n acute care settings and intensive care units (ICUs), quality of care for bedfast patients is under increased scrutiny. With reimbursement for avoidable iatrogenic stage III and IV pressure ulcers and catheter-related urinary tract infections eliminated by the Centers for Medicare and Medicaid Services,\(^1\) strategies to reduce complications of bed rest are ongoing priorities for bedside nurses and advance practice nurses (APNs).

The purpose of this article is to review the data related to frequency of manual turning and turning positions among adults who are receiving mechanical ventilation in ICUs. From this review, bedside nurses and APNs will have a better understanding of the benefits and risks of frequent manual turning and why new evidence must be developed for optimal care of patients in the ICU.

Manual turning is prescribed at traditional intervals of every 2 hours around-the-clock.\(^2\) Although the origins of this common intervention are unclear, it has been adopted in a variety of guidelines.\(^3(p104)-5\) Up to 90% of acute care patients who need assistance in repositioning do not receive manual turning every 2 hours despite these guidelines.\(^6-8\)

Among patients who are in an ICU bed, direct observations indicate that the mean number of manual turns during a 24-hour period ranges from 2 to 6 times instead of the 11 to 12 times expected.\(^9-13\)

Theoretical Support for Frequent Manual Turning

Frequent manual turning is theorized to prevent pressure ulcers, improve oxygenation, alter comfort, decrease urinary stasis, and provide therapeutic sensory stimulation. Animal models suggest that subdermal tissues at bony prominences demonstrate necrosis within 1 to 6 hours after sustained pressure.\(^14\) Manual turning is advocated for prevention and treatment of tissue necrosis resulting in pressure ulcers.\(^15\)
Frequent manual turning can also provide improved regional ventilation in the lung areas and alternating gravitational forces for drainage of mucus from sinus and lung cavities. Position changes from turning may also decrease discomfort from immobility, particularly back pain. Frequent turning is thought to prevent urine stasis associated with urinary tract infection. Finally, repositioning with manual turning provides human contact and stimulation that may reduce delirium.

In common practice, manual turning means alternating supine and lateral positions for bedfast patients. Lateral positioning is generally described as a 30º tilt away from the mattress at the hip and shoulders. The lateral position in acute care is usually supported with pillows, foam wedges, or other weight-distributing devices. Compared with supine positioning, lateral tilting has been associated with adverse changes in ICU patients. Sustained lateral positioning may cause cardiovascular compromise in critically ill patients receiving mechanical ventilation. Among critically ill adults, lateral positions can impair oxygenation in patients with widespread unilateral infiltrates when the diseased lung is in the bottom position. Physiological changes in vascular, lung, and intracranial measures have been reported and are thought to be a result of redistribution of venous volume or pressure immediately after lateral positioning, resolving within 5 to 10 minutes to baseline values.

Examining the Evidence for Manual Turning

The first step in reviewing the evidence is to frame a question by using the patient-intervention-comparison-outcome (PICO) format. For this review, adults who receive mechanical ventilation were selected because they are at risk for activity restriction. The intervention was defined as turning frequency and lateral tilt. Lateral tilt was defined as a side-lying position of 30º to 60º shoulder/hip tilt from a supine position.

The comparative intervention was either more or less frequent turning time than every 2 hours for the first question. Outcomes were selected from commonly reported complications of bed rest: pressure ulcers, pneumonia, discomfort or pain, urinary tract infection, delirium, and physiological instability (such as desaturation or blood pressure changes), as well as duration of mechanical ventilation and length of ICU stay. The first question is, “In mechanically ventilated adults, does manual turning every 2 hours, when compared with other turning schedules, lead to reduced adverse outcomes from bed rest?” The second question is, “Do turning positions, comparing degree of lateral tilts (ie, supine to lateral positioning) reduce adverse outcomes from bed rest?” Prone positioning was excluded in this search, as it is not a common or frequent turning intervention. Specific degree of head-of-bed elevation or backrest position was not considered for this review.

Methods

A search of MEDLINE, CINAHL, and Ovid electronic databases was undertaken without date or language restrictions. Search terms used were “patient turning,” “positioning,” “kinetic therapy,” and “repositioning.” Each of these test terms was combined with each of the following outcome terms: efficacy, skin integrity, pressure ulcer, pulmonary function, mucus, comfort, pain, urinary tract infection, delirium, mood, mental status, and cognition. In addition, the MeSH terms “moving and lifting patients” and “pressure ulcer” were used.

