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CLINICAL RESEARCH STUDY

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# Benefits of Early Active Mobility in the Medical Intensive Care Unit: A Pilot Study

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## ABSTRACT

**BACKGROUND:** Pressure ulcer formation continues to be problematic in acute care settings, especially intensive care units (ICUs). Our institution developed a program for early mobility in the ICU using specially trained nursing aides. The goal was to impact hospital-acquired pressure ulcers incidence as well as factors associated with ICU deconditioning by using specially trained personnel to perform the acute early mobility interventions.

**METHODS:** A 5-point mobility scale was developed and used to establish a patients' highest level of activity achievable during evaluation. A mobility team was created consisting of skin-care prevention/mobility nurses and a new category of worker called a patient mobility assistant. Each level has a corresponding plan of care (intervention) that was followed and adjusted according to the patient's progress and nursing evaluation. Data collection included the type of interventions at each encounter, mobility and skin assessments, new hospital-acquired pressure ulcer, the current mobility level, Braden score, rate of ventilator-associated pneumonia, ICU length of stay, and hospital readmission. Staff was also surveyed about their attitudes toward mobilization and perception of mobility barriers; a prepilot and a postpilot survey were planned.

**RESULTS:** During the 1-year study interval, 3233 patients were enrolled from the medical intensive care unit (MICU). The 2011 preimplementation MICU hospital-acquired pressure ulcer rate was 9.2%. After 1 year of employing the mobility team, there was a statistically significant decrease in the MICU hospital-acquired pressure ulcer rate to 6.1% ($P = .0405$). Hospital readmission of MICU patients also significantly decreased from 17.1% to 11.5% ($P = .0010$). The mean MICU length of stay decreased by 1 day. There were no safety issues directly or indirectly associated with these interventions.

**CONCLUSIONS:** Use of this mobility program resulted in a 3% decrease in the most recalcitrant patients in the MICU. This corresponds to a decrease of 1.2 per 1000 patient days. It is definitely both statistically and clinically significant. We believe this lays the groundwork for further work in this area. We have shown that properly trained nonlicensed professionals can safely and effectively mobilize patients in the ICU setting. This can represent a cost-effective way to introduce early mobility in the ICU setting.

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**KEYWORDS:** Early mobility in intensive care unit; Mobility protocol; Mobility team; Prospective hospital-acquired pressure ulcer

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Pressure ulcer formation continues to be problematic in acute care settings, especially intensive care units (ICUs), despite comprehensive training, education, and newer prevention and treatment techniques. A review of the ICU literature from 2000 to 2005 showed a pressure ulcer prevalence (based on the total number of existing cases among the whole population at a given time) of 4% to as high as 49%; even though 71% of hospitals used prevention and treatment protocols and 61% of caregivers specialized in prevention and treatment of pressure ulcers.[1] Pressure ulcer incidence (the number of persons developing new pressure ulcers during a period of time) ranged between 3.8% and 12.4%.[1] In the International Pressure Ulcer Prevalence Survey in 2009, facility-acquired pressure ulcer prevalence rates were highest in the medical intensive care unit (MICU) at 12.1%.[2]

**CLINICAL SIGNIFICANCE**

- A 5-point mobility scale was created to establish a patient's highest level of activity achievable.
- During the study, the hospital-acquired pressure ulcer rate decreased 3.1% in the medical intensive care unit.
- Hospital readmission decreased 5.6% for this group.
- With the aid of a dedicated mobility team, patients exhibited interest and motivation to improve their mobility while in the hospital.

International guidelines for the prevention of pressure ulcers focus on evidence-based recommendations for risk assessment, skin assessment, nutrition, support surfaces, and repositioning.[3-5] Although repositioning is important, recent research suggests that there should be more aggressive mobility goals for ICU patients. Schweickert et al[6] showed in a randomized, controlled study that early mobility improved functional outcomes at hospital discharge. This study and many similar nonrandomized studies have shown a number of positive patient outcomes and potential cost savings for early mobility in the ICU.[7] However, some are concerned that many ICUs may not be able to provide these highly skilled practitioners for this resource-intensive intervention.[6,8,9] Because of this concern, our institution investigated the utility of specialty-trained unlicensed individuals to perform patient mobility in the ICU.

