The Effect of an Early Mobility Protocol in Critically Ill Mechanically Ventilated Patients on Incidence and Duration of Delirium and Length of Stay

Melody R. Campbell

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THE EFFECT OF AN EARLY MOBILITY PROTOCOL IN CRITICALLY ILL MECHANICALLY VENTILATED PATIENTS ON INCIDENCE AND DURATION OF DELIRUM AND LENGTH OF STAY

A Capstone Project submitted in Partial Fulfillment of the Requirements of for the Degree of Doctor of Nursing Practice

By

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2014
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University of Toledo College of Nursing
Abstract

Campbell, Melody R.  D.N.P.  College of Nursing and Health, Wright State University, 2014. The Effect of an Early Mobility Protocol in Critically Ill, Mechanically Ventilated Patients on Incidence and Duration of Delirium and Ventilator and Intensive Care Unit Length of Stay

Delirium in mechanically ventilated patients is a significant problem. At Good Samaritan Hospital, the incidence of delirium in mechanically ventilated patients was found to be 78%, which is similar to results found by other researchers. Delirium is associated with longer lengths of stay on the mechanical ventilator, in the ICU, and hospital, as well as higher ICU mortality and healthcare costs.

The use of an early mobility protocol has demonstrated effectiveness in decreasing delirium and ventilator stay with minimal risk or harm to patients. The objective of the project was to answer a population-intervention-comparison-outcome-time question (PICOT): In (P) critically ill, mechanically ventilated patients, what is the effect of (I) an early mobilization protocol (as (C) compared to no intervention) on (O) delirium and intensive care unit length of stay over the course of three months (T)?

Champions for each discipline were selected to form a multidisciplinary team. An early mobility protocol and implementation plan, utilizing the Evidence-Based Performance Improvement Model was developed. High fidelity human simulation and small tests of change with actual patients helped build teamwork as well as establish a pattern of safety. Retrospective chart review was utilized to collect outcomes such as
incidence and duration of delirium as assessed by the Confusion Assessment Method-ICU, length of stay including ventilator, ICU and hospital, as well as the occurrence of adverse events during early mobility. Descriptive statistics as well as independent sample $T$-tests and chi-squared methods were used to analyze the data. Fifty-eight patients were included in analysis. Early mobility was implemented in 53% of the patients. Incidence of delirium was high in all patients (91%). Results were attributed to inaccuracy of delirium assessment, analgesia and sedation practices, as well as build of the electronic medical record. There was no statistical significance in ventilator, ICU, and hospital length of stay as well as incidence and duration of delirium between those who had early mobility and those that did not. There were no adverse events during 67 sessions of early mobility. The implementation of early mobility was successful and was sustained one year later.
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Introduction

For many years delirium has been a problem in intensive care units (Arend and Christensen, 2009). Delirium is defined as “an acute change or fluctuation in mental status, inattention, and disorganized thinking or alteration in level of consciousness (Pun and Ely, 2007, p. 624)”. Delirium has been referred to by other names including Intensive Care Unit (ICU) psychosis or ICU syndrome (Pun and Ely, 2007). Patients become agitated and restless, often experiencing visual and auditory hallucinations (Balas et al. 2012). Delirium was felt to be a direct result of being in the ICU and was a problem that was common-place, expected and temporary (Arend and Christensen, 2009). Additional subtypes of delirium have also been recognized including hyperactivity, hypoactivity, and a mixed motoric subtype (Peterson, et al. 2006). Forty-three percent of patients with delirium actually go undiagnosed as the patient appears to be sleeping (Peterson, et al. 2006).

Recent studies have documented the far reaching impact of delirium resulting in increased morbidity and mortality (Balas, Happ, Yang, Chelluri & Richmond, 2009; Lat et al. 2009). Patients with delirium are at risk for increased length of stay on the mechanical ventilator as well as associated complications that can include aspiration, ventilator associated pneumonia, hospital acquired pressure ulcers and deep vein thrombosis (Seeling, Heymann & Spies, 2009). The development of delirium is associated with increased cost of healthcare (Leslie, Marcantonio, Zhang, Leo-Summers & Inouye, 2008), and the effect of delirium extends beyond discharge from the hospital.
Delirium assessment tools have been developed to assist healthcare providers in identifying patients with this syndrome (Bergeron, Dubois, Dumont, Dial & Skrobik, 2001; Ely et al. 2001). The Confusion Assessment Method- ICU (CAM-ICU) (Ely et al. 2001) and the Intensive Care Unit Delirium Screening Checklist (ICDSC) (Bergeron et al. 2001) have been recommended for use to assess for delirium (Barr et al. 2013). The prevalence of delirium in mechanically ventilated patients has been found to be as high as 60-80% as assessed by the CAM-ICU (Gunther, Morandi & Ely, 2008).

Early exercise/mobility has been introduced as an intervention to decrease duration of delirium and ventilator days (Needham et al. 2010, Pohlman et al. 2010; Schweikert et al. 2009). A recently published clinical practice guideline from the Society of Critical Care Medicine details care for the management of pain, agitation, and delirium in adult patients in the ICU (Barr et al. 2013). Within this guideline is described a new bundle of interventions to be utilized in the care of the mechanically ventilated patient. These interventions identified by the mnemonic “ABCDE” include: Awakening and Breathing trial Coordination, Careful selection of sedative, Delirium assessment and management, and Early mobility (Barr et al. 2013; Morandi, Brummel & Ely, 2011).

In the ICU at Good Samaritan Hospital (GSH) located in Dayton, Ohio, the majority of the “ABCDE bundle” (Barr et al. 2013; Morandi, Brummel & Ely, 2011) had already been implemented. Awakening and breathing trial coordination was implemented in 2009 in the form of a sedation vacation protocol paired with a spontaneous breathing trial utilized when appropriate according to specific patient
condition criteria. This implementation was aided by participation in a Critical Care Collaborative with the Institute of Healthcare Improvement (IHI). Experts from IHI provided coaching and mentoring regarding implementation of sedation vacation and spontaneous breathing trials. Hospitals participating in the Critical Care Collaborative shared best practices and pitfalls of implementation. Careful choice of sedative was facilitated by the creation of computerized order sets. Physicians were monetarily incentivized to utilize the standard order sets for care of the patient on the mechanical ventilator. Delirium assessment using the CAM-ICU (Ely et al. 2001) was implemented in September 2009. The experts from IHI including Dr. Wes Ely from Vanderbilt University assisted in provision of education regarding implementation of the CAM-ICU. The change of practice was reinforced by interdisciplinary rounding led by a critical care clinical nurse specialist (CNS) and pharmacist. Early mobility, the last part of this new ventilator bundle, had not yet been implemented.

**Significance and Justification**

In 2010, the incidence and prevalence of delirium among mechanically ventilated patients was examined in a small pilot study (N=30) conducted in the ICU at Good Samaritan Hospital. A retrospective chart review was used to examine assessment of delirium using the CAM-ICU. There was a 78% incidence and 81% prevalence of delirium in subjects on the mechanical ventilator for more than 48 hours (Meyer, Campbell & Vermeersch, 2011). These results are congruent with those found by other researchers (Lat et al. 2009, Pandharipande et al. 2008, Pandharipande et al. 2013 and Pisani et al. 2007).
Delirium has many consequences, including a greater number of ventilator days, longer ICU length of stay and longer overall hospital length of stay (Lat et al. 2009). Patients that experience delirium have a higher ICU mortality (Pun and Ely, 2007) and higher mortality at one year post discharge (Jacobi et al. 2002; Pisani et al. 2007; Pisani et al. 2009). Patients who survived were more likely to be discharged to some place other than their home (Balas et al. 2009). For those patients with Alzheimer’s disease, delirium may actually accelerate the progression of decline (Fong et al. 2009). Those that experience delirium during their critical illness suffer long-term cognitive impairment and disability in activities of daily living (Brummel et al. 2014; Pandharipande et al. 2013).

Healthcare costs are higher for those patients that experience delirium (Morandi, Jackson, & Ely, 2009). Average costs have been documented to be 2 ½ times the costs of those patients who do not experience delirium. Total costs linked to delirium can range from $16,303 to $64,421 per patient and when extrapolated become significant as a burden on our national health system, which may range from $38 billion to $152 billion per year (Leslie et al. 2008).

Statement of Purpose

The purpose of this evidence-based practice project was to implement early mobility as part of a bundled approach to care for mechanically ventilated patients in critical care. The objective of the project is to answer a particular population-intervention-comparison-outcome-time question (PICOT): In (P) critically ill, mechanically ventilated patients, what is the effect of (I) an early mobilization protocol
(as (C) compared to no intervention) on (O) incidence and duration of delirium as well as intensive care unit length of stay over the course of 3 months?

**Evidence-Based Practice Model**

The Evidence-Based Practice Improvement Model (EBPI) (Levin, Keefer, Marren, Lauder & Sobolewski, 2010) guiding this project. Permission to use the model was obtained from Rona F. Levin, PhD (Appendix A). The schematic for the EBPI model can be found in Figure 1. This model is a combination of performance improvement and evidence-based practice (EBP) and is most similar to the method used for the implementation of EBP projects in the GSH ICU during its association with IHI. The model has seven steps which include: describe the problem, formulate a focused clinical question, search for evidence, appraise and synthesize evidence, develop an aim statement, engage in small tests of change (plan-do-study-act cycles), and finally disseminate best practices. The implementation of the project utilizing the EBPI model is described in Chapter III.

**Summary**

Delirium has become a pervasive problem for the majority of patients that require mechanical ventilation. Because of the significant impact in terms of mortality, morbidity, higher healthcare costs and impairment in cognition and activities of daily living following hospital discharge, it is important to implement interventions to prevent and/or decrease the incidence of delirium. Early mobility as a part of a bundled approach to care may prove to be a preventative intervention, or assist to decrease the duration of delirium as well as ventilator and ICU length of stay. An extensive review of the
literature was done to help determine how to design a protocol for early mobility as well as methods for implementation of the intervention.

Figure 1  Evidence-Based Practice Improvement Model

II. Review of the Literature

This chapter will discuss how the evidence was collected, critically appraised and synthesized. The concepts used for the evidence review included delirium, early mobility, and mechanical ventilation. Research studies and other levels of evidence will be detailed. Gaps in evidence as well as recommendations for practice will be examined.

Search Strategies for Review of the Literature

Electronic databases searched for evidence included Cochrane, PubMed, and CINAHL. Key words included mechanical ventilation, critically ill, critical illness, early mobilization protocol, early mobilization, delirium, intensive care unit, length of stay, early mobility, sedation, physical rehabilitation, and physical therapy. In CINAHL, limits included research, English, human, and all adults. Related citations were reviewed in PubMed with limitations of clinical trials, human, English, and limiting publication to the last five years (2007-2012). References were reviewed from key articles to search for additional sources of evidence. Articles were included in the appraisal if content focused on early mobility in the critically ill and mechanically ventilated patient. Articles were excluded if subjects were not mechanically ventilated or those focusing on mobility, physical therapy, and rehabilitation occurring outside of the intensive care unit.

In the method articulated by Melynk and Fineout-Overholt (2011), the evidence was examined in reference to the elements of the PICOT question. This rating system which organizes evidence by the strength of the research was utilized to categorize the articles that were found through the search. Level I evidence, that established by meta-
analysis or systematic review and also the highest level of evidence, was not found. There were no Cochrane reviews or national practice guidelines found in relation to the PICOT question at the time of the search.