To be included in the review, a report had to include all adults who were receiving mechanical ventilation. Individual reports had to have experimental or quasi-experimental designs, and systematic reviews were included. Titles and abstracts of search outputs were imported into an EndNote Library (Thomson Researchsoft, version X1); duplicates were eliminated first by EndNote, then by hand. Both authors reviewed titles, abstracts, and/or the full articles to screen independently for inclusions and any differences were discussed and resolved. The results of the electronic database search are in the Figure.
Results

Four clinical trials, 2 systematic reviews and 2 meta-analyses were identified that met inclusion criteria (see Figure). A checklist, with 10 criteria to evaluate the quality of a nonpharmacological intervention, was used to evaluate all trials. The criteria are listed in the Table footnotes; this established checklist was used because its purpose and format are congruent with the purpose of this topic. Results for each question are detailed next.

In adults receiving mechanical ventilation, does manual turning every 2 hours, when compared with other turning schedules, lead to reduced adverse outcomes from bed rest?

Four clinical trials addressed the patients, intervention, and comparison of interest. In 1 study, manual turning in bed every 2 hours was compared with continuous (automated) turning among patients with acute spinal cord injury in the ICU. However, neither the frequency of turning nor the outcomes of interest were reported, and the study was eliminated from this review.

Two clinical trials examined effects among adults undergoing open heart surgery. Both studies occurred at a time when it was common practice for patients to receive at least 24 hours of bed rest and mechanical ventilation immediately after open chest procedures. In these 2 reports, the control group received no turning/repositioning. Both trials reported an increased incidence of fever among patients who did not have frequent manual turning. In 1 study, researchers reported a reduced length of stay when manual turning occurred. In the other study, researchers reported that the amount of atelectasis was similar and high (74% of patients) in both supine and manually turned patients; pneumonia was not reported.

In another study, researchers used a quasi-experimental design with 3 arms: (1) a 2-hour manual turning regimen, (2) an automated turning regimen every 7 minutes,
and (3) secretion management treatments. All patients had acute lung injury and received paralytic agents. In this study, variations in turning did not result in differences in cardiac or pulmonary function; specifically, frequency of turning did not alter cardiac index, sputum production, or oxygenation requirements but the outcomes of interest are not specifically addressed.

Five related systematic reviews related to frequency of manual turning were identified during our electronic search. During our electronic search. Two,15,36-38 A sixth review,39(p6773) written as a book chapter, also was examined. None of these reviews included mostly patients receiving mechanical ventilation, making their findings difficult to apply in the ICU setting. Surprisingly few individual trials overlapped between these reports, even though all 6 measured the same outcome: occurrence of pressure ulcers. None of these reviews conclude that manual turns every 2 hours are the optimal intervention for all bedfast patients.

In summary, compared with no manual turning, frequent manual turning may reduce fever and length of stay in adults receiving mechanical ventilation. However, many of the data supporting these findings were collected more than 20 years ago in small samples, and the reports show methodological issues (see Table). Systematic reviews of frequent manual turning in mixed populations that include patients receiving mechanical ventilation suggested that outcomes of reduction or prevention of pressure ulcers, pain/discomfort, and pneumonia are inconsistent or inconclusive. No information about the incidence of delirium or urinary tract infection linked to frequent manual turns was found in the reports reviewed.

Do turning positions, comparing degree of lateral tilts (ie, supine to lateral positioning), reduce adverse outcomes from bed rest?