This study investigated the benefit of a mobility team of rehabilitation specialists (physical or occupational therapists) and skin-care nurses that utilized patient mobility assistants to improve mobility in ICU units during January to December of 2013. The patient mobility assistant role was developed as a new job position for this project and was equivalent to a certified nursing assistant. They were given additional training in mobilizing patients, skin care, and patient safety. The program effectiveness was measured by assessing the rates of hospital-acquired pressure ulcers, as there have been strong financial pressures to minimize hospital-acquired pressure ulcers due to their role in extending hospital stay and adding cost.[10,11] Hospital leadership believed that if the team could show that a less expensive staffing model could impact an outcome that is directly related to hospital reimbursement, the program could more easily justify an investment in additional staff to support early mobility in the ICU.

## MATERIALS AND METHODS

The mobility pilot study was set up as a quality improvement initiative for patients at risk for hospital-acquired pressure ulcer. Inclusion criteria were admission to the MICU and a Braden Scale score under 19. The Braden scale is a validated summated rating scale with scores ranging from 6-23 based on 6 indicators: sensory perception, moisture, activity, mobility, nutrition, and friction or shear.[12] The primary goal was to reduce hospital-acquired pressure ulcer incidence. Secondary goals included decreased ventilator-associated pneumonia, hospital or ICU length of stay, and hospital readmission rates. Self-monitoring process metrics based on the interventions were used to measure specific aspects of the program that were deemed critical to the outcomes. The percentage of patients at each mobility level was collected every Wednesday and displayed in a dashboard. Negative events and patient satisfaction with the program were also monitored. Patient safety was reviewed through documentation sent to the project manager, and patient satisfaction with the team was evaluated with a survey card given to a sample of patients prior to discharge.

A 5-point mobility scale was developed based on previous experience within our institution, as well as a review of the literature. The scale was used to establish a patient's highest level of activity achievable during the evaluation and ranged from mobility level 1 (bed rest) to 5 (complete independence) (**Table 1**). The interventions associated with each level maximized the patient's abilities within that classification and guided care when/if patients advanced to the next level (Appendix, available online).

Each morning, the team collaborated with the bedside nurse. This consisted of reviewing the patient's overnight events, vital signs, previous and current mobility level, presence of any skin lesions, and plan for the day. The patient mobility assistant performed interventions according to the mobility level with unit staff or team members during subsequent patient encounters. The rehabilitation specialists assisted with the more complex patients, ordered equipment, educated the patient/family about the need for mobility, and reassessed patients who were ready to progress to the next level. The skin-care nurses performed a visual skin assessment on admission and follow-up as needed based on clinical status and length of stay in the ICU. They ordered skin protection aids and educated staff and patient/families about hospital-acquired pressure ulcer prevention. All patients were enrolled and monitored while in the MICU

**Table 1** Mobility Levels with Descriptor and Intervention Example

| Mobility Level | Description | Common Interventions for Each Mobility Level* |
|---|---|---|
| 1 | Bed rest | Reposition every 2 h and as needed. Range of motion based on restrictions every 4 h. |
| 2 | Edge of the bed | Up to 3 times per day for 5-30 min. Initiate assisted or active exercises. |
| 3 | Stand to chair | Up in chair 3 times per day for 30 min. |
| 4 | Walk with assistance | Up in chair for all meals and walk 3 times per day with assistance. |
| 5 | Walk independently | Up in chair for all meals and walk 3 times per day. |

*For patients who do not progress in mobility as expected or are not tolerating the interventions, the nurse will collaborate with the provider for a physical or occupational therapy consult.

unless they were deemed unstable. Patients with hospital-acquired pressure ulcers were followed by a skin-care nurse until discharge.

Daily data collection for each MICU patient by the team included the type of interventions at each encounter, whether mobility and skin assessments were performed, whether a new hospital-acquired pressure ulcer had occurred, the current mobility level, and the daily Braden score. A data entry clerk entered these data into an online database. The process measure data were displayed in run charts. The hospital's hospital-acquired pressure ulcer rate was derived from the monthly skin inspection prevalence audits. The baseline hospital-acquired pressure ulcer rate was derived from the quarter preceding the ramp-up of the pilot study, third quarter of 2012.

The primary outcome for our study was hospital-acquired pressure ulcer rate. This was calculated as number of all pressure ulcers (stages 1-4, unstageable and deep tissue injury) as a percentage of all patients in the MICU. This was compared with historic preintervention data. We also tracked the number and category of interventions performed during the study period. Secondary outcomes recorded included MICU length of stay, hospital readmission of MICU patients, and ventilator-associated pneumonia of the study patients. Safety was a paramount concern for this project. We enforced to all caregivers the importance of monitoring and recording major and minor safety issues. Major issues to be tracked included falls, injuries, unwitnessed disconnections, and any coincidental change in the patient's clinical status. Minor issues we tracked included witnessed disconnections and patient care delays. We also tracked patient and family complaints.