Eighteen articles found through the search strategy included seven research studies: one randomized control trial (level II), three cohort studies (level IV), one descriptive study (level VI), and two quality improvement projects (level VI). Of the seven research studies, one study was not directly related to the PICOT question, but described barriers and facilitators for implementation of early mobility. This was included in the evaluation of the literature but not in the synthesis. Eleven articles were foundation knowledge or of expert opinion (Level VII). Two of these level VII articles contained detailed early mobility protocols. Evaluation tables for each article can be found in Tables 1 through 9 on the next page.
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<td>Schweickert, W. D., Pohlman, M. C., Pohlman, A. S., Nigos, C., Pawlik, A. J., Esbrook, C. L., … Kress, J. P. (2009). Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomized controlled trial. <em>The Lancet</em>, 373(9678), 1874-82. doi: 10.1016/S0140-6736(09)60658-9</td>
<td>None</td>
<td>Design: Randomized controlled trial</td>
<td>N = 104 critically ill, mechanically ventilated for more than 72 hours. Control group N = 55. Intervention group N = 49.</td>
<td>IV- early exercise and mobilization</td>
<td>Functional Independence Measure</td>
<td>X², Fisher exact test to compare variables between two groups</td>
<td>Majority (59%) of intervention group returned to independent functional status at hospital discharge as compared to control (35%); p=.02, O.R. 2.7 (95% CI 1.2-6.1)</td>
<td>Strengths-established safety in performance of early exercise and mobilization in select population. Well-orchestrated study.</td>
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<td></td>
<td>Purpose: To study efficacy of combining daily interruption of sedation with PT/OT on functional outcomes in mech vented pt.</td>
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<td></td>
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<td></td>
<td>Weakness – Subjects included patients who may be considered more well prior to onset of critical illness. Not generalizable to all critically ill, mechanically ventilated patients. Smaller sample size, even though power analysis was done prior to beginning study.</td>
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<tr>
<td></td>
<td>Setting: University of Chicago Medical Center and University of Iowa Hospitals</td>
<td>N = 55</td>
<td>Number of hospital days without delirium (measured by the CAM-ICU)</td>
<td>Number of days alive and breathing without assistance (ventilator-free days) during first 28 days of hospital stay</td>
<td>ICU LOS</td>
<td>Kaplan-Meier procedure used to compare effect of treatment protocol on return to independent functional status. Logistic, and Cox regression models used to predict outcomes.</td>
<td>One serious adverse event in 498 sessions: desat &lt; 80%.</td>
<td>Conclusion: Beginning study examining implement of early mobility in care of mechanically ventilated patient. Good results.</td>
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<td></td>
<td>Hospital LOS</td>
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<td>Feasibility: Risk/Benefit</td>
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<td>Bailey, P., Thomsen, G. E., Spuhler, V. J., Blair, R., Jewkes, J., Bezdjian, L., … Hopkins, R. O. (2007). Early activity is feasible and safe in respiratory failure patients. Critical Care Medicine, 35(1), 139-145. doi: 10.1097/01.CCM.0000251130.69568.87 (Level IV evidence)</td>
<td>None</td>
<td>Design: Prospective cohort study Purpose: Determine whether early activity is feasible and safe in respiratory failure pt. Setting: LDS Hospital, Salt Lake City, Utah Respiratory ICU (patients often treated in another ICU before being transferred there)</td>
<td>IV: Early activity Duration of mechanical ventilation Total ICU LOS RICU LOS Hospital LOS Hospital to RICU admission APACHE II scores Multiple organ failure score Highest FiO₂ in any ICU Lowest PaO₂ mm Hg in any ICU Lowest PaO₂/FiO₂ in any ICU Endotracheal intubation – 49% (249 events) were ambulation. Adverse events &lt; 1% .</td>
<td>Descriptive statistics for demographic, medical, activity, and adverse events.</td>
<td>&gt;50% patients had multiple co-morbidities. 57% male. Median age was 63 y. 94% of patients admitted to another ICU before the RICU (admission mean 10.5 ± 9.9 days) = 89% of patients on mechanical ventilation. 1,449 activity events were studied. 223 (16%) sit on bed, 454 (31%) sit in chair, 726 (53%) ambulate.</td>
<td>Strength: Demonstrate impact of multidiscipline team on improving outcomes in critically ill. Weakness: Patients in another ICU before transfer to RICU. Time to exercise – longer than in other studies. Worth to practice: development of definition of initial physiologic stabilization. Could be seen as safety screen for early mobility Feasibility: Reasonable intervention Risk/Benefit (Harm) No serious adverse events.</td>
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<td>Citation</td>
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<td>Morris, P. E., Goad, A., Thompson, C., Taylor, K., Harry, B., Passmore, L. … &amp; Haponik, E. (2008). Early intensive care unit mobility therapy in the treatment of acute respiratory failure. <em>Critical Care Medicine</em>, 36(8), 2238-2243. doi: 10.1097/CCM.0b013e318180b90e (Level IV evidence)</td>
<td>Quality improvement project</td>
<td>Design: Prospective cohort study</td>
<td>N = 330 mechanically ventilated patients. Control N= 165 Intervention N = 165 Setting: University hospital MICU Wake Forest Winston Salem, N.C.</td>
<td>IV = Protocol DV = Proportion of patients surviving to hospital discharge who had received ICU physical therapy. Secondary outcomes: days until first OOB, ventilator days, ICU LOS, hospital LOS. Average days until patient first got out of bed = 8.5 days.</td>
<td>Demographics Mortality Baseline assessment Hospital outcomes</td>
<td>Descriptive statistics Means, standard deviations for continuous measures. Counts and percentages for categorical measures Student’s t-test comparison between groups – continuous variables Chi-square categorical variables. Multiple linear regression to identify significant variables assoc with outcomes.</td>
<td>More protocol patients received at least one physical therapy session than did usual care patients Protocol patients OOB earlier, hospital LOS shorter. No untoward events, no cost difference between treatment arms.</td>
<td>Strength: Good description of process used for mobility team. Safety demonstrated More discussions of operations, no link to outcome related to delirium. Strength and Weakness: Independent team delivered the mobility intervention - this is an advantage for study outcomes but may decrease applicability in practice. Feasibility: ● Good description of protocol could be replicated with ease. ● Risk/Benefit (Harm) Benefits outweigh risk.</td>
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Each patient served as his or her own control allowing comparison of control (pre-transfer) and intervention (post-transfer)
Purpose: To determine if ambulation of pt with acute resp. failure would increase with transfer to an ICU where activity is key component of care. | N = 104 patients requiring mechanical ventilation < 4 days
Setting: Adult ICU’s and RICU at LDS in Utah | IV: Early activity protocol in the RICU
DV: Ambulation of patients | Demographic data
Reason for admission
Comorbid disorders
LOS
APACHE II
Multiple organ failure scores
Vent data
Activity levels
Hospital disposition | Descriptive statistics
Mean ± SD
Multivariate logistic regression
LOS in another ICU on average 10.3 ± or – 7.5 days before transfer to this RICU. | Transfer to a unit where early activity is key component of care – significant increase in ambulation.
Likelihood of ambulation decreased with admin of sedatives.
Female gender and decreasing APACHE scores predicted increased ambulation. | Strengths: Unit culture and priorities impact outcome.
Weakness: RICU at LDS – second ICU placement for patient. Patient has decreased severity of illness.
Feasibility:
● Importance of changing culture.
● Risk/benefit (Harm) Benefits outweigh risk
Table 5

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<td>(Level VI evidence)</td>
<td></td>
<td>Purpose: Reduce deep sedation and delirium to permit mobilization.</td>
<td>Setting: 16 bed MICU – Johns Hopkins University</td>
<td>DV: Sedation and delirium status, rehab treatments, functional mobility.</td>
<td>Sedation and delirium status</td>
<td>Linear, logistic, and multinomial regression</td>
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<td>Citation</td>
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<th>Data Analysis</th>
<th>Findings</th>
<th>Appraisal: Worth to Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Design: Descriptive study of one arm of a randomized controlled trial</td>
<td>N = 49 mechanically ventilated patients</td>
<td>Described how intervention was performed.</td>
<td>None</td>
<td>None</td>
<td>Early PT/OT is feasible and safe from onset of mechanical ventilation.</td>
<td>Strength: Great explanation of how therapy was done including daily screen, contraindications to initiating PT/OT; contraindications to continuing therapy. Helpful for protocol development.</td>
</tr>
<tr>
<td></td>
<td>Purpose: Describe protocol of daily interruption of sedation and early PT/OT, neurocognitive state, potential barriers, and adverse events.</td>
<td>Setting: Two tertiary care academic medical centers</td>
<td></td>
<td></td>
<td></td>
<td>Weakness: Medical ICU patients, screened carefully for participation.</td>
<td></td>
</tr>
</tbody>
</table>

Feasibility: Not generalizable to all critically ill patients esp. surgical.

Risk/Benefit (Harm) Benefits outweigh risk in this select patient population.
<table>
<thead>
<tr>
<th>Citation</th>
<th>Conceptual Framework</th>
<th>Design/Method</th>
<th>Sample Setting</th>
<th>Major Variables Studied and Their Definitions</th>
<th>Measurement</th>
<th>Data Analysis</th>
<th>Findings</th>
<th>Appraisal: Worth to Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article 7</td>
<td>None</td>
<td>Design: Descriptive study</td>
<td>N= 33 nurses participated in 49 interviews; pre and post protocol implementation. Interview tool developed for study. Setting: academic medical center</td>
<td>Barriers</td>
<td>Demographics Characteristics of patients in study</td>
<td>Descriptive statistics Correlation Kendall tau</td>
<td>Staff availability, equipment not related to decision to implement activity Barriers: decreased consciousness, unstable vital signs, low respiratory and energy reserve, safety concerns, sedation or agitation. Facilitator: Cooperative pt., good oxygen reserve, Dr. order, new bed. Presence of protocol associated with planned out of bed activity</td>
<td>Strengths: Clearly written with good explanation of perceptions of nurses to progressive mobility. Weakness: None noted. Feasibility: Helpful to note perceptions prior to implementation of protocol – will aid in successful implementation. Risk/Benefit (Harm): No harm to patient. Interview of staff.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Citation</th>
<th>Conceptual Framework</th>
<th>Design/Method</th>
<th>Sample Setting</th>
<th>Major Variables Studied and Their Definitions</th>
<th>Measurement</th>
<th>Data Analysis</th>
<th>Findings</th>
<th>Appraisal: Worth to Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hopkins, R. O., &amp; Spuhler, V. J. (2009). Strategies for promoting early activity in critically ill mechanically ventilated patients. AACN Advanced Critical Care, 20(3), 277-289. (Level VII evidence)</td>
<td>None</td>
<td>Informational article</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Change in culture is determinant for success.</td>
<td>Protocol for early mobilization is included in article (from LDS in Utah). Good review of literature.</td>
</tr>
<tr>
<td>Citation</td>
<td>Conceptual Framework</td>
<td>Design/Method</td>
<td>Sample Setting</td>
<td>Major Variables Studied and Their Definitions</td>
<td>Measurement</td>
<td>Data Analysis</td>
<td>Findings</td>
<td>Appraisal: Worth to Practice</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
Critical Appraisal of the Evidence

Several articles written in the last several years have focused on the benefits of early mobility in critical care (Morris et al. 2008; Needham et al. 2010; Schweickert et al. 2009). Early mobility has been defined in reference to the timing during the patient’s critical illness trajectory (Bailey et al. 2007; Schweickert et al. 2009; Thomsen, Snow, Rodriguez, & Hopkins, 2008). One of the earliest studies defined the timing of early mobility as the “interval starting with initial physiologic stabilization and continuing through the ICU stay” (Bailey et al. 2007, p. 139). This was compared to usual care where activity began after the patient was transferred from the ICU to the floor. Another definition of early mobility describes it as beginning “when the patient is minimally able to participate with therapy, has a stable hemodynamic status, and is receiving acceptable levels of oxygen” (Perme and Chandrashekar, 2009, p. 214). In a randomized control trial, Schweickert et al. (2009) initiated early mobility in patients who had been mechanically ventilated less than 72 hours. These patients received early physical therapy (PT)/occupational therapy (OT) occurring within a median of 1.5 days (range 1.0-2.1 days) after intubation. Researchers used a list of contraindications to screen patients to determine when it was safe to begin early mobility (Morris et al. 2008; Needham et al. 2010). Studies done in a respiratory intensive care unit (RICU) found that the unit culture where activity was considered a key component of care positively influenced initiation of early mobility resulting in an increase in ambulation for both intubated and non-intubated patients (Hopkins and Spuhler, 2009; Thomsen et al. 2008).
Effect of early mobility on delirium and length of stay.

Two studies examined the effects of early mobility on delirium and length of stay. In the study by Schweickert et al. (2009), patients were randomized to receive early mobility versus usual care. Physical therapy was provided in 90% of the days that subjects were in the medical intensive care unit during daily interruption of sedation. Overall, patients in the intervention group (N=49) had a shorter duration of delirium (median 2.0 days, IQR 0-6.0 vs. 4.0 days, 2.0-8.0, p = 0.02) than those patients in the control group (N=55). Ventilator free days were increased in the intervention group (23.5 days, 7.4-25.6 vs. 21.1 days, 0-23.8, p=0.05). Length of stay in the ICU and hospital LOS were not changed. The intervention arm of this study is detailed further in a descriptive study (Pohlman et al. 2010). The early mobility protocol strategically coordinated daily awakening from sedation with PT/OT. When sedatives were turned off, passive range of motion was performed. The sedative remained off until the patient could actively participate, or until the patient’s condition warranted resumption of the sedative. Activity was gradually progressed in accordance with the patient’s wakefulness, medical condition and tolerance. A multidisciplinary team (Needham et al. 2010) implemented a quality improvement project which evaluated the impact of the early mobility protocol on sedation and delirium status, rehabilitation treatments and functional mobility. The change in practice improved all outcomes. Subjects were more often awake (29% vs. 66% of MICU days, p < 0.001) and not delirious (21% vs. 53%, p=.003). There was a much greater median number of rehabilitation treatments per patient (1 vs. 7, p= < .001), with a greater number of treatments including sitting at the edge of the bed (27 vs. 225, p= .020), transferring from bed to chair (3 vs. 113, p=.005),
transferring sitting to standing (12 vs. 145, \( p = .050 \)), as well as walking (2 vs 39, \( p = .240 \)).

The change in practice also resulted in a decreased intensive care LOS by 2.1 days; 95% C.I., (0.4-3.8 days) and hospital LOS by 3.1 days; 95% C.I. (0.3-5.9 days).

**Methods of early mobility.**

The intervention of early mobility is carried out in different methods in the various studies. An early study (Bailey et al. 2007) included sitting on the bed, sitting in a chair and progression to ambulation as the three activity events included in an early activity protocol. Early activity performed in this same RICU (Thomsen et al. 2008) was further delineated as progressing from sitting at the edge of the hospital bed without support, sitting in a chair after transfer from bed, and ambulation with a walker and support from RICU staff. Early mobility can begin with passive range of motion and progress to performance of activities of daily living, sitting, standing and then proceed to walking (Pohlman et al. 2010; Schweikert et al. 2009). Morris et al. (2008) implemented a protocol delivered by a mobility team composed of a physical therapist, critical care nurse and nursing assistant. This protocol had four levels of activity. The first level of activity was passive range of motion performed by the mobility team nursing assistant. Physical therapy was begun in the second level, which included active resistance physical therapy, and being placed in the sitting position three times per day. Activity increased in the third and fourth levels from sitting on the edge of the bed, and then actively transferring to a chair out of bed.

**Adverse events during early mobility.**

The occurrence of adverse events is described in six research studies. Of 498 sessions, one serious event occurred which was an oxygen desaturation < 80%
Bailey et al. (2007) reported a < 1% adverse event rate which included fall to knees without injury, feeding tube removal, systolic blood pressure > 200 mm Hg and < 90 mm Hg as well as oxygen desaturation < 80% in 1,449 activity events. These events did not result in harm to patients and there were no unplanned extubations. There were four instances (in 810 sessions) where a rectal or feeding tube was displaced or removed (Needham et al. 2010); these events were not felt to be unique to the mobility program as they could also occur during normal nursing care. No adverse events occurred in a program delivered by a mobility team (Morris et al. 2008).

