-Fowler positions in 18 hospitalized patients. However, these studies were conducted without the use of pressure mapping, using less-reliable measurement systems, which may account for some of the conflicting findings.

In a more recent study, Mimura et al¹⁰ evaluated backrest elevation, body type, knee elevation, and position in the bed. Pressure was evaluated using sensor plates in 14 healthy volunteers (slender, average, and obese), continually in 5 sites (sacrum, lateral sacrum, coccyx, scapula, and posterior thigh) during constant backrest elevations from 0 to 80 degrees. Regardless of body type, maximum pressure was found at the coccyx; slender subjects experienced a higher pressure at the coccygeal bone site than obese subjects. Obese subjects experienced higher pressures than slender subjects at other sites. The data show that higher backrest elevation produces lower pressures in the sacrum and lateral sacrum for the slender body type.

Studies of interface pressure are often conducted using volunteers with a variety of measurement methods and different surfaces and body types, making comparisons difficult. Skin interface pressure also may not consider the internal tissue pressures as well as capillary, lymph, and reperfusion effects thought to be involved in pressure ulcer formation.^{35,55} Future study is needed to determine whether higher backrest elevation is associated with both higher interface pressures and pressure ulcer formation. In addition, few studies have described the effect of backrest elevation on interface pressure in the mechanically ventilated (MV) or critically ill population. These populations may be at greater risk for higher pressure because of their decreased levels of consciousness, frequent use of sedatives, reduced mobility, and inability to seek positions of comfort.

Pressure–Time Relationship—Pressure ulcer development also may be affected by the length of time a patient is in elevated backrest positions. The classic animal studies by Kosiak³⁷ and Husain⁵⁶ showed that application of constant pressure on a limb produced more microscopic pathologic tissue changes than intermittent pressure. Kosiak³⁷ noted that the critical time interval at which pathologic change occurred was between 1 and 2 hours. This pressure–time relationship has been supported by other studies with both deeper muscle structures and surface epidermal cells.^{57–59} By using rats, Linder-Ganz and Gefen⁵⁷ investigated changes in the mechanical properties of muscles exposed to prolonged intensive compression. They showed that prolonged pressure results in increased muscle stiffness and concluded that elevated tissue pressure exacerbates the potential for tissue necrosis. In an in vitro model system of engineered muscle tissue, Breuls et al⁵⁸ applied pressure to skeletal muscle cells and found that cell death occurs within 1 to 2 hours. They suggested that sustained deformation of the cells was the principle cause of cell death. Bronneberg et al⁵⁹ used commercial epidermal cells to evaluate the effects of pressure on damage progression and found that prolonged mechanical loading of soft tissue, such as skin, can eventually lead to tissue breakdown in the form of pressure ulcers.

The classic work of Reswick and Rogers⁶⁰ describes the “pressure-time tolerance curve.” By using data from more than 980 subjects, they described a relationship between the maximum pressure on supporting tissues over bony prominences and the time over which that maximum pressure was applied. To avoid skin damage, they suggested keeping pressures > 150 mm Hg to less than 2 hours. They indicated that this pressure–time curve was a “general guideline” and that it should not be used quantitatively for clinical decision making. However, this classic study has frequently served as the basis for clinical management practices.

Friction and Shear—As backrest elevation increases and patients slide down the bed or are repeatedly pulled back up, the forces of friction and shear are introduced. Frictional force is the resistance to motion in a parallel direction relative to the common boundary of 2 surfaces.⁶¹ Friction removes the outer protective stratum corneum layer, accelerating the onset of ulceration.⁶² Friction occurs between the surface (bed sheet) and the body and, when combined with pressure, creates shear forces implicated in pressure ulcer

development.⁶³ Shear is the force per unit area exerted parallel to the plane of interest⁶¹ and is produced when there is displacement of the upper tissue layers in reference to the underlying fascia. The skin and superficial fascia are interlocked, whereas the deeper fascia is loose and more mobile and slides easily in relation to the adjacent well-anchored deep fascia.⁶³ The higher the backrest elevation, the greater likelihood for the patient to slide down and experience shear. Reichel⁶³ believed that shearing forces were concentrated in the deeper tissues and suggested that they produced stretched or deformed blood vessels, which may be the source of multiple thromboses (and subsequent necrosis) found in pressure ulcers. In early animal studies, Dinsdale^{64,65} applied pressure with and without friction to trochanters and evaluated the degree of ischemia, and concluded that friction did not further decrease skin perfusion. However, he reported that shear can significantly reduce the time needed to develop pressure ulcers.