Specific interventions for each patient were defined by the mobility level based on medical history, physical examination, the patient's condition, and the bedside caregiver's input. The interventions fell into general categories for recordkeeping. The interventions included reposition (level 1), range of motion (level 1), sitting bedside unsupported (level 2), assistance with activities of daily living (level 2), transfer from bed to chair (level 3), exercise while seated (level 4), and ambulation and stationary bicycle (level 5). In some cases patients were deemed a level higher than 1 but were too tired or distracted to participate. In those cases, education and reinforcement were provided.

Patient satisfaction cards were given to patients (or their significant other) that the team worked with for at least 2 days who were willing to provide feedback starting in August 2013. A patient is deemed satisfied if their response card has 3 or more "always" answers for the following 4 statements: 1) the mobility team introduced themselves; 2) I knew what activity we were going to do; 3) I felt comfortable asking questions; and 4) the team was polite and respectful. The team distributed cards to 335 patients from August to December 2013.

## Statistical Methods

The data were analyzed using SAS version 9.4 (SAS Institute Inc, Cary, NC). Categorical variables are displayed as frequency and percent, numeric as mean and standard deviation. Statistical significance was set at $P < .05$. To test for differences, chi-squared test of independence was used for categorical variables and independent $t$ test or Wilcoxon rank-sum test for numeric variables. For the hospital-wide data on hospital-acquired pressure ulcers, length of stay, readmission, and ventilator-associated pneumonia, we assumed that observations were independent because the data were from different years.

## RESULTS

During the 1-year study interval, 3233 patients were enrolled from the MICU. The demographics of this patient population are shown in Table 2. The preimplementation (2011) MICU hospital-acquired pressure ulcer rate was 9.2%. After 1 year of employing the mobility team, the 2013 MICU hospital-acquired pressure ulcer rate was 6.2%. Using the chi-squared test of independence, we calculated the hospital-acquired pressure ulcer rate significantly decreased for the MICU from 2011 to 2013 ($P = .0405$). Patient safety was monitored throughout. There were no serious or critical incidents. There were 2 minor incidents. Both were witnessed and corrected immediately. In one case an intravenous line was disconnected and immediately re-connected. In the other incident, transcutaneous pacer wires were disconnected and immediately re-connected. The patient was not being paced at the time. There were no patient or family complaints.

Secondary outcomes were also tracked. Hospital readmission of MICU patients significantly decreased from 17.1% in 2011 to 11.5% in 2013 ($P = .0010$). The mean MICU length of stay decreased from 11.7 to 10.7 days

**Table 2** Patient Demographics with Comparison to Historical Control

| Category | Variable | % 2011 | % 2013 |
|---|---|---|---|
| Sex | Female | 44.8% | 47.7% |
| | Male | 55.2% | 52.3% |
| Race | Black | 51.9% | 56.8% |
| | White | 45.2% | 41.6% |
| | Other* | 2.9% | 1.6% |
| Age, y | 18-25 | 1.8% | 3.3% |
| | 26-64 | 50.6% | 53.2% |
| | 65+ | 47.6% | 43.5% |
| Insurance | Medicare/Medicaid | 61.4% | 65.8% |
| | Uninsured | 29.0% | 21.1% |
| | Private/other† | 9.6% | 13.1% |
| Case mix index | Medicare patients | 1.683 | 1.838 |

None of the statistical comparisons between 2011 and 2013 were statically significant, $P < .05$.

*Other included Hispanic or Latino, American Indian/Alaskan Native, Native Hawaiian or Pacific Islander, Asian, and 2 or more races.

†Insurance — Tricare, Veteran Affairs Health System, or insurance information was not available.

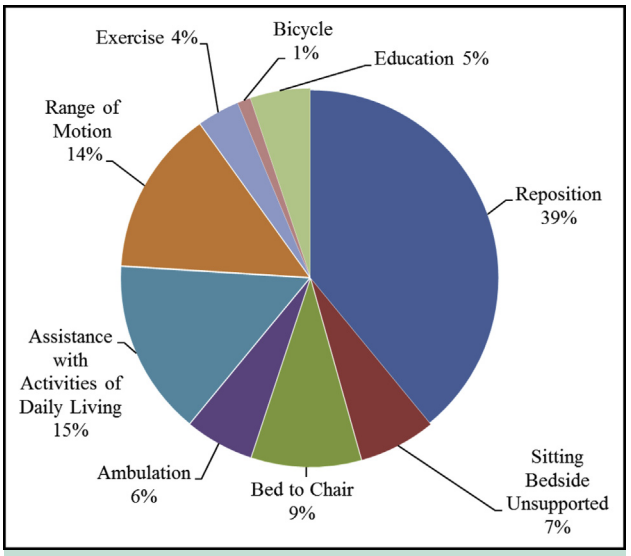


**Figure** Year 2013 total interventions.

during that same interval. The ventilator-associated pneumonia rate did not decrease as expected in the MICUs. This may have been due to much higher patient acuity.