**Barriers and facilitators to implementation of early mobility.**

A descriptive study utilizing staff interviews examined staff perceived barriers and facilitators of an early mobility program (Winkleman and Peereboom, 2010). Nurses were reluctant to plan out of bed activity for chronically critically ill patients requiring mechanical ventilation. The most common reasons for restricting activity included unstable vital signs and low respiratory and energy reserve. Other nurses identified safety concerns such as fear of patient falls or risk to invasive catheters. Barriers to out of bed activity included sedation, decreased level of consciousness, and agitation. The presence of a protocol and a unit champion were both thought to be facilitators of out of bed activity.

**Synthesis of the Body of Evidence**

Synthesis tables of the research studies that provide the evidence for the conductance of this project were developed. The rating of the level of evidence of six key research articles is presented in a summary format in Table 10. Synthesis of evidence relevant to the outcomes of early mobility is displayed in Table 11. The evidence related
to various components of early mobility interventions including differences in timing of initiation, description of contraindications to mobility/safety screen, who delivered the therapy and the result with discussion of adverse outcomes is shown in Table 12. Two additional articles (Level VII) are added to Table 12 because they have detailed descriptions of early mobility protocols.

**Table 10: Levels and Types of Evidence of Key Six Research Studies**

| Level I: Systematic review or meta-analysis | 1 | 2 | 3 | 4 | 5 | 6 |
| Level II: Randomized controlled trial | | | | X | | |
| Level III: Controlled trial without randomization | | | X | X | X |
| Level IV: Case-control or cohort study | | | | | | |
| Level V: Systematic review of qualitative or descriptive studies | | | | X | X | |
| Level VI: Qualitative or descriptive study (includes evidence implementation projects) | | | | | X | X |
| Level VII: Expert opinion or consensus | | | | | | |

### Table 11: Synthesis Table of Six Key Research Studies for Outcomes of Early Mobility

<table>
<thead>
<tr>
<th>Study</th>
<th>Delirium</th>
<th>Vent LOS</th>
<th>ICU LOS</th>
<th>Hospital LOS</th>
<th>Adverse Events</th>
<th>Other comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schweickert et al. (2009)</td>
<td>↓ duration</td>
<td>↓ vent LOS</td>
<td>No change</td>
<td>No change</td>
<td>One serious adverse event: desaturation &lt; 80%. No harm.</td>
<td>Higher level of wellness prior to critical illness</td>
</tr>
<tr>
<td>Bailey et al. (2007)</td>
<td>Not studied</td>
<td>No difference</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Number of events low, no serious.</td>
<td>Chronic mechanical ventilation patients 89% of subjects were mechanically ventilated</td>
</tr>
<tr>
<td>Morris et al. (2008)</td>
<td>Not studied</td>
<td>No difference</td>
<td>↓ LOS</td>
<td>↓ LOS</td>
<td>No untoward events.</td>
<td>Mobility team – no additional cost.</td>
</tr>
<tr>
<td>Thomsen et al. (2008)</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Not mentioned; included in another study.</td>
<td>Culture of unit important aspect to aid early mobility.</td>
</tr>
<tr>
<td>Needham et al. (2010)</td>
<td>↓ duration</td>
<td>Not studied</td>
<td>↓ LOS</td>
<td>↓ LOS</td>
<td>No untoward events</td>
<td>Implementation of early mobility</td>
</tr>
<tr>
<td>Pohlman et al. (2010)</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Adverse events uncommon.</td>
<td>Descriptive study of intervention of RCT.</td>
</tr>
</tbody>
</table>
Table 12: Characteristics of the Early Mobility Interventions

<table>
<thead>
<tr>
<th>Study</th>
<th>Timing of initiation</th>
<th>Safety screen or contraindications described</th>
<th>Level of Protocol Detail</th>
<th>Responsibility of Delivery of Therapy</th>
<th>Result</th>
<th>Adverse Outcomes</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schweikert (2009) Level II</td>
<td>MV &gt; 72 hours During daily interruption of sedation and/or narcotics (patients also had goal directed sedation – RASS)</td>
<td>Contraindications for initiation and continuation</td>
<td>Yes PROM AROM Bed mobility activities ADL Sit to stand Bed to chair Bed to commode Pre-gait Walking</td>
<td>Physical and occupational therapist</td>
<td>Therapy ~ 30 minutes/day Therapy started 1.5 days after intubation (median) More patients returned to independent functioning Decreased delirium Decreased vent LOS</td>
<td>1 serious event in 498 sessions Patient desaturation to &lt; 80%</td>
<td>Barthel Index Score &gt; 70 2 weeks before admission (more well)</td>
</tr>
<tr>
<td>Bailey (2007) Level IV</td>
<td>Patients transferred from primary ICU to RICU</td>
<td>Three criteria for initiation: Neurologic- patient responds to verbal stimuli Respiratory- FiO2 ≤ 60, PEEP ≤ 10 Circulatory – absence of orthostatic hypotension, and catecholamine drips</td>
<td>Sit on edge of bed Sit in chair after transfer from bed Ambulate with assistance</td>
<td>Physical therapist Respiratory therapist Nurse Critical care tech/assistant Physical therapy</td>
<td>69% were able to ambulate &gt; 100 ft. at RICU discharge &lt; 1% activity related adverse events: Fall to knees without injury Feeding tube removal SBP &gt; 200 mm HG</td>
<td>Time to RICU admission 10.5 ± 9.9 days after ICU admission Farther in critical care trajectory</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Protocol Initiation</td>
<td>Criteria to Limit or Withhold Mobility Interventions</td>
<td>Mobility Team</td>
<td>Outcomes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------------------</td>
<td>-----------------------------------------------------</td>
<td>---------------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morris (2008) Level IV</td>
<td>Protocol initiated within 48 hours of MV</td>
<td>Criteria to limit or withhold mobility interventions described. No limit to FiO₂ or PEEP.</td>
<td>Mobility team (Physical therapist, Nurse, Nursing assistant).</td>
<td>OOB earlier ICU LOS↓, Hospital LOS ↓, No change in vent LOS, No adverse events, No additional costs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thomsen (2008) Level IV</td>
<td>Same as Bailey study – conducted in same unit – LDS in Utah</td>
<td>Safety guidelines: FiO₂ ≤ 0.6, PEEP ≤ 10 cm H₂O, No titration of pressor for 2 hours, RASS ≥ -3.</td>
<td>Physiatrist (consultation), Physical therapist, Occupational therapist, Respiratory therapist, Nurse, Technician.</td>
<td>Recd ↓ benzo ↓ narcotics. More frequently alert and not delirious. ↑ therapy per pt and day. ↓ ICU LOS ↓ Hospital LOS.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Needham (2010) Level VI</td>
<td>When patient met criteria per safety guidelines</td>
<td>Not described.</td>
<td></td>
<td>4 instances of adverse events: tube feeding removed, rectal tube removed. ↑ MICU admissions by 20%.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FiO₂ increased 0.2 for therapy. SBP < 90 mm Hg. Desaturation < 80%. No unplanned extubations.
<table>
<thead>
<tr>
<th>Study</th>
<th>Level</th>
<th>Safety Criteria</th>
<th>Heart Rate &lt; 110/min</th>
<th>MAP 60-100 mm Hg</th>
<th>FiO₂ ≤ 60</th>
<th>May titrate supplemental O₂ to keep SpO₂ &gt; 88% with activity</th>
<th>Phases</th>
<th>More similar to rehabilitation</th>
<th>Physical Therapist</th>
<th>Respiratory Therapist</th>
<th>Nurse</th>
<th>No outcomes studied</th>
<th>No adverse events studied</th>
<th>Detailed protocol – from physical therapy perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pohlman (2010)</td>
<td>Level VI</td>
<td>Same as Schweickert study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 Phases</td>
<td>Very detailed</td>
<td>Physical therapist</td>
<td>Respiratory therapist</td>
<td>Nurse</td>
<td>No outcomes studied</td>
<td>No adverse events studied</td>
<td>Detailed protocol – from physical therapy perspective</td>
</tr>
<tr>
<td>Perme (2009) Level VII</td>
<td></td>
<td>When patient met safety criteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No outcomes studied</td>
<td>No adverse events studied</td>
<td></td>
<td></td>
<td></td>
<td>For physical therapy perspective</td>
</tr>
<tr>
<td>Hopkins (2009)</td>
<td>Level VII</td>
<td>Same as Bailey study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No outcomes studied</td>
<td>No adverse events studied</td>
<td></td>
<td></td>
<td></td>
<td>Protocol contained within article</td>
</tr>
</tbody>
</table>

Note:  MV = mechanical ventilator, RASS = Richmond Agitation Sedation Scale, PROM= passive range of motion, AROM= active range of motion, ADL= activities of daily living, LOS= length of stay, ICU= intensive care unit, RICU= respiratory intensive care unit, FiO₂= fraction of inspired oxygen, PEEP = positive end expiratory pressure, SBP = systolic blood pressure, OOB = out of bed, benzo = benzodiazepines, MICU = medical intensive care unit, MAP = mean arterial pressure, SpO₂ = pulse oximetry oxygen saturation.
Gaps in Literature

There are several gaps in clinical knowledge related to the problem being studied. There is a lack of studies that examine and compare early mobility in different patient populations i.e. surgical, medical, trauma, and neuroscience critically ill patients. Several of the studies have focused on medical patients (Morris et al. 2008; Needham et al. 2010; Schweikert et al. 2009). Different patient populations may have characteristics related to age, co-morbid conditions or functional level prior to the critical illness that may change how early mobility may be implemented. Overall, there are several studies that provide the evidence for the development and implementation of an early mobility intervention (Needham et al. 2010; Pohlman et al. 2010; Schweikert et al. 2009). Studies focused on early mobility as an intervention to decrease the incidence of delirium have been limited to specific patient populations, therefore, generalization to all critically ill patients cannot be made. Additional studies that include a broader population of patients and a wide variety of hospital types would be beneficial.

Recommendations for Practice Change

The synthesis of evidence supports implementation of an early mobility protocol into routine care for mechanically ventilated patients. The use of an early mobility protocol has demonstrated effectiveness in decreasing delirium and ventilator length of stay (Schweikert et al. 2009), and has been demonstrated to be safe, with minimal risk or harm to patients (Morris et al. 2008; Needham et al. 2010; Pohlman et al. 2010; Schweikert et al. 2009; Thomsen et al. 2008). All studies included in the synthesis detailed contraindications for initiation of early mobility as well as criteria to use to determine how the patient is tolerating the intervention. The use of an established
protocol limits adverse events (Bailey et al. 2007; Hopkins and Spuhler, 2009; Morris et al. 2008; Needham et al. 201; Pohlman et al. 2008; Schweickert et al. 2009) and improves adherence (Winkelman and Peereboom, 2010). The summary table can be found in Table 13. Based on the evidence, the recommendation for practice is to implement an early mobility protocol for mechanically ventilated patients.
### Table 13: Recommendations for Practice Change

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Reference in Support of Recommendation</th>
<th>Level of Effectiveness</th>
</tr>
</thead>
</table>
of intervention for patients.

| 3. Monitor patient’s tolerance of increasing mobility (determine when further activity is contraindicated). | Bailey et al. (2007). Early activity is feasible and safe in respiratory failure patients. *Critical Care Medicine, 35*(1), 139-145. doi: 10.1097/01.CCM.0000251130.69568.87

Morrisey et al. (2008). Early intensive care unit mobility therapy in the treatment of acute respiratory failure. *Critical Care Medicine, 36*(8), 2238-2243. doi: 10.1097/01.CCM.0b013e318180b90e


Pohlman et al. (2010). Feasibility of physical and occupational therapy beginning from initiation of mechanical ventilation. *Critical Care Medicine, 38*(11), 2089-2094. doi: 10.1097/CCM.0b013e3181f270c3

<table>
<thead>
<tr>
<th>4. Utilize defined mobility protocol to enhance teamwork, consistency.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey et al. (2007). Early activity is feasible and safe in respiratory failure patients. <em>Critical Care Medicine</em>, 35(1), 139-145. doi: 10.1097/01.CCM.0000251130.69568.87</td>
</tr>
</tbody>
</table>

| Limits adverse events. (Level II, IV, VI) Improves adherence. (Level VI) |
5. Use multidisciplinary group to help with refinement of protocol, action plan for implementation, guidance of small tests of change, education of providers, maintenance and sustaining change (monitoring).

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title and Details</th>
</tr>
</thead>
</table>

Effectiveness not studied as such. This is expert opinion and Level VII evidence.
III. Methods: Project Implementation

This chapter focuses on the implementation of an early mobility protocol utilizing the EBPI model (Levin et al. 2010) as the framework for the change in practice. The early mobility protocol was developed for use in mechanically ventilated, critically ill patients. A multidisciplinary team worked together to test the protocol using simulation and small tests of change with actual patients. The protocol was then implemented for use and outcomes evaluated over the course of the next three months.

Project Setting and Population

The setting for this evidence-based project was the Intensive Care Unit at Good Samaritan Hospital (GSH) in Dayton, Ohio. GSH is a 520 bed facility with 29 adult ICU beds. The ICU is a mixed, medical-surgical intensive care unit. The average ICU length of stay at the time of implementation of this project was 4.8 days. The Director of Nursing provided written support for the implementation of this EBPI project. (See Appendix B).

Patients included in the project were 18 years old and over, admitted to the GSH ICU from February 15, 2013 through May 31, 2013 and placed on mechanical ventilation during the ICU stay for at least 48 hours. Patients were excluded from the intervention if admitted to the ICU with a primary diagnosis of stroke with coma, myocardial infarction with coma, pregnant, history of developmental disability, or dementia. Patients were also excluded if receiving therapeutic hypothermia and those patients determined by their
primary healthcare provider to be moribund. Patients who were dependent in activities of daily living also were excluded.

**Stakeholders and Anticipated Barriers Identified Prior to Implementation**

There are various stakeholders in the project. The patient and family are the most important stakeholders. Patient and family education will be critical during the implementation of the EBPI project. The provision of calm reassurance and support during this process helps to facilitate a safe and trusting environment. Education of the patient and family will be done just prior to the intervention and throughout the patient’s stay in the ICU.