Lower Versus Higher Backrest Elevation—There are benefits and risks for the use of both lower and higher backrest elevations. Although lower backrest elevations may reduce pressure ulcer formation risk, facilitate side-to-side changes of position by nurses, and facilitate overall nursing care, they may also enhance hemodynamic stability and cerebral perfusion pressure, and facilitate cervical spine or pelvic stability.^{66,67} Alternately, higher backrest elevations have been shown to reduce aspiration risk and VAP, enhance oxygenation and ventilation, and facilitate mechanical ventilation weaning.⁶⁶⁻⁶⁹ However, higher backrest elevation may result in skin tears due to shear forces and increase the risk of sacral pressure ulcers and venous stasis in the lower extremities, especially with knees-bent positions.^{66,69-71} MV patients are frequently sedated, reducing natural body movements, which may increase pressure ulcer risk. Clearly, one position is not consistently superior.

Skin Effects with Higher Backrest Elevation—Evaluations of the effect of higher backrest elevation on skin integrity are limited. van Nieuwenhoven et al⁷² evaluated position with a secondary outcome of pressure ulcer development and found no difference in pressure ulcer formation for subjects in supine versus semirecumbent positions. When pressure ulcers were identified, they were present in the heel or sacral region. Higher backrest elevation incurs additional loading pressures. Mayrovitz et al⁷³ hypothesized that if resting sacral skin blood flow was greater than in surrounding tissues, a decrease or stoppage of blood flow during loading might represent increased risk because relative tissue deficits would be greater. They studied blood flow in sacral, lower back, and gluteus maximus skin using laser Doppler imaging and found that sacral skin blood flow was significantly greater than in gluteal or low back sites ($P < .001$). Decreases in skin blood flow may be more serious in the sacral area than in other areas, suggesting that sacral areas may be at greater risk even without use of higher backrest elevation.

More recently, Mimura et al¹⁰ examined shear in relation to body positioning by evaluating backrest elevation, body type, knee elevation, and position in the bed. They found shear force at the coccyx to be greater than at other sites when the knees were raised; when lowered, the weight distribution was high at the posterior side of the thigh, resulting in lower shear at the coccyx. Other studies further explicated the effects of shear on capillary blood flow. Bader et al⁷⁴ examined the effect of shear on skin capillaries of the forearms of healthy volunteers by “twisting” the skin. They found that relatively low levels of shear force virtually obliterated blood flow to capillaries, emphasizing the potentially damaging effects of surface forces on skin vasculature. Further, Zhang and Roberts⁷⁵ applied pressure and normal and shearing forces to the thighs of 4 healthy volunteers and concluded that skin shear forces have approximately the same effect on underlying tissues as pressure and that blood flow reduces with shear. They believed that if these forces were maintained or repeated, cell necrosis and eventual tissue damage would result. These studies emphasized

the potentially damaging effects of shear on the integrity of the skin blood vessels, which can ultimately contribute to pressure ulcer formation.

Ventilator-Associated Pneumonia

Supine positioning (backrest elevation of 0 degrees) is an independent risk factor for VAP.^{22,25,26,76-79} Higher backrest elevation has been shown to decrease the risk of aspiration of gastrointestinal contents or oropharyngeal and nasopharyngeal secretions.^{22,26} However, guidelines differ as to the degree of recommended elevation on the basis of differing interpretations of data and opinion (Table 1).