The number and nature of interventions was also documented. The number of interventions was calculated as the average number of interventions per patient per day. The denominator was the total number of days seen and the numerator was the total number of interventions. The mean number of interventions per patient per day increased from 2.11 during the first quarter to 2.51 for the fourth quarter. The **Figure** shows the distribution of the interventions. Qualitative changes were noted in the way the program was implemented over the course of the study that resulted in a change in the frequency of interventions over time. Repositioning and assistance with Activities of Daily Living both increased significantly from the first to the fourth quarter, and the interventions labeled "Up in Chair" and "Dangled" significantly decreased ($P < .0001$). Of the remaining 5 interventions, they also decreased in frequency, but the amount was not significant (**Table 3**).

Sixty-four percent (213/335) of patient satisfaction cards were completed and returned. Overall, 97% (207/213) of patients were satisfied with the team's interactions with them. Many patients included positive comments specifically thanking the patient mobility assistant for being focused on the patient's well-being and recovery. There were no adverse events reported as a result of this program.

## DISCUSSION

The results show that focused attention on patient mobility with the addition of trained personnel may improve certain clinical outcomes. More importantly, it can be done safely and reliably. Over the course of the study, there was a statistically significant decrease in the hospital-acquired pressure ulcer rate to 3.0% in the MICU. This corresponds to a decrease of 1.2 per 1000 patient days, which is clinically significant given the high acuity of this patient cohort. Other secondary outcomes that were followed were hospital readmission of MICU patients and MICU length of stay. Prolonged ICU stay does correlate with loss of muscle mass.[13,14] This loss correlated to a longer length of stay. The secondary outcomes for this project showed positive changes with respect to readmission and length of stay, which may be attributed to decreased patient deconditioning in the MICU (**Table 4**). It is the deconditioning that leads to many of the physical impairments seen even 2 years after hospital discharge.[15] This can be a financial drain if the person cannot return to previous gainful employment. It can also be a psychological and emotional

**Table 3** Summary of Outcomes

| MICU Care Measures | Preimplementation | Postimplementation | *P*-Value |
|---|---|---|---|
| Hospital-acquired pressure ulcers prevalence | 9.20% | 6.10% | .041* |
| Hospital readmission rate | 17.10% | 11.50% | .001* |
| Length of stay (d) | 11.7 | 10.7 | .165 |
| Patient satisfaction | - | 97% | - |

MICU = medical intensive care unit.
*$P < 0.05$ significant.

**Table 4** Average Number of Interventions Per Patient Per Day

| | Quarter 1 2013 | Quarter 4 2013 | |
|---|---|---|---|
| Intervention | Mean ± SD | Mean ± SD | *P*-Value |
| Reposition | 0.55 ± 0.61 | 1.08 ± 0.98 | <.0001* |
| Assistance with activities of daily living | 0.28 ± 0.36 | 0.43 ± 0.46 | <.0001* |
| Bed to chair | 0.36 ± 0.43 | 0.27 ± 0.45 | <.0001* |
| Sitting bedside unsupported | 0.19 ± 0.30 | 0.13 ± 0.28 | <.0001* |
| Exercise | 0.09 ± 0.20 | 0.07 ± 0.19 | .0413* |
| Bicycle | 0.03 ± 0.12 | 0.02 ± 0.10 | .0406* |
| Education | 0.14 ± 0.23 | 0.10 ± 0.24 | .0024* |
| Ambulation | 0.20 ± 0.33 | 0.18 ± 0.40 | .1096 |
| Range of motion | 0.26 ± 0.40 | 0.24 ± 0.35 | .3057 |

SD = standard deviation.
*$P$ <.05 significant.

problem for family members who have to become caregivers after discharge.

There was a statistically significant decrease of 33% in hospital readmission for MICU patients who participated in the mobility program. This is despite an upward trend in case mix index severity relative to the control population. Fewer pressure ulcers means fewer niduses for infection, less need for skilled nursing, and less pain.[16] For a patient on the borderline of continuing on a healing trajectory after discharge, small perturbations can have substantial ramifications. A pressure ulcer may result in less physical reserve for a patient. A small setback after discharge may be easier for the body to compensate for in the absence of a hospital-acquired pressure ulcer. This patient can therefore continue to be managed successfully outside of the acute care setting. This has very real financial and resource-allocation ramifications. All health systems have to be aware of their readmissions. Not only are many readmissions not paid for by third-party payers, but there is also public reporting now in place.[17] This gets buy-in from administrators and managers. No longer can the system push back that this is merely a provider education and bedside care issue. Resources and personnel must be allocated specifically for this problem if quality outcome is the desired goal.