Gaining the support of staff nurses is also critical for the success of the EBPI project. A previous study Winkleman and Peereboom, (2010) used interviews to identify barriers to the implementation of an early mobility protocol. Their findings suggest that having a protocol increased out of bed activity. A protocol will be used to help develop a standardized practice in this project. Additionally, Winkleman and Peereboom (2010) identified that a multidisciplinary team was needed to promote the intervention. Introduction of early mobility will be a culture shift. The concept of early mobility has been introduced to staff through lecture by the medical director of the ICU and a multidisciplinary team will round daily to aid in implementation.

Respiratory therapists and physical/occupational therapists are also stakeholders. The intervention of early mobility will alter their work patterns, and increase workload. Managers of these departments will have to monitor workload and use/cost of resources. The managers of respiratory therapy and PT/OT are positive and engaged in planning for
the intervention. Identified champions from PT/OT are positive about the project and eager to begin implementation.

Critical care physicians are key stakeholders in the implementation of the EBPI project. As a whole, the physicians are supportive of this change in practice. Two critical care physicians have some concerns regarding early mobility related to the fear of adverse events. Physicians will be involved in refinement of the protocol as well as small tests of change during implementation. Ultimately, physicians and providers will ensure that this intervention is appropriate for each patient when completing mechanical ventilation orders or orders for physical/occupational therapy consults.

Leadership individuals within the intensive care unit are proponents for change and for keeping abreast of scientific advances. The medical director is extremely engaged and will be a facilitator of change to implement early mobility. The clinical pharmacist is also quick to adapt to new science and to help champion change. The nurse manager and clinical educator are committed and will help educate and cement the practice change. There is a good spirit of teamwork which will help to facilitate implementation.

Barriers to implementation identified include fear of adverse effects, inadequate staffing and change in practice. Many critical care providers will be afraid of adverse events and caring for a ventilated patient that is more awake. There is a measure of control and safety when a patient is deeply sedated and has limited movement. Daily multidisciplinary rounding will support staff in lightening sedation, and beginning to move patients on the ventilator. Staffing may sometimes present a barrier. During times of high acuity, and tighter staffing, mobility interventions may seem to be less of a
priority. Leadership will work to assist with ensuring that patients are cared for and priorities maintained. Change is always difficult. Individuals are confident performing practices with familiarity, and are less likely to adapt to new practices. Introducing the new practice with small tests of change will allow the staff to visualize the intervention. The use of champions will encourage other staff members and provide support to the implementation. Multidisciplinary rounding will assist in problem-solving regarding whether early mobility is appropriate for individual patients and aid the caregivers in accepting the change in practice. See Tables 14 for facilitators and Table 15 for barriers to implementation of the project.

**Ethical Considerations**

The project is not experimental in nature and is based on strong evidence collected from numerous research studies. Patients will be screened prior to increasing activity and will be monitored carefully during activity. Minimal protected health information will be collected to determine outcomes of the project (See Data Collection Form – Appendix C). Data will analyzed and reported without identification of individual patients or providers. Potential benefits may include shortened ventilator length of stay, decreased ICU length of stay, decreased hospital length of stay and decreased incidence and duration of delirium. The study received approval from the Wright State University Institutional Review Board (IRB) and the Human Institutional Review Committee at GSH prior to beginning the intervention and subsequent data collection.
Budget

Costs related to training using high fidelity human simulation including programing of the Laerdal Sim Man™ and employee time for participation in simulation were absorbed by the various hospital departments involved in the project. Participation in an IHI Expedition on Early Mobility, costs for copying of educational material, and any additional costs related to dissemination of the project were paid for by the critical care administration department of GSH.
### Table 14: Facilitators for Implementation

<table>
<thead>
<tr>
<th>Facilitators</th>
<th>Approach to use facilitator in implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician colleague</td>
<td>Collaborating physician; has been very involved in project concept. Continue to involve in each step of concept development. He will be the physician involved in small tests of change (STOC).</td>
</tr>
<tr>
<td>Collaborating Physician Group</td>
<td>Proponents of EBP change and will help champion. Provide regular updates at monthly meeting.</td>
</tr>
<tr>
<td>Physical therapy champion</td>
<td>Physical therapy champion will be link to PT/OT personnel. Content expert. Will help with development of mobility protocol; education plan for PT/OT and other disciplines.</td>
</tr>
<tr>
<td>ICU Unit Council</td>
<td>Nurse champions. Involved to help with practice change and dissemination of new practice. Each champion has list of staff nurses that she is responsible to communicate with.</td>
</tr>
<tr>
<td>PharmD in ICU</td>
<td>Pivotal role in small tests of change with EBP implementation. Will assist with rounding.</td>
</tr>
<tr>
<td>Staff nurse – expert</td>
<td>Content expert as attended IHI workshop on Early Mobility. Involve as a key team member to help with Sim-Man training of staff nurses and therapies.</td>
</tr>
<tr>
<td>Leadership (ICU manager, PT/OT manager, respiratory therapy manager)</td>
<td>Use to assist with communication of EBP implementation to staff, support project implementation.</td>
</tr>
<tr>
<td>Director of Nursing</td>
<td>Will provide administrative support for project.</td>
</tr>
<tr>
<td>Barriers</td>
<td>Approach to address barrier</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Physician Group 2</td>
<td>Provide information regarding practice change. Have NP assist with management of his patients.</td>
</tr>
<tr>
<td>Physician Group 3</td>
<td>Provide information regarding practice change. Involve supportive member of group in early STOC.</td>
</tr>
<tr>
<td>Fear of change</td>
<td>Provide continual small pieces of information about evidence, prior to implementation of change. Small test of change format helps to rollout change slowly and with care.</td>
</tr>
<tr>
<td>Fear of adverse events</td>
<td>Provide practice with Sim-Man and develop steps to address worst case scenarios i.e. patient accidently extubated while walking in hall. Practice steps with multidisciplinary team.</td>
</tr>
<tr>
<td>Staffing</td>
<td>Will estimate impact on PT/OT staffing in October, 2012. Will discuss impact of staffing with leadership to determine course of action if acuity rises and staffing unable to meet acuity.</td>
</tr>
<tr>
<td>Infectious conditions</td>
<td>May be barrier to walking in hall with patient. Will need to review with infection control and determine how this will be done.</td>
</tr>
</tbody>
</table>
Implementation Plan  (developed prior to implementation)

Step One- Description of the Problem. As discussed in Chapter 1, the EBPI model will be used to guide the implementation of this project (Levin et al. 2010). The initial step in this model is description of the problem. Delirium has a significant impact on mortality and morbidity as well as increased cost of healthcare (Lat et al., 2009; Pun & Ely, 2007; Leslie et al., 2008). The incidence of delirium is 60-80% in mechanically ventilated patients (Lat et al., 2009; Pisani et al., 2007). The high incidence and prevalence of delirium in subject patients on the ventilator for more than 48 hours was identified as a problem at Good Samaritan Hospital through a pilot study conducted by a Wright State University undergraduate honors student in collaboration with faculty and a CNS preceptor (Meyer, Campbell & Vermeersch, 2011).

Step Two – Formulation of a Focused Clinical Question. Levin et al. (2010) describe the second step of the EBPI model as determination of a more focused clinical question as a means to focus improvement work or efforts. This clinical question is developed in the PICOT format (patient-intervention-comparison-outcome-timeframe). Concise PICOT statements or questions help to target the search of the evidence and guide further development of the evidence-based practice process (Melynk and Fineout-Overholt, 2011 p. 29). The PICOT question for this project is: In (P) critically ill, mechanically ventilated patients, what is the effect of (I) an early mobilization protocol (as (C) compared to no intervention) on (O) incidence and duration of delirium as well as intensive care unit length of stay over the course of three months(T)?

Step Three- Search for the Evidence. The PICOT statement helps to target the search for the evidence. (Melynk and Fineout-Overholt, 2011). The WSU librarian was
consulted regarding the search strategy and use of various medical databases. A systematic search was conducted. Numerous articles were reviewed for inclusion or exclusion in the appraisal process. References at the end of articles were also reviewed to locate additional evidence.

**Step Four – Appraise and Synthesize Evidence.** In this step, a team works together to review and summarize the evidence that has been gathered. This step is essential in determining whether there is sufficient strength in the evidence to support a change in practice. Additionally, the specific change in practice is defined by what has been previously studied and examined (Levin et al. 2010 and Melyn and Fineout-Overholt, 2011). For this project, a multidisciplinary team at Good Samaritan worked together to appraise and synthesize the evidence related to early mobility for mechanically ventilated patients.

**Step Five – Development of an aim statement.** This step of the model is derived from performance improvement work (Levin et al. 2010). The aim statement is used to help define an immediate goal with a measure of achievement. Aim statements can be altered as the project continues or as performance improves. An initial aim statement for this project was: By month three of the project, early mobility will be incorporated into the care of 25% of the mechanically ventilated patients in the ICU at GSH. This aim statement was determined by the project leader/CNS and the medical director of the ICU.

**Step Six – Engage in small tests of change.** This step is also derived from the performance improvement part of the EBPI model (Levin et al. 2010). This performance improvement section uses the process known as plan-do-study-act (PDSA). This
particular approach details a specific way in which a new practice is tested. The small test of change takes place with one patient, the new intervention and the multidisciplinary team. The practice change is utilized with that patient, and then studied or evaluated. Changes are made to the practice change as necessary and this PDSA cycle is repeated as needed. This small test of change method helps to ensure patient safety as well as success of the practice change during dissemination.

For this project several activities will need to occur prior to the small tests of change. An early mobility protocol has been drafted by the multidisciplinary team (see Appendix D). This protocol was used by the team with the patient and then revised as needed. A flowchart that depicts how early mobility fits into the current practice is depicted in Appendix E. Members of the physical therapy team expressed the desire to use high fidelity human simulation prior to implementation of the practice change with critically ill patients. They had learned of a study examining the benefits of simulation using mannequins such as the Laerdal’s SimMan™. The study demonstrated that training with simulation helped improve physical therapy students’ confidence prior to beginning in an acute care clinical experience (Shoemaker, Riermersma, & Perkins, 2009). The implementation plan will include simulation of the protocol prior to use with critically ill patients (See Appendix F, G, and H).

**The Final Step – Disseminate best practices.** After the small tests of change have been completed, and the protocol for early mobility is revised, the final step of the EBPI model is spread of the change to other providers and patients (Levin et al. 2010). This step must also be carefully done to ensure that the same results obtained during the small tests of change (STOC) occur during dissemination. Levin et al. (2010) describes
this final step as a pilot that could be done on only one or two units. Education of members of the team that were not involved with the STOC would be done prior to the dissemination.

Monitoring of outcomes is very important during this final step to ensure that the practice change is implemented correctly, and that the desired patient outcomes are being achieved (Levin et al. 2010). During this final step, the multidisciplinary team at GSH has planned rounding on Monday, Wednesday and Friday. Rounding is a process where the multidisciplinary team can see each patient and talk with staff about how the practice change is progressing. Questions regarding the change can be answered, and the protocol can be reinforced so that consistency in practice is attained. Rounding will be done using a rounding script (see Appendix I).

Dissemination as described by Levin et al. (2010) includes sharing of practices with outcomes to the professional community, so that others can learn from and improve care to patients in other centers. Studies regarding early mobility have taken place in large, academic centers. Implementation of this evidence-based practice in a community setting may have unique perspectives to share with medium to small hospitals who are not university affiliated. Dissemination is planned through communication with other hospitals throughout the Premier Health Partners network as well as the development of papers for publication. Communication throughout the process of STOC is vital to the project success. In the ICU at GSH there are several standard ways of communicating including a bi-weekly meeting of the multidisciplinary team so that problems can be shared and addressed. The Stall Street Journal is a publication used for communicating short pieces of information and is usually published biweekly and a weekly email titled
“FYI’s” is sent to all nursing staff to share important changes that are occurring within the ICU. All of these communication methods will be utilized to update staff on the project as it progresses. Strategies to improve communication with therapy staff will need to be explored.

Sustaining evidence-based practice changes has proven to be difficult for most hospitals. When implementing a new practice, the implementation plan must include methods to sustain that practice by creating organizational memory and storing knowledge in what is referred to as knowledge reservoirs (Virani, Lemieux-Charles, Davis & Berta, 2009). Good Samaritan uses various methods to sustain new practices. These methods include the creation of nursing standards of practice. These practice documents serve as a product of the established care practices related to a specific disease or patient population, are evidence-based and a blend of the art and science of nursing. The standard of practice for the care of the mechanically ventilated patient will be updated to reflect the changes in early mobility. The computerized physician/provider order set for mechanical ventilation is also being revised to include the order for early mobility to begin as soon as appropriate for each patient. Additionally, the order set will include orders for physical and occupational therapy consultation and evaluation/treatment. The actual early mobility protocol will be placed as a resource document in Epic, the electronic medical record, so that it can be easily accessed by staff members from any computer. Table 16 depicts the implementation plan with timeframes.
<table>
<thead>
<tr>
<th>Task</th>
<th>Notes</th>
<th>Team Members Involved</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step Four – Appraisal and Synthesis of the Evidence</strong></td>
<td>1. Review and critique evidence.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>September-November 2012</td>
</tr>
<tr>
<td></td>
<td>2. Draft early mobility protocol.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>November 2012</td>
</tr>
<tr>
<td>Obtain IRB approval for project.</td>
<td>1. Submit IRB petition and summary to WSU. Once approved, forward to HIRC at GSH.</td>
<td>Project Leader</td>
<td>December-January 2012</td>
</tr>
<tr>
<td><strong>Step Five – Engage in small tests of change.</strong></td>
<td>1. Practice protocol utilizing Sim Man scenarios, revise protocol if needed.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>February 2013</td>
</tr>
<tr>
<td></td>
<td>1. Plan and perform small tests of change, revise protocol as needed.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>February 2013</td>
</tr>
<tr>
<td><strong>Step Six – Disseminate best practices</strong></td>
<td>1. Provide education in various forms.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>February 2013 through June 2013</td>
</tr>
<tr>
<td></td>
<td>2. Begin rounding with multidisciplinary team utilizing rounding script.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>February 2013 and ongoing</td>
</tr>
<tr>
<td></td>
<td>3. Examine outcomes every two weeks with multidisciplinary team.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>February 2013 through June 2013</td>
</tr>
<tr>
<td></td>
<td>4. Ensure products to sustain change are in place.</td>
<td>Project Leader – author</td>
<td>February 2013 through June 2013</td>
</tr>
<tr>
<td></td>
<td>5. Analyze data; determine impact of change in practice.</td>
<td>Project Leader-author</td>
<td>Following June 2013</td>
</tr>
<tr>
<td></td>
<td>5. Disseminate findings outside organization.</td>
<td>ICU Multidisciplinary Team Project Leader - author</td>
<td>Following June 2013</td>
</tr>
</tbody>
</table>
Implementation Process

The implementation process will be described in terms of the steps of the Evidence-Based Performance Improvement Model (Levin et al. 2010). Steps one through three have been described previously.