### Table
Summary and evaluation of identified clinical trials

<table>
<thead>
<tr>
<th>Reference, year</th>
<th>Sample and setting</th>
<th>Duration of follow-up</th>
<th>CLEAR NPT criteria&lt;sup&gt;a&lt;/sup&gt; (&lt;N = no, not present; U = unknown, Y = yes&gt;)</th>
<th>Outcomes improved?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chulay et al.,33 1982</td>
<td>35 postoperative coronary artery bypass patients Intensive care unit (ICU) in United States</td>
<td>24 hours</td>
<td>(1) N (2) Y (3) Y (4) N (5) N (6) N (7) U (8) U (9) Y (10) U</td>
<td>Turning resulted in a decrease in the incidence of fever (and a reduced length of stay)</td>
</tr>
<tr>
<td>Gavigan et al.,34 1990</td>
<td>50 postoperative coronary artery bypass patients ICU in United States</td>
<td>3 days in the ICU</td>
<td>(1) N (2) N (3) Y (4) U (5) Y (6) U (7) N (8) U (9) Y (10) N</td>
<td>No differences in atelectasis via morning radiographs; patients in the control group had increase in frequency of fever</td>
</tr>
<tr>
<td>Davis et al.,31 2001</td>
<td>19 patients with acute respiratory distress syndrome who were chemically paralyzed and sedated ICU in United States</td>
<td>6 hours</td>
<td>(1) N (2) Y (3) Y (4) U (5) Y (6) U (7) Y (8) U (9) Y (10) Y</td>
<td>No differences in cardiac index, delivered oxygen (FiO₂), or arterial oxygen (PaO₂)</td>
</tr>
<tr>
<td>de Laat et al.,35 2007</td>
<td>55 postoperative coronary artery bypass patients ICU in the Netherlands</td>
<td>120 minutes</td>
<td>(1) Y (2) Y (3) Y (4) U (5) Y (6) U (7) Y (8) U (9) Y (10) Y</td>
<td>No differences greater than 15% in cardiac index between individual participants after either 30 or 120 minutes in the assigned position compared with values obtained with patient supine as baseline</td>
</tr>
<tr>
<td>&lt;sup&gt;a&lt;/sup&gt;Based on data from Davis et al.31</td>
<td></td>
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<tr>
<td><strong>CLEAR NPT criteria&lt;sup&gt;b&lt;/sup&gt;</strong></td>
<td></td>
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<tr>
<td>(1) Was the generation of allocation sequences adequate?</td>
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<tr>
<td>(2) Was treatment allocation concealed?</td>
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<td>(3) Were details of the intervention administered to each group made available?</td>
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<tr>
<td>(4) Were care providers’ experiences or skill in each arm appropriate?</td>
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<td>(5) Was participant adherence assessed quantitatively?</td>
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<tr>
<td>(6) Were participants adequately blinded? (Or were all other treatments and care the same, with each group having similar attrition?)</td>
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</tr>
<tr>
<td>(7) Were the care providers caring for participants adequately provided? (Or were all other treatments and care the same, with each group having similar attrition?)</td>
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<tr>
<td>(8) Were outcome assessors blinded to assess the primary outcomes?</td>
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<tr>
<td>(9) Was the follow-up schedule the same in each group?</td>
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<tr>
<td>(10) Were the main outcomes analyzed according to the intention-to-treat principle?</td>
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</tbody>
</table>
Five articles were found that met inclusion criteria. Two were systematic reviews with meta-analyses. These 2 analyses detailed several of the outcomes of interest: incidence of ventilator-associated pneumonia, length of stay in the ICU, and mortality. Two additional systematic reviews and 1 clinical trial examined physiological outcomes from lateral positioning during mechanical ventilation. The meta-analysis from Delany and colleagues supports a significant reduction in the development of nosocomial pneumonia in adults who received mechanical ventilation and kinetic bed therapy (odds ratio = .38, P < .001). This review had the broadest definition of automated turning. The inclusion of a variety of both soft surface and kinetic tabletop beds, with and without oscillation, make it difficult to determine if automated, frequent turns like continuous lateral rotating therapy (CLRT) alone or combined therapies (bed type and oscillation) influenced the outcomes of ICU length of stay or duration of mechanical ventilation. The definition of tilt in this review included a 90° lateral turn from automated beds; a turn this steep is not commonly provided without a specialized turntable bed, limiting comparability with manual turning. As well, the authors described methodological reporting issues that led to insufficient evidence for definitive recommendations regarding the use of kinetic bed therapy.