Position Recommendation Evidence

The earliest studies of aspiration, backrest elevation, and VAP showed an important link between backrest elevation and VAP^{25,76}; as a result, guidelines were written and adopted on the basis of these compelling data. However, more recent studies have found less definitive results and reported difficulties and risks with adherence to the higher backrest elevation.^{72,79}

Backrest Elevation and Aspiration—Causes of VAP are multifactorial, and low backrest elevation positioning has been shown to be a risk factor in studies.^{25,76} Bacterial nosocomial pneumonias can occur by aspiration of bacteria colonizing the oropharynx or upper gastrointestinal tract.^{22,26} Aspiration occurs frequently,⁸⁰ is more common in the presence of nasogastric tubes (NGTs), and can even occur around an inflated endotracheal tube cuff;^{22,81} however, backrest elevation may reduce this risk.⁸²

Studies have associated semirecumbency (45-degree backrest elevation) with decreased aspiration of gastric contents and therefore presumed decreased source for VAP. By using radioactive tagged gastric secretions, Torres et al²⁶ evaluated whether semirecumbency decreased aspiration and found that endobronchial samples obtained during semirecumbency had lower radioactive counts than those in the supine position (0-degree backrest elevation). In a study of 360 adult patients in 5 ICUs, Metheny et al⁸² studied aspiration of gastric contents in tube-fed patients by testing for pepsin-positive tracheal secretions and their relationship to several factors, including backrest elevation. Comparison between the high- and low-aspiration groups showed that a backrest elevation of 30 degrees or higher was associated with less aspiration risk.

However, not all studies have shown a significant relationship between patient positioning and aspiration. Ibanez et al²² evaluated the effect of supine and semirecumbent positions (backrest elevation 30-45 degrees) on gastroesophageal reflux in MV patients with an NGT using radioactive tagged gastric contents. Reflux with an NGT was greater in the supine position versus semirecumbency (21 of 26 [81%] vs 16 of 24 [67%]), although this was not statistically significant ($P = .26$). Orozco-Levi et al⁸³ evaluated the effect of supine and semirecumbent positions on gastroesophageal reflux also using radioactive labeling of gastric contents. They found that, regardless of body position, all subjects showed significant increases in radioactive counts at 3, 4, and 5 hours in oropharyngeal secretions. The slopes of the regression lines of sequential oropharyngeal counts were not different between each position (0.39 ± 0.09 vs 0.45 ± 0.11 , respectively); however, bronchial secretion counts were higher at 5 hours in the supine position compared with baseline ($P < .05$) and semirecumbency ($P < .01$). Reflux in MV patients with an NGT occurs regardless of body position, and semirecumbency may not completely eliminate it, leading to subsequent oropharyngeal colonization from gastric origin.

Backrest Elevation and VAP—Several early studies found a significant relationship between backrest elevation and VAP. In a landmark study, Kollef⁷⁶ evaluated numerous factors, including backrest elevation, associated with the development of VAP in different critically ill populations. Supine position (0-degree backrest elevation) during the first 24 hours of mechanical ventilation was found to be an independent risk factor for VAP (adjusted odds ratio, 2.9; 95% confidence interval, 1.3-6.8; $P=.013$). Supine position was also found to be independently associated with mortality (adjusted odds ratio, 3.1; 95% confidence interval, 1.2-7.8; $P=.016$). In another early study, Drakulovic et al²⁵ evaluated supine position as a risk factor for pneumonia by randomly assigning 86 MV ICU patients to supine (0-degree backrest elevation) or semirecumbent body position (45-degree backrest elevation). An interim analysis revealed significant reduction in the semirecumbent position ($P=.003$), and the study was halted early. On the basis of the data from these studies, guidelines were developed recommending the use of backrest elevation of 30 degrees or more for MV patients.

However, more recent studies have not consistently shown similar results. In an attempt to directly compare 0-degree backrest elevation (supine) and 45-degree backrest elevation positions, van Nieuwenhoven et al⁷² randomly assigned MV patients to these 2 groups, although backrest elevation of 45 degrees was reported to be unable to be achieved 85% of the time. The achieved difference in treatment position (10 vs 28 degrees), although not at the 45-degree elevation desired, did almost achieve the guideline level of backrest elevation of 30 degrees, but did not prevent the development of VAP. In a smaller pilot study (N 30), Keeley⁷⁹ assigned MV patients to 25-degree (current practice within the ICU) or 45-degree backrest elevation. Twenty-nine percent of those in the 45-degree group versus 54% in the 25-degree group contracted VAP ($P<.176$). Although they were able to achieve the high backrest elevation, the difference between the groups was not statistically significant, but a trend toward reduction was found. Keeley⁷⁹ stated that a larger sample may have shown a statistical difference. Grap et al²⁴ described the relationship between backrest elevation and development of VAP in 66 subjects (276 patient days) using the Clinical Pulmonary Injection Score to determine VAP. They found that VAP was more likely to develop in patients who were more seriously ill and spent greater time at backrest elevation of less than 30 degrees during the first 24 hours of intubation.