**Step Four – Appraisal and Synthesis of Evidence** - The project leader/CNS and the ICU multidisciplinary team began meeting in October of 2012. The six key research articles were distributed to all members for review prior to meeting. An early mobility protocol (Appendix D) was drafted from descriptions included in two studies (Pohlman et al. 2010; Schweickert et al. 2009). This draft was reviewed and approved for use in small tests of change by the medical director. The group felt that there was sufficient evidence and strength of evidence to pursue implementation of early mobility. Presentations were made to the ICU unit council (shared governance committee) as well as the critical care committee (a medical staff committee) with discussion about the project and anticipation of implementation.

IHI offered an Expedition related to implementation of early mobility. This expedition was a series of webinars scheduled for the months of November, December and January (2012-2013). The purpose of the webinars was to support critical care units in implementation of early mobility. The director of nursing was approached and approved funding for participation ($750).

Key individuals were involved with participation in the IHI Early Mobility Expedition. The ICU nurse manager selected two nurses to become champions for early mobility. The practice of using specific staff nurses as champions had been done with other projects in the ICU, such as decreasing hospital acquired pressure ulcers and central
line bundle implementation. Respiratory therapy and rehabilitation medicine had already selected champions and the PharmD from the ICU also participated. The IHI Expedition included presentation and discussion of the evidence supporting implementation of early mobility as well as sharing of strategy for beginning the program. This expedition aided in the review of evidence with a larger audience and helped build momentum for beginning the project.

The project proposal was reviewed by the Nursing Research Committee at GSH in December 2012. IRB approval was submitted to the IRB at Wright State University in December of 2012. Approval was granted after provision of additional information in January 2013. The Human Institutional Review Committee at GSH also reviewed and approved the project in December, 2012.

**Step Five – Engage in Small Tests of Change (STOC)**

**Small Test of Change using High Fidelity Human Simulation**

The first STOC for early mobility was conducted using high fidelity human simulation. Three scenarios were developed that included Safety Screening for Early Mobility (Appendix G), Preparing for Early Mobility and Review of Contraindications to Continuing Early Mobility (Appendix H), and Inadvertent Endotracheal Extubation during Early Mobility (Appendix I). Laerdal’s SimMan™ was utilized for the simulation and was programmed to match the scenarios. The draft protocol was reviewed with simulation participants as well as explanations about how the protocol would fit into the present care of the mechanically ventilated patient. The champions that had participated in the IHI Expedition were the individuals who participated in the simulation. Each
scenario was acted out, and the participants discussed the application of the protocol to each patient scenario.

Several priorities for implementation were identified at the end of the simulation. These priorities included:

1) The nurse caring for the patient could begin to prepare all invasive catheters anticipating the respiratory/physical/occupational therapist’s arrival. This would decrease the preparation time for the other disciplines, thereby increasing the number of patients that they were able to see.

2) One person should be designated to communicate with the patient and provide direction to the team during early mobility. The physical therapist or occupational therapist was positioned immediately in front of the patient during patient movement and the group determined that this person would prompt the patient as well as lead communications for the team. This would hopefully help the patient understand what to do next, and decrease confusion for team members.

3) Additional roles were delineated. The respiratory therapist was responsible at all times to monitor endotracheal tube security and oxygenation status. The nurse would monitor other invasive catheters as well as vital signs. Physical and occupational therapy would assess and monitor motor strength, balance and tolerance of activity. The decision to stop the intervention and return the patient to bed would be a group decision and this would be led by the nurse. The patient could also decide to stop the activity.

4) Specific equipment would be helpful for mobilization. A reclining back manual wheelchair would be positioned behind the patient walking in the hall in the event of
change in condition or inadvertent extubation. This specific type of wheelchair would allow for supine positioning for ease in transferring the patient back into the bed. The portable ventilator would be used when the patient was ambulating in the hall.

The team really enjoyed participating in the simulation and felt that it was very valuable and worthwhile. Discussion during the scenarios was intense, with team members focused on considering how the implementation would be done with a real patient. The protocol was reviewed and it was determined that no changes were needed at that time.

**Small Tests of Change with Patients**

The first patient was identified a day prior to the STOC. The patient was male, 45 years of age, and slight in build. He had been mechanically ventilated and sedated for two days with the diagnosis of respiratory failure. His past medical history included hypertension, alcohol abuse, and hyperlipidemia. He had been well prior to this illness, and independent in activities of daily living. He was identified as a candidate for early mobility by the interdisciplinary team and was being cared for by the medical director of the ICU. Physical and occupational therapy consult was ordered by the project leader/CNS. Prior to the team arrival, the nurse caring for him prepared the invasive catheters and initiated the sedation vacation. The patient was drowsy, but would easily awaken and follow commands (Richmond Agitation Sedation Score (RASS) = -1). The team worked together to sit him upright, watching his vital signs closely, and then set him up at the side of the bed. With activity, he was still very drowsy and required maximal assistance in remaining upright. He was assisted back into bed, from a side-of-bed dangling position without adverse event.
The team reviewed this first patient STOC and felt the patient was too sedated to participate actively in early mobility. The nurse had turned sedation off prior to the team’s arrival, but the effects had not sufficiently dissipated. The group felt that the protocol was executed well, and that the team worked well together. The team concluded that sedation needed to be stopped earlier, and the patient should be a RASS of 0 with ability to follow commands before beginning activity.

The following day a second patient was identified for a STOC. This patient was two days post-op from abdominal surgery and was older, an 85 year old male and very tall (6’ 4”). He had been on the ventilator for four days. He was identified as a good candidate for early mobility on the day prior to the intervention. The nurse caring for him was one of the designated champions. The sedative had been turned off for 16 hours and the patient was awake, alert and calm. He was also delirious (CAM-ICU positive). Pain medication had been administered an hour before the team arrived. Invasive catheters had been prepared by the nurse in anticipation of early mobility. His daughter was present in the room with many other on-lookers. The bedside nurse had provided both the patient and daughter with explanations about the benefits of early mobility including what to expect. The patient worked well with the team and was able to sit at the side of the bed for ten minutes. He then stood at the side of the bed and took several steps, then was assisted back into bed without adverse event. The daughter was anxious, but supportive of early mobility and expressed hope that his condition was improving.

The team reviewed this second patient STOC. Intravenous sedation had been off for sixteen hours and the patient was much more awake. The nurse had maximized preparation of the patient for success of early mobility. He had received pain medication
an hour before the team arrived, and was able to move with tolerable pain. He was very tall, and team members discussed his height as a factor in assisting him in standing at the bedside. He was extubated later that same day. The team felt that the protocol worked well and required no revision.

**Step 6- Disseminate Best Practices**

After the two patient small tests of change had been completed, the multidisciplinary team met with the medical director. It was determined that rounding would begin using the script and that patients that met the criteria for early mobility would receive the intervention. All members of the team would be present during the first session of early mobility to ensure that patient met criteria and that the intervention was safely done. Physician/provider order for early mobility as well as PT/OT consult would be obtained prior to initiation. The Stall Street Journal and FYI’s (email) were used to alert staff the project was continuing to progress and that rounding was beginning.

The team began rounding on a Monday, Wednesday, Friday schedule. The rounding script was utilized to assist with guiding the discussion. A nursing education graduate student assisted with the project by the creation of buttons that stated “Mobility is Medicine”. These were given to nurses that were early adopters as well as members of the project team, unit leadership as well as select physicians. The “Mobility is Medicine” theme was continued in posters on the unit as well as the Stall Street Journal and weekly FYI’s to staff.

The script for rounding worked well, and nurses very quickly learned to present their patient in a focused manner which helped the multidisciplinary team discuss the
plan for sedation and ventilation for the day. Physicians were often included in this rounding, and if not present, then review of the progress note assisted in including their input into the plan. Nurses were initially hesitant to consider early mobility for their patient, but were encouraged and supported in decision-making by the team. When patients were mobilized, the nurse would often say, “I think that the patient could be extubated soon and he/she is doing better than I thought.” The patient was much more alert and engaged in the environment when sitting at the side of the bed, than when lying in the bed supine.

After approximately four weeks of rounding on Monday, Wednesday and Friday, the intervention of early mobility began to be initiated by physicians and staff nurses independent of the rounding process. Physicians began to write orders without request, and nurses would identify patients that were candidates and contact PT/OT independently. The nurse practitioners (Day and Night Shift) began to order “early mobility when appropriate”, as well as the PT/OT consult with the initiation of mechanical ventilation. Patients were being mobilized cautiously and without adverse event.

The multidisciplinary team met with the medical director during the project every two weeks to discuss any problems or changes that needed to be made to assist with improvement. In early April, two patient problems were identified for discussion at this meeting. One patient had been mobilized without all team members present. Only PT and OT were present for the intervention. A patient in the next room had experienced a cardiac arrest and many team members were attending to this crisis. The two therapists felt comfortable mobilizing a 28 year old patient on the ventilator without other team
members. They were able to sit him at the side of the bed without problem. However, when moving the patient back into a supine position, the endotracheal tube was slightly dislodged. The respiratory therapist was notified to assist with securing the endotracheal tube. The patient did not experience desaturation, or a decrease in tidal volumes received from the ventilator, and the problem was rectified quickly. The group discussed the importance of working together as a team, utilizing the agreed upon roles. Since patient safety was a primary concern, the project leader/CNS and medical director discussed the importance of recognizing how the overall activity level of the unit can influence whether the early mobility intervention should be attempted. A second patient experience was discussed. An elderly male had been mobilized and tolerated ambulation well while on the mechanical ventilator without desaturation or coughing. The medical director was present for this session, and encouraged the team to work to allow the patient to walk in the hallway outside the patient room. He was the first patient who had progressed to walking in the hallway. The patient was safely assisted back into the room and into bed. Ambulating this patient created excitement among the staff in the ICU. Approximately one hour following the ambulation, the physician decided to extubate the patient, which was performed without incident, however, immediately the patient’s condition worsened. Re-intubation was complicated and required the use of fiberoptics. The following day a bronchoscopy was performed and a mass was noted in the airway. The patient was scheduled for surgery and was not mobilized again until after the surgery. These events surrounding the extubation and re-intubation were not felt to have been related to the early mobility. A discussion did underscore a note of caution when caring for these
critically ill patients who are dependent on the artificial airway and oxygenation and ventilation.

The subsequent multidisciplinary team meeting included the manager of rehabilitation, who discussed the economics of having the physical therapists and occupational therapists involved in early mobility. Consults for PT/OT had increased not only for early mobility but for other patients as well. She outlined that there was return on investment for her department when they were able to bill for seeing at least 8 patients a day per therapist. Rounding was taking approximately one hour per day on Monday, Wednesday and Friday. This was considered non-productive time for the therapists. The group discussed the possibility of scheduling early mobility once the patient became a candidate so that all team members were present. Having the patient ready to mobilize at the agreed upon time would shorten the therapists’ time with each patient, allowing other patients to be seen. The group decided also that rounding would change slightly. Abbreviated rounding would occur once a day early in the morning with a PT or OT and the project leader/CNS. Patients who were candidates for early mobility would be identified, and the “appointment” arranged. This would minimize time for the therapists that was non-productive. The abbreviated rounding was successful and consults for PT/OT continued to increase. Subsequently, a PT and OT were assigned to the ICU. This allowed for increased integration with the staff, and identification of patients for early mobility.

Tools for sustaining the practice were created or existing tools revised to include early mobility. The early mobility protocol which had not required revision was placed as a resource document into Epic (a file located within the electronic medical record).
This allowed ease of access for any critical care provider. The mechanical ventilation nursing standard of practice was also revised by the project leader/CNS. This revised document was reviewed by the ICU Unit Council and then the Practice Council (shared governance practice committee for the hospital). Upon approval, it replaced the previous practice document which was located in the policies and procedures on-line as well as the resource documents in Epic.

Changes to the mechanical ventilation order set required standardization of practices across the Premier Health Partners network, which included four hospitals. A critical care nursing committee had been formed approximately one year prior to the project to begin standardization work. A standard sedation scale, delirium assessment tool, spontaneous awakening and spontaneous breathing trial had been agreed on for all four hospitals. With these practices determined, creation of a standard mechanical ventilation order set was much easier. The order set was built to include pre-checked orders. Early mobility as soon as appropriate per clinical guidelines was added as a pre-checked order as well as the consult to physical/occupational therapy for evaluation and treatment. Physicians and other specialties (respiratory therapy, dieticians, and pharmacists) were included in the development, review and approval of the order sets which at times was a complex and challenging process led by the project leader/CNS.

The final product was released for use in Epic in August of 2013.

In June, 2013 Good Samaritan Hospital held a critical care educational conference. This was a yearly event, planned to include updates on topics so that nursing staff could remain current. A lecture regarding early mobility was provided by the project leader/CNS in conjunction with a physical therapist from the project team. The
lecture was developed using Turning Point technology allowing audience response. Case study examples of patients that had experienced early mobility while on the ventilator were presented. Participants were asked whether certain patients met criteria for early mobility, reviewed contraindications to continuing early mobility and identified problem-solving as well as response to adverse events. Handouts to the participants included a copy of the early mobility protocol, the revised mechanical ventilation standard of nursing practice as well as the revised order set in production. One of the patients that had early mobility had consented to being videotaped. This videotape was used at the end of the lecture. The patient provided a description of what he experienced while walking in the hallway on the ventilator. He talked about feeling like he was “going to get better, and that it broke up the monotony of the day which otherwise would have been spent lying down”. He relayed that he felt “well enough to do more, but that staff were nervous, and didn’t want him to overdo it.” He walked all the way around the ICU, which was quite some distance. He also said he “felt very supported by staff, and very safe.” His testimony provided insight into the patient experience, and many of the staff discussed this video for days following the educational conference.