Mobility in the MICU is not a novel idea.[6-9,14,15,18,19] Others have shown the benefit of physical therapists in the ICU to impact all facets of deconditioning. There are clear and reproducible benefits both immediately and in the long term for early mobility. Despite being in the literature for over almost a decade, a recent national survey showed <50% of ICUs had adopted an early mobility program in 2015.[17] Staffing was considered one of the major hurdles. Such a staffing model may be expensive and impractical on a large scale. To be impactful, our 68-bed MICU would likely need 8 dedicated therapists to provide 7 day/week mobility. This is difficult to imagine at one institution, let alone scalable to a national level. The goal of our work was not to replace what others have advocated for early mobility, but rather to offer another option. Unlicensed personnel under the supervision and direction of therapists and nurses can be the lynchpin in an early mobility program.

The cost savings of our model compared with a physical therapist model are obvious. We have also shown cost savings for payers and our own institution by paying for prevention instead of treatment (manuscript in preparation). Although Medicare does not reimburse for hospital-acquired pressure ulcers, there are many numerous downstream costs for a patient discharged from the hospital with a pressure ulcer; dressing supplies, skilled nursing, surgical debridement and reconstruction in the outpatient setting, and specialty equipment can be costly.[16] For the hospital, all the items not reimbursed by payers during the hospital stay have both a financial and a resource management impact.[16,20] If the institution's wound team is occupied managing hospital-acquired pressure ulcers, there is little time available to focus on prevention and education.

Limitations of the study include its design. The study was designed to be a prospective consecutive case series. A randomized protocol may have been more powerful. Logistically, a randomized study would be very difficult to manage. Trying to administer the program in only half of the MICU or in a staggered manner would have made training and acceptance of our team difficult. Inherent in this model is the idea of culture change. We wanted the ICU staff to embrace the concept of early mobility.[21] This meant adjusting sedation schedules, active participation in quality rounds, and acceptance of the patient mobility assistants as integral team members. The bedside staff would come to anticipate and appreciate the mobility team. Historical control meant that the populations might have been different, possibly from different referral patterns, specific infectious outbreaks, or socioeconomic conditions. Our review of the data did not bear this out.

## CONCLUSION

There is increasing attention and focus on hospital-acquired conditions. Assessment of a patient's mobility level and performing prevention interventions during each phase of their recovery can play an important part in decreasing hospital-acquired conditions. Improving mobility through the use of a mobility team using patient mobility assistants may be one solution. Our findings suggest that specially trained unlicensed personnel in conjunction with nurses and therapists can provide a safe and effective program of early mobility in the ICU. Use of these personnel can provide lower-cost additional manpower to impact the problems of immobility, including hospital-acquired pressure ulcers. Further work is necessary on how to expand and modify this type of program for various patient populations and settings. Patients and their families reported satisfaction with the program, and there were no adverse events. This innovative

design has been well received by overworked unit staff and their managers.

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## SUPPLEMENTARY DATA

Supplementary appendix accompanying this article can be found in the online version at http://dx.doi.org/10.1016/j.amjmed.2016.03.032.

## APPENDIX

Interventions

| Intervention | Description |
|---|---|
| Reposition | Patient is moved in bed to off-load pressure areas (floating heels, shift position, and restraint skin checks) or bed is placed in the chair position |
| Activities of Daily Living | Assisting the patient with activities an individual normally performs on a daily basis for self-care, such as feeding, bathing, dressing or grooming |
| Up in Chair | Patient stands and is assisted with pivoting into or out of a chair positioned next to the bed |
| Dangled | Patient sits at the edge of bed with assistance |
| Exercise | Exercises with patient participation (includes active range of motion and arm and leg bike exercises) |
| Order Equipment | Ordering of bed or chair cushions, turn and position system or assistive walking devices |
| Education | Information given to patient or family about the need to reposition while in bed to prevent pressure ulcers or pressure ulcer prevention strategies and products. Reasons about the need and benefit of progressive mobilization are provided when patient improves |
| Ambulation | Four or more steps taken in a standing position with or without assist |
| Range of Motion | The mobility team moves the patient limbs through range of motion exercises (no patient assistance)<br>When the patient performs 100% of the movement on his or her own after being directed to do so by the mobility team |