In a recent meta-analysis, Alexiou et al⁸⁴ evaluated the effect of semirecumbency (45-degree backrest elevation) of MV patients on the incidence of VAP. They analyzed data from 3 randomized, controlled trials^{25,72,79} totaling 337 patients and found that the odds of developing clinically diagnosed VAP were significantly lower in patients in semirecumbent positions compared with those supine (odds ratio, 0.47; 95% confidence interval, 0.27-0.82). However, this analysis compared only higher backrest elevation (45 degrees), not the standard 30-degree backrest elevation, with supine (0-degree backrest elevation) positions. Alexiou et al⁸⁴ indicated that their study provides additional support that the standard practice of backrest elevation of 15 to 30 degrees may not be sufficient to prevent VAP in MV patients.

Niel-Weise et al⁶⁹ advanced this discussion with a review of the same 3 randomized, controlled trials but also asked whether backrest elevation should be higher than standard practice and which degree of backrest elevation does more harm than good, using both clinically suspected VAP and microbiologically confirmed VAP as outcomes. In addition, secondary outcomes included, among other factors, decubitus ulcers. A European expert panel developed their recommendation on the basis of a systematic review and considerations beyond the scientific evidence in a 3-round electronic Delphi procedure. They recommended use of backrest elevation of 20 to 45 degrees and preferably to 30 degrees as long as it does not interfere with nursing tasks, medical interventions, or patients'

wishes. However, it was not clear whether use of backrest elevation of 45 degrees for 24 hours per day increased other risks. This comprehensive review failed to prove clinical benefits of backrest elevation; however, the experts preferred backrest elevation in ventilated patients.

Recent studies question the usefulness of the semirecumbent position and suggest that a lateral body position may be more beneficial. Animal models have been used to study the effect of gravity on tracheal mucus and VAP. Panigada et al⁸⁵ randomized ventilated animals to a “head up” or “head down” position. The animals in the “head up” position had significant decrease in lung function and heavy bacterial colonization of the lungs, whereas the animals in the “head down” position retained excellent lung function with no evidence of bacterial lung colonization and VAP. Bassi et al⁶⁸ found the semirecumbent position caused mucus flow toward/into the lungs, which is highly associated with the development of VAP. When the trachea was oriented slightly below horizontal (in a marginally Trendelenburg position), airway secretions always cleared outward and no VAP was found. Mauri et al⁸⁶ compared 10 human subjects placed in a horizontal lateral position with 10 subjects in a semirecumbent position and showed that the lateral horizontal position was feasible and did not cause serious adverse events. Aspiration of gastric contents, as detected by pepsin assessment, did not increase in the lateral position and the authors found more ventilator-free days and a trend of lower incidence of VAP when the lateral position was applied.

Backrest Elevation Compliance—There are compliance issues with higher backrest elevation in both research and implementation. In research studies, the process of monitoring, confirming, or fully describing backrest elevation has been inconsistent. In the Kollef⁷⁶ study, backrest elevation was monitored during the first 24 hours of mechanical ventilation but frequency of observations was not described. Drakulovic et al²⁵ instructed medical care personnel not to change the preset patient position but only checked correctness of the position daily. In analysis, they excluded patients whose position changed for more than 45 minutes; however, it is not clear how this was determined because the patient's position was only monitored daily. van Nieuwenhoven et al⁷² evaluated both the backrest elevation and the feasibility of using the higher position. Backrest elevation was measured every 60 seconds during the first week of ventilation. The investigators noted that the semirecumbent treatment position backrest elevation goal of 45 degrees was not feasible for MV patients. Keeley⁷⁹ withdrew patients from the protocol if the patient was out of the randomized position for more than 6 hours in 24; there was no mention of the frequency of backrest elevation checks. A significant number of patients were withdrawn by request because of expressed discomfort or they did not wish to remain in the randomized position. Variability in backrest elevation measurement and monitoring may therefore affect study results.