Successes related to implementation as well as the experience with simulation were disseminated with the other hospitals in the network as well as personnel from IHI. A paper for publication regarding the use of simulation was written by the project leader/CNS in conjunction with two physical therapists and an occupational therapist and has been submitted for publication.
Summary

Implementation of the change in practice was planned thoroughly using the EBPI model (Levin et al. 2010). A multidisciplinary team led the implementation which started with using high fidelity human simulation. The simulation scenarios created a foundation of teamwork and a good understanding of the early mobility protocol. Small tests of change assisted the team in examining the protocol for use with patients, and lessons were learned. Every two weeks the team met with the medical director to review implementation. This constant communication helped ensure success and patient safety. Practice documents were revised or developed and ease of access ensured so that the practice could be sustained. The early mobility intervention protocol was disseminated using education sessions for all staff, revision of existing computerized order sets, and the constant reinforcement through multidisciplinary rounding. One year later, the change in practice is still in place.
IV. Project Evaluation

This chapter will examine the data collection and analysis used to evaluate outcomes related to the implementation of early mobility in mechanically ventilated, critically ill patients. Retrospective data collection was done using a standardized data collection form. All data was collected by the project leader/CNS.

Data Collection Instruments and Procedures

A printed list of potential subjects meeting the inclusion criteria was obtained from the Center for Outcomes Research and Quality Effectiveness (CORCE) department at Good Samaritan Hospital. This listing was based on charges for ventilator usage and was created post-discharge. Once the list of subjects was obtained, the project leader/CNS assigned a study number to each patient. The study number was placed on the data collection form (Appendix C) so that the data could not be directly linked to the medical record.

The medical record of each subject was accessed and data recorded by hand onto the data collection form. Subjects included for data collection were age 18 and over, admitted or in the GSH ICU from February 15, 2013 to May 31, 2013 and placed on mechanical ventilation during the stay for at least 48 hours. Patients were excluded if admitted to the ICU with a primary diagnosis of stroke with coma, myocardial infarction with coma, pregnant, history of developmental disability, dementia or patient receiving
therapeutic hypothermia. Patients who were dependent in activities of daily living prior to admission, or actively dying were also excluded.

Data points were defined to ensure reliability of the data collection (Appendix J). All of the data were collected retrospectively by the project leader/CNS. The following information was recorded on the data collection form in addition to the assigned study number: patient age, gender, month/day of admission and transfer from the ICU, date of intubation, date of extubation, ICU admitting diagnosis, APACHE II score, daily CAM-ICU score at 0800, whether the patient had the intervention of early mobility on that date and discharge status from the hospital (alive, dead) and discharge disposition (extended care facility or home). Additionally, adverse events that occur during early mobility were collected including systolic blood pressure > 200 mm Hg, systolic blood pressure < 90 mm Hg, desaturation < 80%, accidental extubation and fall to knees). If the patient was on the mechanical ventilator more than ten days, data collection was limited to the first ten days.

Data Analysis

Fifty-eight subjects were included in data analysis. Descriptive statistics were used to summarize demographic data. Independent sample $T$ tests were used to evaluate the difference between average ventilator, ICU, and hospital length of stay (measured in days), and duration of delirium (measured in days) for the two groups (early mobility vs. no early mobility). A two-tailed t-test was used for determining statistical significance. Chi-Squared was used to compare incidence of delirium between the two groups.

Of the 58 patients, 31 (53%) patients had early mobility on the ventilator, while 27 patients (47%) did not. Subjects were 60% male, and average age was 66.8 years +
13.9 (range 29-87 years). Seven patients died (12%), and the majority of those discharged from the hospital went to an extended care facility (63%). Medical data regarding all subjects is included in Table 17. A comparison between the groups is displayed in Table 18. Demographic data is included in Table 19. APACHE II scores were used to describe the severity of illness for the patients who were included in the project. APACHE II calculates an estimated mortality utilizing physiologic and laboratory values as well as a chronic health evaluation (Bouch & Thompson, 2008; Knaus, Zimmerman, Wagner, Draper, & Lawrence, 1981). The worst data from the first 24 hours in the ICU are used in the calculation and the maximum score is 71. A score of 25 has a predicted mortality of 50% while a score of over 35 represents a predicted mortality of 80%. The average APACHE II score of subjects in the project was $23 \pm 6.54$ (range 11-40) indicating that the participants were quite ill.

**Table 17 – Medical Data, All Subjects**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>66.8 ± 13.9</td>
<td>29-87</td>
</tr>
<tr>
<td>APACHE II</td>
<td>23 ± 6.54</td>
<td>11-40</td>
</tr>
<tr>
<td>Duration of Mechanical Ventilation, days</td>
<td>6.13 ± 3.7</td>
<td>2-15</td>
</tr>
<tr>
<td>Total ICU Length of Stay, days</td>
<td>10.10 ± 6.63</td>
<td>2-31</td>
</tr>
<tr>
<td>Hospital length of stay, days</td>
<td>16.29 ± 9.4</td>
<td>3-43</td>
</tr>
</tbody>
</table>
### Table 18 – Medical Data Comparison Between Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Early Mobility</th>
<th>No Early Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
</tr>
<tr>
<td>Age, years</td>
<td>67.35 ± 14.4</td>
<td>29-85</td>
</tr>
<tr>
<td>APACHE II</td>
<td>22 ± 6.73</td>
<td>11-36</td>
</tr>
<tr>
<td>Duration of mechanical ventilation, days</td>
<td>6.35 ± 3.76</td>
<td>2-15</td>
</tr>
<tr>
<td>Total ICU length of stay, days</td>
<td>10.35 ± 6.67</td>
<td>3-31</td>
</tr>
<tr>
<td>Hospital length of stay, days</td>
<td>16.87 ± 9.46</td>
<td>7-42</td>
</tr>
</tbody>
</table>

### Table 19- Demographic Data

<table>
<thead>
<tr>
<th></th>
<th>All Subjects</th>
<th>Early Mobility</th>
<th>No Early Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>35 (60%)</td>
<td>21 (68%)</td>
<td>14 (52%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>7 (12%)</td>
<td>4 (13%)</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>Disposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>18 (35%)</td>
<td>8 (30%)</td>
<td>10 (42%)</td>
</tr>
<tr>
<td>ECF</td>
<td>32 (63%)</td>
<td>18 (67%)</td>
<td>15 (58%)</td>
</tr>
<tr>
<td>VA</td>
<td>1 (2%)</td>
<td>1 (3%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Intensive care unit and hospital length of stay were calculated as well as ventilator length of stay. The independent sample T-test was used to compare the effect of early mobility on average length of stay (ventilator, ICU and hospital). Patients in the intervention group had a slightly longer ventilator length of stay ($M = 6.35 ±3.76$, range 2-15) when compared to those who did not have early mobility ($M=5.89 ± 3.69$, range 2-13). This difference was not statistically significant $t (56) = 0.47, p=0.64$. ICU length of
stay was also slightly longer for the intervention group \((M=10.35 \pm 6.67, \text{ range 3-31})\) than for those patients who did not have early mobility \((M=9.81, \pm 6.69, \text{ range 2-29})\). This difference was not statistically significant, \(t (55) =0.31, p=0.76\) (assuming unequal variances). Hospital length of stay was slightly shorter for those patients who did not have early mobility \((M=15.63 \pm 9.46, \text{ range 3-43})\) when compared to the group that had early mobility \((M=16.87 \pm 9.46, \text{ range 7-42})\). This was also not statistically significant \(t (56) =0.5, p=0.62\). This data can be found in Table 20.

**Table 20 – Length of Stay Comparison**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Early Mobility (N=31)</th>
<th>No Early Mobility (N=27)</th>
<th>(p) value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Duration of mechanical ventilation,</td>
<td>6.35 ± 3.76</td>
<td>2-15</td>
<td>5.89 ± 3.69</td>
</tr>
<tr>
<td>days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total ICU length of stay, days</td>
<td>10.35 ± 6.67</td>
<td>3-31</td>
<td>9.81 ± 6.69</td>
</tr>
<tr>
<td>Hospital length of stay, days</td>
<td>16.87 ± 9.46</td>
<td>7-42</td>
<td>15.63 ± 9.46</td>
</tr>
</tbody>
</table>

Note: \(SD =\) standard deviation.

Incidence of delirium was calculated and the two groups compared using chi-squared. There was a slight difference between the groups as to incidence of delirium but this was not statistically significant, \(X^2 (1, N=38) =0.398, p=0.53\). Average duration of delirium in days was compared between the two groups using an independent sample T-test. On average, the patients in the early mobility group had more days of delirium \((M=3.58 \pm 2.68, \text{ range 0-9})\) as compared to those patients that had no early mobility \((M=2.70 \pm 2.18, \text{ range 0-9})\) but this was not significant \(t (56) =1.35, p=0.18\). Incidence and duration of delirium information are included in Tables 21 and 22.
Table 21 – Incidence of Delirium

<table>
<thead>
<tr>
<th></th>
<th>All Subjects</th>
<th>Early Mobility (N=31)</th>
<th>No Early Mobility (N=27)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of Delirium</td>
<td>53 (91%)</td>
<td>29 (93.5%)</td>
<td>24 (89%)</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Table 22 – Duration of Delirium

<table>
<thead>
<tr>
<th></th>
<th>All Subjects</th>
<th>Early Mobility</th>
<th>No Early Mobility</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>Duration of delirium, days</td>
<td>3.25 ± 2.54</td>
<td>3.58 ± 2.68</td>
<td>2.7 ± 2.18</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>0-9</td>
<td>0-9</td>
<td>0-9</td>
<td></td>
</tr>
</tbody>
</table>

Summary

Data were collected on 58 critically ill, mechanically ventilated patients. Over half of the patients (53%) had early mobility. While there were differences between the two groups in ventilator, intensive care unit, and hospital length of stay as well as incidence and duration of delirium, these differences were not statistically significant. These results will be discussed in Chapter V.
V. Project Findings

Discussion of Results

Based on the appraisal and synthesis of the literature, an early mobility protocol was developed. A detailed implementation plan based on the EBPI model (Levin et al. 2010) was created by a multidisciplinary team. The initial test of change included high fidelity human simulation using scenarios that helped the team understand the protocol, and learn to work together to perform early mobility. Subsequent STOC focused on application of the protocol with actual patients and the team gained confidence. The protocol worked well and required no revision prior to dissemination. In the project time period, 31 patients had early mobility. These 31 patients experienced 65 sessions of early mobility while on the mechanical ventilator. There were no serious adverse events. Physical and occupational therapy consults increased to the point of assigning a therapist to the ICU.

Many patients (47%) were unable to participate in early mobility due to contraindications including; high oxygen requirements, difficult intubations/unstable artificial airway, hemodynamic instability, severity of illness and the use of sedation to control alcohol withdrawal. Additionally, 112 patients were excluded using the pre-determined criteria. Early in the implementation phase, there were several instances where the order for early mobility and consult for physical/occupational therapy was not
given until the patient was extubated. This physician barrier was overcome as the experience with early mobility increased, and safety had been demonstrated. Advanced practice nurses (project leader/CNS, and NP) also worked to ensure that the appropriate orders were in place so that the intervention could occur for those patients who met criteria.

The incidence of delirium for all patients in the project was high (91%). This is higher than previously noted in a pilot project conducted in the same ICU three years before (Meyer, Campbell & Vermeersch, 2010). This is also higher than averages noted in other studies (Lat et al. 2009, Pandharipande et al. 2008, Pandharipande et al. 2013, & Pisani et al. 2007). Although the early mobility group had a slightly higher incidence and duration of delirium than those who did not have early mobility, this was not statistically significant.

Delirium assessment was reviewed in the entire sample. There were 82 instances of charting the CAM-ICU as unable to assess (UTA). The CAM-ICU is UTA when the Richmond Agitation Sedation Score (RASS) is -4 or -5 (Ely et al. 2001), and is indicative of deep sedation or coma. These delirium assessments of UTA were reviewed individually. Of those patients who were UTA, 29 (35%) instances were incorrect. The patients were incorrectly assessed as UTA when their RASS scores were -3 or higher. At the time of the project, charting options for assessment of the CAM-ICU were Positive, Negative or Unable to Assess. The four features of the CAM-ICU were not required to be charted, only the final determination. Charting in the electronic medical record (EMR) did not provide any detail to support decision-making. The CAM-ICU instrument was laminated and hanging in each patient room on the wall, and was adjacent to the
computer where documentation occurred. In the Premier Critical Care Network group, other hospitals were implementing delirium assessment and it was decided to change the build of the delirium assessment requiring the four features of the CAM-ICU to be documented. Additionally, if the patient’s RASS score was -4 or -5; the documentation row would not open to continue with assessment of delirium. This change in documentation was put into production and implemented in June, 2013. Additional chart audit and review needs to occur to determine whether the change in the EMR improved documentation of CAM-ICU and influenced the incidence of delirium as well. See Figure 2 through 7 that relates to changes made to documentation in the electronic medical record.