The conclusion from the more recent systematic review used 13 of the 15 clinical trials from Delaney and colleagues along with 3 unique trials. Their meta-analysis also supports the use of continuous rotational therapy to prevent or treat pneumonia (odds ratio = 0.34, P < .01). These authors similarly report issues with low methodological quality in the trials reviewed and an inability to make universal recommendations for the use of rotational therapy. Goldhill and colleagues indicate that rotational therapy decreased urinary tract infections in 2 of the trials included in the review. In 2 other systematic reviews that do not specifically address patients receiving mechanical ventilation, continuous lateral rotation therapy (CLRT) was compared with manual turning with a focus on ICU patients. Similar inconclusive findings were reported and attributed to the problems with poor methodological reporting. Thus, evidence regarding the degree of lateral tilts is such that a specific position cannot be recommended in terms of tilt or duration of tilt for decreasing complications of bed rest.

Two systematic reviews were focused on physiological stability, comparing the effects of lateral versus supine positioning on arterial oxygenation and other measures of gas exchange, respiratory mechanics, and hemodynamic effects. Both reviews conclude that extreme right lateral positioning and lateral positioning among coronary artery bypass patients may compromise heart rate, blood pressure, and other hemodynamic values. In addition, the authors note that individual variation in patients’ response to lateral tilts is large, which suggests that future studies will need a large sample size.

The last report in this series is a clinical trial of 55 patients after coronary artery surgery. In some patients, the lateral tilt was randomly assigned to occur 2 hours after surgery, whereas other participants were randomized to receive a tilt position 4 hours after surgery. Patients’ responses were observed for 2 hours after positioning, and a 30° right or left tilt did not significantly alter cardiac index. It is not clear whether patients were receiving mechanical ventilation during the observations.
In summary, a total of 4 reviews and 1 clinical trial were identified that met inclusion criteria for the second PICO question. Meta-analysis supports automated lateral tilting over manual turning as an intervention to reduce the incidence of and provide treatment for pneumonia. Some results indicate that extreme lateral positions may induce physiological instability in some patients receiving mechanical ventilation. Information about the influence of frequent versus continuous turning on ICU length of stay or duration of mechanical ventilation was inconclusive. Researchers in 2 clinical trials within systematic analyses reported a decrease in urinary tract infection with automated turning compared with manual turning, but the data were insufficient for a specific recommendation. No information about the outcomes of delirium or pain/discomfort was reported in these series.

**Implications for Nursing Practice**

No recommendations about the frequency or the position (ie, degree of lateral tilt) for manual turns to prevent complications from bed rest among mechanical ventilator patients in the ICU can be made from the available data. Returning to the PICO format, 4 individual studies addressed the population of interest (see Table); 4 reviews also were focused on adults receiving mechanical ventilation. In these reports, the comparative intervention for mechanical ventilator patients was either no turns or automated turns in a specialized bed, with a wide variation as to duration or degree of automated tilt when it was reported. Small samples with inconsistent time frames for collecting data make it difficult to apply findings across settings confidently. These observations have implications for future investigations.

No harm to patients was reported in relation to frequent manual turning. This finding may be an artifact related to insufficient data collection rather than a true absence of harm. Among all clinical trials and the studies included in the systematic reviews, only 2 studies reported no adverse events from manual turning. Goldhill and colleagues list complications of rotational therapy: disconnection of intravascular catheters, intolerance of patients to the rotation, adverse effects on intracranial pressure, and arrhythmias. As a result, it is difficult to determine if harms are associated with different turning therapies. One unrelated report suggests that moving and turning in bed causes patients discomfort.

Most of the studies in this review occurred before current mattress technology became available. Nursing home patients who used a viscoelastic ("memory foam") mattress had reduced formation of pressure ulcers when they were turned every 4 hours. Although the sample and setting do not support adopting an every-4-hour turning schedule in the ICU, this information illustrates the importance of evaluating the patient’s environment—in this study, a mattress—as a covariate in determining the optimal turning regimens.

The characteristics of devices used for positioning during manual turning, including the mattresses, wedges, pillows, and pressure-distributing supports, are also important to consider when evaluating manual turning. Details about adjunctive support surfaces are missing from systematic reviews. Standard mattresses for inpatients have changed over time, and the ability to distribute pressure evenly has improved. New bed technology provides turn assistance (eg, inflating baffles so that the patient is “tilted”) as well as the ability to alter “seat” pressure when the head of the bed is elevated. These innovations could markedly alter turning practices and should be evaluated.

Additional factors suggested by experts when investigating the effects of frequent manual turning include the influence of staffing on turning regimens. Turning schedules are labor intensive and difficult to maintain. The time required for a nurse to complete the manual turn has been reported as 2 to 17 minutes and should be considered for investigations that examine frequent manual turning in non–ICU settings. Staff can be injured while handling patients, and occupational injury rates are important in considering the effects of manual turns.