Although a 30- to 45-degree backrest elevation is the current recommendation, studies have shown it is not standard practice,⁸⁷⁻⁸⁹ and there are data illuminating some of the factors involved, including enteral feeding status, hemodynamic instability, and care provider decisions. In 2 ICU studies to document the level of backrest elevation and identify factors associated with the level among others, Grap et al^{88,89} found mean backrest elevation to be 22.9 and 19.2 degrees; 86% and 70% of subjects were supine, respectively. In both studies, they determined that the use of higher backrest elevation (>30 degrees) is minimal and not related to use of enteral feeding. The first study found backrest elevation not associated with hemodynamic status; the second study found a minimal relationship to hemodynamic status. Ballew et al⁹⁰ found lower backrest elevation was associated with lower mean blood pressure and vasopressor use in 100 thoracic cardiovascular surgical ICU patients. The authors commented that the nurses may use lower backrest elevation for support of hypotension; however, it is unknown whether this maneuver is actually beneficial. Nurses'

estimates of backrest elevation were also investigated. Dillon et al⁹¹ investigated nurses' estimates of patients' positions and reported that a correlation between the real angle and the estimated angle was 0.85, indicating that nurses were generally able to estimate backrest elevation accurately. In contrast, Li et al⁶⁷ made 295 unannounced inspections of patients' backrest elevation and asked the nurses to estimate the angle of backrest elevation. They found that nurses consistently overestimated the angle of backrest elevation ($P < .001$); the 30-degree minimum angle was observed on only 41% of occasions.

Studies also have described clinicians' determinants of higher backrest elevation use. Cook et al⁶⁶ found that, for nurses, the main determinant of semirecumbency was physicians' orders. Intensivists perceived that the main determinant was nursing preference. Barriers to semirecumbency were alternative positions, contraindications (eg, hemodynamic instability), risk of harm (eg, decubitus ulcers), safety (eg, sliding out of the bed), and resources (eg, insufficient beds facilitating semirecumbency). Likewise, Sinuff et al⁹² also sought to identify barriers to backrest elevation compliance with a multicenter qualitative study in 3 university-affiliated ICUs. Barriers to guideline implementation were found to be high ICU workload, severity and acuity of patient illness, complexity of patient illness, high volume of guidelines, and guidelines that conflict regarding patient goals.

The semirecumbent position has generally been shown to reduce the risk of VAP and continues to be part of national guidelines. Although this noninvasive, low-cost intervention may be important to reduce VAP, it may not be without risk, including deleterious effects on the skin.

Pressure Ulcer Versus Ventilator-Associated Pneumonia Prevention

Conflicting Recommendations

Conflicting Backrest Elevation Data Evaluation—Two meta-analyses have been conducted examining the use of backrest elevation to reduce VAP. The findings of Alexiou et al⁸⁴ support several national guidelines (Table 1). Their recommendation was based on their statistical analysis. In contrast, Niel-Weise et al⁶⁹ found no compelling indication for high backrest elevation, using both scientific evidence and a group of 22 experts in intensive care medicine. Niel-Weise et al recommended backrest elevation for MV patients from a 20- to 45-degree position, preferably 30 degrees, as long as it does not pose risks or conflicts with other nursing tasks, medical interventions, or patients' wishes. Alexiou et al⁸⁴ believed that, in formulating a patient position recommendation, both the scientific evidence and the arguments underpinning the recommendation regarding consideration of human factors (eg, skin integrity and nursing and medical intervention) need to be considered. They stated that to maintain a certain elevation 24 hours per day is not feasible because of demands from nursing tasks, medical regimens, and patients' wishes. In addition, rest is an important aspect of acute and critical care and may be difficult to achieve with backrest elevation of 30 to 45 degrees. Use of higher backrest elevation may require additional time and personnel to pull patients up in the bed, adding to the cost of patient care and to increased nurse workloads. In addition, higher backrest elevation may require pulling patients up more frequently, which may result in skin shear, a known risk factor for pressure ulcers.