Sedation practices may have influenced the incidence of delirium. The majority of patients at this hospital are intubated using rapid sequence intubation (RSI). This method generally uses a general anesthetic and a paralytic to prepare the patient for intubation. Continuous sedative infusions are usually started immediately to continue the sedative effects of the RSI medication. Sedatives were ordered with a target level of sedation. In a pilot study done at this hospital, (Campbell, Trout, Yunger & Vermeersch, 2014), patient records were reviewed to determine whether sedative infusions were titrated to meet the target level of sedation. Twenty-nine patients were reviewed and 128 days of sedation examined. Two-thirds (65.6%) of the time, the patient was not at the target level of sedation prescribed, with more than half (54%) of the patients more deeply sedated than the prescribed target. Staffing levels generally require one nurse to care for two patients who are receiving mechanical ventilation. Balancing the level of sedation
and patient safety can be difficult. Changing the culture to one of using less sedation remains a challenge.
Figure 2 – Detail of Documentation of CAM-ICU during Project
Figure 3 – Detail of Documentation Enhancement of CAM-ICU

Step One – Documentation of Patient RASS and Determination of CAM-ICU Unable to Assess (Note: Fictitious Patient)
Figure 4 – Detail Enhancement of CAM-ICU Feature One

Step Two – Documentation of CAM-ICU Feature One (See row information provided to support decision-making)
Figure 5 – Detail Enhancement of CAM-ICU Feature Two

Step Three – Documentation of CAM-ICU Feature Two (See row information provided to support decision-making)
Figure 6 – Detail Enhancement of CAM-ICU Feature Three

Step Four – Documentation of CAM-ICU, Feature Three (See row information provided to support decision-making)
Figure 7 – Detail Enhancement of CAM-ICU Feature Four

Step Five – Documentation of CAM-ICU, Feature Four (See row information provided to support decision-making)
Pain management also impacts sedation practices and the practice at this hospital was inconsistent. Some physicians did not utilize analgesia for medical patients requiring mechanical ventilation, while others utilized analgesia through continuous infusion or as needed intravenous dosing. Many authors have advocated the concept of analgesia first or analgosedation so that pain is addressed initially (Devabhakthun, Armahizer, Dasta & Kane-Gill, 2012; Sessler & Varney, 2008). Most pain medications also produce some sedation, and therefore less sedative may be required to obtain the target level of sedation if the pain medication is given first (Sessler & Varney, 2008). The Pain, Agitation and Delirium clinical practice guidelines advocate for the treatment of pain first, as well as pre-emptively in an effort to improve patient comfort as well as decrease the amount of sedative required (Barr et al. 2013).

Sedatives have been proven to be deliriogenic (Barr et al. 2013, Pandharipande et al. 2006, and Pandparipande et al. 2008). The benzodiazepines, specifically lorazepam, have been identified to be an independent risk factor for the development of delirium (Pandharipande et al. 2006). During the implementation of the project, the hospital experienced a propofol shortage, leading to an inconsistent choice for sedation. The alternatives for sedation were lorazepam, midazolam, and dexmedetomidine. This is a confounding variable that may have influenced the incidence of delirium.

Length of stay on the ventilator in the ICU, and total hospital length of stay (LOS) were not impacted by the implementation of early mobility. Patients that had early mobility had slightly longer average lengths of stay (ventilator, ICU and hospital) than
those who did not have early mobility, but this difference was not statistically significant in this project. It is important to note that during this time period, 56 patients had a ventilator length of stay of less than 48 hours (these patients were excluded from the study). Additionally, when non-survivors were excluded from the intervention group, the median ventilator LOS (4 days) was similar to the findings of Schwiekert et al. 2009 (3.7 days). Average ventilator LOS for all patients in this project (6.13 days) was less than other studies which ranged from an average of 7.9-18.7 days (Bailey et al. 2007; Morris et al. 2008; Thomsen et al. 2008).

Average APACHE II scores of the patients in this project, as a severity of illness index, were similar to other studies (Bailey et al. 2007; Morris et al. 2008; Schweikert et al. 2009). However, the average age of patients who had early mobility in this project (67.35 years) was at least ten years older than patients in other studies (Morris et al. 2008; Needham et al. 2010; Schweikert et al. 2009). The older age of patients in this project may have had an influence on length of stay. A much higher percentage of patients were discharged to ECF (67%) than in other studies (range 2-28%) (Bailey, et al. 2008; Morris et al. 2008; Needham et al. 2010; Schweikert et al. 2009; Thomsen et al. 2008).

An aim statement had been developed prior to implementation of the project as part of the EBPI model (Levin et al. 2010). The aim statement developed was “By month three of the project, early mobility will be incorporated into the care of 25% of the mechanically ventilated patients in the ICU at GSH”. The aim was revised by the medical director and project leader to state: By month three of the project, early mobility will be incorporated into the care of 25% of the mechanically ventilated patients who meet inclusion criteria. In the month of May 2013, 54 patient charts were reviewed for data
abstraction. A large percentage of patients met exclusion criteria (80%). Of thirteen patients that met inclusion criteria, five (38%) had received early mobility. More importantly, implementation had been done safely and had been accepted by the nursing staff. One nurse used early mobility as a topic to write about as part of clinical ladder project. Her summary of early mobility noted that she had “seen first-hand the difference that early mobility has made in the outcomes of the patients and will continue to implement the program into daily care of my patients.” She stated that “Early mobility is just the Right Thing to Do, both for the patient and the industry”. See Appendix K.

Future Recommendations & Conclusions

Strengths of Project Implementation

Implementation of early mobility in critically ill, mechanically ventilated patients is one part of a bundle of interventions recommended by current clinical practice guidelines (Barr et al. 2013). This guideline recommends meeting pain needs first and preemptively. The “ABCDE” bundle, which is complex and detailed in its execution, includes spontaneous awakening trials (SAT), spontaneous breathing trials (SBT), coordination of SAT and SBT, careful selection of sedative, delirium assessment and prevention as well as early mobility (Barr et al. 2013). An early mobility protocol was developed and successfully implemented to complete the ABCDE bundle at Good Samaritan Hospital. There were no serious adverse patient events.

The implementation plan was very detailed and developed in accordance with the EBPI model (Levin et al. 2010). This plan and the plan-do-check-act methodology helped guide the successful implementation. Involvement in the IHI webinar as a method to
begin knowledge translation helped create a solid foundational understanding of the science of early mobility. Multidisciplinary rounding and the use of champions were also noted to be strengths of the implementation. Champions attended the IHI webinars and then used high fidelity human simulation to learn about the early mobility protocol and helped to perform the small tests of change and demonstrate success and patient safety which helped other staff members feel comfortable with the practice change. The multidisciplinary team identified priorities of care for each patient through the rounding process, and supported critical decision-making and the practice change. The use of champions and a multidisciplinary rounding team have been noted by others as contributors to successful implementation of early mobility (Engel, Needham, Morris & Gropper, 2013). The presence PT and OT personnel gave a face and visual reminder to other staff of the emphasis on mobility.

**Limitations**

Reliability of delirium assessment was a limitation in this project. The EMR did not fully support accurate assessment. Extensive changes to add detail have been built and put into production. Additional audit and follow-up needs to occur to ensure reliability and validity of delirium assessment. The multidisciplinary team emphasized getting the patient to sit at the side of the bed with feet to the floor. Because of this emphasis, passive and active range of motion interventions which were the first two steps of early mobility may have been minimized. This was not practiced in the simulation because it was felt to be standard nursing care. Additional education and demonstration was provided to nursing staff to highlight the importance of these initial steps of the protocol.
When implementing complex bundles, the reliability of each part of the bundle must be ensured. Constant education and monitoring as staff changes must be performed to ensure that the bundle is sustained. Pain and sedation management were limitations to the success of this project. A reliable tool for pain assessment such as the Critical Care Pain Observation Tool or Behavior Pain Scale is recommended for implementation to assist with pain assessment (Barr et al. 2013). An analgesia first approach may assist with decreasing the amount of sedative required for patient compliance with mechanical ventilation. Targeting sedation and decreasing exposure to sedatives may also be helpful in decreasing incidence and duration of delirium.

**Future Recommendations**

Studies that focus on the use of the CAM-ICU may be helpful in identifying barriers and facilitators for accurate assessment and documentation. This may have a major influence on incidence and duration of delirium and the value of this accuracy should not be underestimated. A patient and family educational brochure on delirium has been developed by the ICU Delirium & Cognitive Impairment Study Group at Vanderbilt University (Delirium: A Guide for Families and Patients, 4/2010). Use of this brochure may be helpful in explaining the causes and signs of delirium as well as the importance of the intervention of early mobility. The influence of the use of champions, multidisciplinary rounding, and integration of advanced practice nursing in the care of the critically ill and implementation of EBP would be important to study to further identify best practices. Additional studies are recommended that focus on knowledge translation from formal research studies to integration into clinical practice.
References


sustained use of sedatives and analgesics in the critically ill adult. *Critical Care Medicine, 30*(1), 119-41.


mechanically ventilated, critically ill patients: a randomized controlled trial. 

*Lancet, 373*(9678), 1874-82. 

doi: 10.1016/S0140-6736(09)60658-9


*Critical Care Nurse, 30*(2), S13-S16. doi: 10.4037/ccn2010393
Hello Melody,

I am delighted that you find the EBPI Model useful for your project. Yes, of course, you may use the Model.

Please use the appropriate citation to the article in which it was published and send me an abstract of your proposed project now. I would also appreciate your sharing the results of your project when it is finalized.

I wish you much success,

Rona Levin

On Wed, Jan 22, 2014 at 8:39 PM, Campbell, Melody <Melody.Campbell@kettering.org> wrote:

Dear Dr. Levin,

I am writing to request permission to use your EBPI model for my IBP project in the pursuit of the IBP degree. My project is entitled "The Effect of Early Mobility in Mechanically Ventilated Patients on incidence and duration of delirium and intensive care length of stay." I would like to use it as the model guiding the change in practice, and would include a copy of it in my final defense presentation as well as written scholarly project. Please let me know at your convenience.

Thanks in advance.

Melody A. Campbell, RN, DNP (C), OCN, COR, CSHE
Kettering Hospital Network/Children’s Hospital National Professional
Kettering Medical Center
5055 Southern Blvd
Kettering, Ohio 45429
361-941090

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Date: December 3, 2012

To: Office of Research and Sponsored Programs
   Institutional Review Board
   Wright State University
   201J University Hall
   Dayton, OH  45435

From: Betty Love, RN, MS, Director of Nursing
      Intensive Care Unit
      Good Samaritan Hospital
      2222 Philadelphia Drive
      Dayton, Ohio  45406

Subject: Proposed Research Project at Good Samaritan Hospital

I am very pleased and excited to support the proposed evidence-based research project “The Effect of Early Mobility on Delirium and Length of Stay in Mechanically Ventilated Patients” by investigator Melody R. Campbell, RN, MSN, CEN, CCRN, CCNS, Critical Care Clinical Nurse Specialist, Good Samaritan and Wright State University College of Nursing and Health Doctor of Nursing Practice Program student.

This project represents a significant collaborative opportunity to bring academia and clinical practice together. By understanding more about our patient populations, we will know better how to service them and address their needs.

Thank you for the opportunity for our patient population at Good Samaritan Hospital to be considered for this research project.

Betty J. Love, RN, MSN

Sincerely,
Betty Love, RN, MS
Appendix C

EFFECT OF EARLY MOBILITY ON DELIRIUM
Data Collection Tool

Study Patient: __________

1. Age: ______
2. Gender: (circle) Male Female
3. Date of Admission to ICU: __________
4. Admitting diagnosis: ____________
5. Date of transfer out of ICU: __________
6. Date of discharge from hospital: __________
7. Status at Discharge: (circle one) Alive Dead ECF Home
8. Date of Intubation: __________
9. Date of Extubation: __________

<table>
<thead>
<tr>
<th>Date</th>
<th>CAM-ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
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</table>
(If patient ventilated > 10 days, only abstract first 10 days)

**APACHE II score components:** (use worst physiologic value during the initial 24 hours after ICU admission)
MedCalc will be used to calculate score.

**Patient Facts**
Age _____ yr
Temperature _____F
Respiratory rate _____ min
Heart rate _____ bpm
MAP _____ mm Hg
GCS _____ points
Chronic Organ Insufficiency and/or Immunosuppression Yes  No (circle one response)
No Surgery  Elective Surgery  Emergent Surgery  (select one response in this line)

**Lab Values**
Acute Renal Failure  Yes  No (circle one response)
Serum Creatinine  _____ mg/dl
Hematocrit _____ %
WBC _____ c/mm3
ABG available ?
   Arterial pH _____
Na _____ mEq/L
K _____ mEq/L
FiO₂  < 50%  > 50%  (select one response)
PaO₂ _____ mm Hg
Appendix D

Early Mobility Protocol
October 5, 2012

Contraindications to Initiating Early Mobility
1. MAP < 65 mm Hg
2. Heart rate < 60, > 120 beats/min
3. Respiratory rate < 10, > 32 breaths/min
4. Pulse oximetry < 90%
5. Actively undergoing a procedure
6. Patient agitation requiring increased sedation in last 30 minutes
7. Insecure airway device or difficult airway

Prepare for Early Mobility
1. Assess all devices before beginning
2. Secure all devices
3. Stop tube feeding
4. Remove/unattach unnecessary devices (SCD)
5. Move foley, IV poles, fecal collection bag to side of bed next to ventilator
6. Always mobilize to side of bed next to ventilator
7. For ambulation, use transport ventilator. Always have wheelchair behind patient to use in event of weakness, intolerance of activity

Contraindications to Continuing Early Mobility
1. MAP < 65 mm Hg
2. Heart rate < 60, > 120 beats/min
3. Respiratory rate < 10, > 32 breaths/min
4. Pulse oximetry < 90%
5. Patient distress
   A. Evidenced by non-verbal cues, gestures
   B. Physically combative
7. New arrhythmia
8. Concern for myocardia ischemia
9. Concern for airway integrity
10. Fall to knees
11. Inadvertent endotracheal tube removal
12. RN/PPT/OT judgement

Prepare for Early Mobility
1. Assess all devices before beginning
2. Secure all devices
3. Stop tube feeding
4. Remove/unattach unnecessary devices (SCD)
5. Move foley, IV poles, fecal collection bag to side of bed next to ventilator
6. Always mobilize to side of bed next to ventilator
7. For ambulation, use transport ventilator. Always have wheelchair behind patient to use in event of weakness, intolerance of activity