**Implications for APNs**

Best practices for manual turning of patients in the ICU are not clear. APNs are in key positions to re-examine manual turning as therapy and to advocate for patients who are bedfast. APNs can take a leadership role in identifying a supply of special surfaces (eg, foam overlays) and evaluating their cost-effectiveness in preventing pressure ulcer formation and promoting comfort. Manual turning may not address the special needs of patients receiving mechanical ventilation.
Specifically, frequent manual turning may not prevent sacral pressure ulcers in patients who need head-of-bed elevation, for example, patients receiving mechanical ventilation and enteral nutrition. Thus, relying on manual turning for patients receiving mechanical ventilation may ignore evidence regarding the benefits of CLRT.

Other than optimizing manual turning and identifying adequate supporting surfaces, APNs can prescribe therapy to prevent complications from bed rest, including consulting a physical therapist and ordering CLRT. Interventions to prevent complications from bedrest may affect hospital charges and reimbursement. For example, physical therapy includes a reimbursable cost for services. Purchase or rental of a bed that provides CLRT costs more than purchase or rental of a standard bed. However, if interventions reduce complications from bed rest and/or reduce duration of mechanical ventilation, then costs may be offset by reduced charges for treatment of complications such as prolonged ICU stay. Information about the costs of turning and positioning therapies is limited. Neither the optimal physical therapy regimen nor the optimal dose of CLRT has been established (ie, dose of in-bed physical therapy, number of hours daily in automated rotation, degree of rotation, and number of turns per hour).

Emerging data from progressive mobility studies suggest that protocols of activity reduce duration of mechanical ventilation and length of ICU stay and activity may be conceptualized as in-bed turning activities. Evaluating cost versus benefit will contribute to decisions about therapies to minimize complications of bed rest.

Although individual patients’ responses to manual turning by bedside caregivers must be taken into consideration, helpful and harmful outcomes must be evaluated systematically. APNs can work with bedside nurses to investigate turning regimens through quality improvement projects. These projects can examine both individual and aggregated responses of patients to various turning schedules and positions. Further, research into the patient care practice of frequent manual turning is warranted.

Repositioning by using manual turning is influenced by multiple factors. The patient’s condition, including severity of illness, nutritional status, and hemodynamic stability, contributes to clinical decisions about turning and turning frequency. Patients’ ability to spontaneously reposition themselves, skin moisture, fever or skin temperature, age and weight, altered tissue perfusion, and use of intravenous vasoactive drugs also must be taken into account during investigations of manual turning. Confounding factors in an ICU setting are not consistently addressed in the research reports. Well-designed research studies conducted by APNs attending to factors related to patients, staff, and the patient care environment will strengthen the level of evidence around frequency and positioning with manual turning.

Conclusion

Investigating modes of activity in ICU patients has been identified as a priority in several nursing and medical professional organizations and has triggered new research projects. Two clinical trials done to investigate turning regimens in acute care and ICU patients are reported on the clinical trials Web site (www.clinical.trials.gov). One trial (NCT00847665) compares the incidence of pressure ulcer formation with other outcomes in mechanical ventilator patients who use alternating pressure mattresses. Participants are randomized to manual turns every 2 or 4 hours. In the second study (NCT00542321), researchers are examining the incidence of pulmonary complications and other outcomes between patients assigned to manual turning or an automated turning bed. Both trials are scheduled to end in 2011. Bedside nurses and APNs will need to look for the results from these studies to provide optimal patient care.

Patients receiving mechanical ventilation are dependent on others for assistance with turning and are at risk for complications from bed rest. However, optimal turning schedules and positions have not been clearly established, particularly for patients who are especially vulnerable to immobility such as patients undergoing prolonged mechanical ventilation. Patients receiving mechanical ventilation may benefit from more or less frequent turning than every 2 hours. Ideal tilt positions and methods to...
provide tilt have not been established. Continuous rotational therapy is likely to improve outcomes related to pneumonia in these patients. Bedside nurses and APNs have ample opportunity to work together to develop and evaluate strategies to reduce complications from bed rest, including optimization of frequent manual turning. 

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References


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