Position Decisions and Clinical Implications—The point at which higher backrest elevation increases the risk for developing a pressure ulcer is not known. Is 15- to 30-degree backrest elevation perhaps adequate to deter the onset of VAP, while also reducing pressure ulcer risk, or is use of 45 degrees the only goal? Temporal issues related to pressure ulcer and VAP risk may be important and help to determine which position and risk take “precedent.” For example, Grap et al²⁴ found the first 24 hours of lower backrest elevation was a factor in the development of VAP. It may be that once this critical time is passed, the

focus can switch to pressure ulcer risk reduction with the use of lower backrest elevation. Would intermittent change in backrest elevation to lower positions allow for increased tissue perfusion, thus reducing pressure ulcer risk? To date, these comparative studies have not been performed.

As described earlier, guidelines have been published for patient position for prevention of both pressure ulcers and VAP. Because the evidence base for the management of pressure ulcers has been influenced by expert opinion, new studies are required to clarify the processes involved in the onset of pressure ulcers to be able to make the best clinical decisions with respect to backrest elevation. However, having published guidelines makes it difficult to randomly assign patients at a specific backrest elevation for continuing studies. Although guidelines for the management of VAP were largely based on scientific data, the same problem exists. Therefore, until empiric data are available to illuminate the best approach for these 2 common complications, conflicts in individual patient management may continue.

Each patient has unique characteristics and health conditions that may dictate use of one position over the other. Many intrinsic and extrinsic factors have been associated with pressure ulcer development. Shear can be involved in combination with pressure in the development of pressure ulcers, and backrest elevation strongly influences the level of shear stresses.⁹³ Therefore, attention to and reduction of all pressure ulcer risk factors should be the focus of care, not just the choice of patient position. Although increased backrest elevation has been shown to reduce aspiration and VAP, more studies are needed to clarify the optimal position for both. Research to identify which patients will benefit from higher versus lower backrest elevation will help to guide clinicians positioning decisions. Do patients who can adjust body position spontaneously, that is, those who are alert, compared with sedated patients, present less risk with high backrest elevation? At what point do issues related to patient comfort and preferences, as well as patient care effectiveness, also dictate nurses' positioning decisions? It is unlikely that decisions about patient position in the MV population will ever be straightforward, but nurses, in considering all the risks for both pressure ulcer and VAP, will allow this consideration to determine the interventions that are best for each patient individually.

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Table 1

National backrest elevation positioning recommendations for the prevention of pressure ulcers and risk reduction for ventilator-associated pneumonia

Pressure ulcers	Ventilator-associated pneumonia
<p>Agency for Health Care Policy and Research. Pressure Ulcers in Adults: Prediction and Prevention, Clinical Practice Guideline Number 3¹¹</p> <ul style="list-style-type: none"> • Limit the amount of time the head of the bed is elevated. <p>European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel. Treatment of pressure ulcers: Quick Reference Guide¹²</p> <p>Wound, Ostomy, and Continence Nurses Society¹³</p> <ul style="list-style-type: none"> • Maintain head of bed at 30 degrees or at the lowest degree of elevation consistent with the patient's medical condition. 	<p>Centers for Disease Control and Prevention and the Healthcare Infection Control Practices Advisory Committee²⁷</p> <p>American Thoracic Society and the Infectious Diseases Society of America²⁸</p> <p>National Quality Forum²⁹</p> <ul style="list-style-type: none"> • In the absence of medical contraindication(s), elevate at an angle of 30-45 degrees of the head of the bed of a patient at high risk for aspiration (eg, a person receiving mechanically assisted ventilation or who has an enteral tube in place). <p>Institute for Healthcare Improvement³⁰</p> <ul style="list-style-type: none"> • Elevate the head of the bed to > 30 degrees for all MV patients. <p>Canadian Critical Care Trials Group and the Canadian Critical Care Society³¹</p> <ul style="list-style-type: none"> • We recommend the use of semirecumbent positioning, with a goal of 45 degrees, in patients without contraindications.

MV, mechanically ventilated.