Adapted from Pohlan, Schweickert, Pohlan, Nigos, Esbrook... & Kress. (2010). Feasibility of physical and occupational therapy beginning from initiation of mechanical ventilation. Critical Care Medicine, 38, 11, pp. 2089-2094.
Esbrook... & Kress, (2010) Level VI Descriptive
Appendix E

- **Incorporation of Early Mobility**
- **Into current process**

**Patient Meets Criteria For Sedation Vacation**

1. Assess Wakefulness
   - **Proceed with Early Mobility with PT/OT**
   1. Patient is Awake and Calm
      1. Opens eyes to voice
      2. Squeeze hand of RN
      3. Stick out tongue
   2. Patient with ↓ responsiveness
      1. Perform PROM
      2. Continue sedation vacation
      3. Continue to monitor and assess

**Perform Sedation Vacation**

**Assess Wakefulness**

**Patient with ↓ responsiveness**

1. Perform PROM
2. Continue sedation vacation
3. Continue to monitor and assess

**Agitation**

Restart sedation at ½ dose

**Considerations for CPAP Trial**

1. CPAP trial should be done daily when indicated
2. Coordinate PT/OT with CPAP trial
   a. Perform CPAP trial earlier in day
   b. PT/OT session later in day after CPAP trial
   c. Patient to be extubated? Extubate, and do PT/OT later in day

2. Pohlman, Schweickert, Pohlman, Nigos, Pawlik, Esbrook... & Kress, (2010) Level VI Descriptive
### Appendix F

**Sim-Man Scenario One for Early Mobility**

**Safety Screening for Early Mobility**

<table>
<thead>
<tr>
<th>Cardiac Monitor</th>
<th>Ventilator</th>
<th>Sim-Man</th>
<th>Instructor Content</th>
<th>Expectations of Student Group</th>
<th>Important Learning Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinus tachycardia – rate = 110</td>
<td>Assist Control</td>
<td>Oral Endotracheal tube with subglottic suction</td>
<td>As the multidisciplinary team caring for Mr. Sim today, you need to decide whether he has any contraindications for early mobility. Please assess the patient and determine whether you may begin to work with him. The patient’s current RASS score is -2.</td>
<td>Verbalize the contraindications to initiating early mobility. Examine patient and infusions. Review ventilator settings and vital signs.</td>
<td>Have chart of contraindications available for team to review. Note patient has no contraindications – however proceed with caution. Patient with borderline Sp02.</td>
</tr>
<tr>
<td>NIBP = 104/60</td>
<td>Fi02 = 50%</td>
<td>PICC line in left arm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp02 = 90%</td>
<td>Peep = 5</td>
<td>Infusions: Propofol 35 mcg/kg/min Fentanyl 25 mcg/hr Norepinephrine 12 mcg/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RR = 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Case 2</strong></td>
<td>Assist Control</td>
<td>Oral endotracheal tube</td>
<td>Target RASS not ordered</td>
<td>Verbalize the contraindications to initiating early mobility. Examine patient and infusions. Review ventilator settings and vital signs.</td>
<td>Have chart of contraindications available for team to review. Note patient has contraindications to early mobility – patient has unstable</td>
</tr>
<tr>
<td>Sinus tachycardia – rate = 112</td>
<td>Fi02 = 70%</td>
<td>PICC Line in left arm</td>
<td>Patient RASS score = -3 CAM-ICU +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIBP= 88/60</td>
<td>Peep = 10</td>
<td>Infusions: Propofol 25 mcg/kg/min Fentanyl 25 mcg/hr</td>
<td>Again, determine whether patient has any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp02 = 94%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RR = 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norepinephrine 20 mcg/min</td>
<td>contraindications for early mobility. Review the patient and determine whether you may begin to work with him.</td>
<td>Discuss current RASS and CAM-ICU score. Verbalize possible plan for sedation and interventions.</td>
<td>blood pressure. Team to discuss unit protocol for sedation level if not ordered, as well as interventions for delirium using STOP-THINK.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix G

**Sim-Man Scenario Two for Early Mobility**
- **Preparing for Early Mobility**
- **Contraindications to Continuing Early Mobility**

<table>
<thead>
<tr>
<th>Cardiac Monitor</th>
<th>Ventilator</th>
<th>Sim-Man</th>
<th>Instructor Content</th>
<th>Expectations of Student Group</th>
<th>Important Learning Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case 1</strong></td>
<td></td>
<td>Oral Endotracheal Tube with continuous subglottic suction Sequential Compression Device (both legs) NG tube – tube feeding/pump Foley catheter PICC Line Infusions: Precedex 0.7 mcg/kg/hr Insulin 2 units/hr</td>
<td>As the multidisciplinary team caring for Mr. Sim today, you need to decide whether he has any contraindications for early mobility. Please assess the patient and determine whether you may begin to work with him. The patient’s current RASS score is 0. Plan is to do some sitting balance activities, and perhaps work on sit to stand, move from bed to chair.</td>
<td>Verbalize the contraindications to initiating early mobility. Examine patient and infusions. Review ventilator settings and vital signs. Verbalize preparing patient for early mobility. Prepare patient for sit to stand, move from bed to chair. Verbalize:  - Secure all devices  - Turn off tube feeding  - Move foley,</td>
<td>Have chart of contraindications for early mobility available for team to review. Note patient has no contraindications. Have chart of items for consideration for planning for early mobility. Discuss roles and responsibilities of different personnel. Respiratory therapy – responsible for ETT and tubing to ventilator. Nurse – responsible for</td>
</tr>
</tbody>
</table>
**Patient condition change**  
**Sinus tachycardia**  
HR = 130  
NIBP = 140/80  
Sp02 = 94%  
RR = 30  

<table>
<thead>
<tr>
<th>No change in ventilator settings</th>
<th>Patient anxious, shaky. Coughing</th>
<th>Patient is coughing and gaggy. What should you do?</th>
<th>Examine patient. Review ventilator settings and vital signs. Talk with patient, assure them of safety. Get settled in chair if transfer was in process. Determine whether patient needs suctioned.</th>
<th>Examine contraindications for continuing early mobility. Have chart of contraindications available for team to review. Determine next steps as a team.</th>
</tr>
</thead>
</table>
## Appendix H

### Sim-Man Scenario Three for Early Mobility

Inadvertent Endotracheal Tube Removal

<table>
<thead>
<tr>
<th>Cardiac Monitor</th>
<th>Ventilator</th>
<th>Sim-Man</th>
<th>Instructor Content</th>
<th>Expectations of Student Group</th>
<th>Important learning considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Sinus Rhythm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR = 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIBP = 130/80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SpO2 = 98%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RR = 16</td>
<td></td>
<td>Oral Endotracheal Tube to subglottic suction</td>
<td>Patient is improving. Yesterday patient was able to sit and dangle at bedside. Sit to stand with two person assist. Gait was steady. Plan for today is to march in place, weight shift and determine if patient can ambulate in room.</td>
<td>Verbalize the contraindications to initiating early mobility. Examine patient and infusions. Review ventilator settings and vital signs.</td>
<td>Have chart of contraindications for early mobility available for team to review. Note patient has no contraindications.</td>
</tr>
<tr>
<td></td>
<td>Assist Control</td>
<td></td>
<td></td>
<td>Verbalize preparing patient for early mobility. Prepare patient for sit to stand, march in place, weight shift, possible ambulation in room. Verbalize:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FiO2 = 40%</td>
<td>Oral Endotracheal Tube to subglottic suction</td>
<td></td>
<td>• Secure all devices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peep = 5</td>
<td>Sequential Compression Device (both legs)</td>
<td></td>
<td>• Turn off tube feeding</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NG tube – tube feeding/pump</td>
<td></td>
<td>• Move foley,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foley catheter</td>
<td></td>
<td>Have chart of items for consideration for planning for early mobility. Discuss roles and responsibilities of different personnel. Respiratory therapy – responsible for ETT and tubing to ventilator. Set up of portable ventilator. Nurse – responsible for IV poles and IV</td>
<td></td>
</tr>
<tr>
<td>Change in condition</td>
<td>Low pressure alarm from ventilator</td>
<td>Inadvertent endotracheal tube removal, patient is anxious, tachypneic.</td>
<td>There has been a change in the patient condition. Please work as a team to remedy the situation.</td>
<td>Nurse: talks to patient and assures them of their safety, tells them what will happen. Team assists patient back to bed. Respiratory therapy</td>
<td>Calm approach to patient very important. Indications that patient may need reintubation: Tachypnea,</td>
</tr>
</tbody>
</table>

- Sinus Tachycardia
  - HR = 116
  - NIBP = 150/84
  - SpO2 = 90%
  - RR = 30

- Lines. Cardiac monitor onto walker.
- PCT - remove SCD, and move foley to side of bed by ventilator. Attach to walker. Emphasize maintaining foley below level of bladder.
- PT – apply gait belt, instruct patient. Assess trunk stability, balance. Assist to sit at side of bed. Determine whether may sit to stand, march in place, begin ambulation in room.
<table>
<thead>
<tr>
<th>Resource</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100% 02</td>
<td>Team assesses patient tolerance of extubation. RN notifies physician/provider of extubation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decreased Sp02, circumoral cyanosis, tachycardia, hypotension. Resources for reintubation: NP, physician, or anesthesia.</td>
</tr>
</tbody>
</table>
Appendix I

Scripting for Rounding on Early Mobility Implementation

Nurse presents patient to team with following information:

Mr. Jones is a ____ year old male, hospitalized for ________. Today is his _____ day in the hospital and ______ day on the ventilator.

Pain score is _______.
Current pain regimen is and the patient has received _______.
Target RASS is _______.
Current RASS is _______.
He is CAM _______ (positive or negative).
Currently his sedation is _________ at _rate__, or he has received so many boluses of sedation (or mg given during last shift).

Patient’s current vent settings are: _______________________________.
(This information could be added to conversation per respiratory therapy)

Spontaneous awakening trial – contraindicated or performed? If done, did patient tolerate? If not, for patient on continuous sedation, was infusion re-started at 50%.

Spontaneous breathing trial – contraindicated or performed? If SBT indicated and has been done – respiratory therapy would indicate that patient tolerated/did not tolerate SBT and why.

Early Mobility – Is patient a candidate for early mobility? Has it been performed? If not, what time would work for team to work with patient? If performed, how did the patient tolerate it? What are the next steps?

Team discusses:

1. Plan for sedation and ventilation for the day.
2. Target RASS -determine whether it needs changed. If changed, this is ordered as a nursing communication order.
3. If patient is CAM- ICU positive, plans for patient management focusing on ensuring that non-pharmacologic measures have been put in place (STOP-Think).
4. Next steps for early mobility.
Appendix J

Data Definitions

1. **Age** - Age in years.
2. **Gender** - M-Male, F-Female.
3. **Date of Admit** - Date of admission to hospital.
4. **Date of Admit to ICU** - Date of admission to the intensive care unit.
5. **Date of Transfer out of ICU** - Date when patient was transferred out of the intensive care unit.
6. **Date of Return to ICU** - Date when patient returned to the intensive care unit during the same admission to the hospital.
7. **Date of 2nd Transfer out of ICU** - Date when patient was subsequently transferred out of the intensive care unit following a return to the ICU. This time is included in the ICU length of stay.
8. **Date of Discharge** - Date patient left the hospital.
9. **Discharged to** - Place patient went to following discharge from the hospital.
   ECF = extended care facility, Home, NA = not applicable (used in instances of patient death)
10. **Date of Intubation** - Date endotracheal tube was inserted and mechanical ventilation started.
11. **Date of Extubation** - Date endotracheal tube was removed and mechanical ventilation was discontinued.
12. **Date of Intubation 2** - Date endotracheal tube was re-inserted following a period of removal of the initial endotracheal tube.
13. **Date of Extubation 2** - Date endotracheal tube was removed following a re-intubation.
14. **Date of Trach** - the date that tracheostomy was performed.
15. **Ventilator Length of Stay** - The time in days between the date of intubation and the date of extubation. If the patient required a second re-intubation, this second time period is included in the ventilator length of stay.
16. **APACHE II** - calculation of factors as an indication of severity of illness and ICU mortality prognosis. Uses the worst values during the first 24 hours following admission to the intensive care unit.
17. **Date – 1** - the first day including 0800 following the intubation date.
18. **CAM-ICU 1** - Documentation of the Confusion Assessment Method for ICU on Date-1. (-) indicates patient is not delirious, (+) indicates presence of delirium, UTA indicates that the patient is unable to be assessed. ND indicates not documented. When available, the RASS score is collected when the CAM-ICU is noted to be UTA.
19. **RASS** - Richmond Agitation Sedation Scale - ranges from -5 to +4. When documented as a positive number on the data collection form, the number appears without the +.
20. **Early Mobility Done** - N=No, Y=Yes, PT = Physical Therapy (documented when activity continues after extubation. No PT – no physical therapy was done on this date following extubation (patient has order for PT, and is
extubated but therapy was not performed for some reason. If PT/OT worked with patient on the day of extubation, this was counted as early mobility.

21. Adverse event – the occurrence of changes in blood pressure, oxygen desaturation, accidental extubation or fall to knees during mobility.
Appendix K

Laura J. Robinson BSN, RN, PCCN Good Samaritan Hospital Dept 62200 ICU

*Demonstrate knowledge of the importance of early mobility for the ICU patient.*

Since joining the ICU team in January 2013, there have been 4 ventilated patients under my care who have participated in the early mobility program and have been ambulated on the unit. The difference the program has made in the improvement of patients neurological as well as physical condition has been nothing short of amazing.

For patients on mechanical ventilation receiving sedatives, it is protocol that they are assessed each morning to determine if they can safely undergo a spontaneous awakening trial. If the trial is successful the respiratory therapist assesses if the patient can safely undergo spontaneous breathing trial. If all goes well the patient could possibly be extubated. As sometimes happens, the patient may “pass” the SAT trial but not the SBT trial, it is these patients that early mobility especially benefit. Full collaboration with pharmacy, physical therapy, occupational therapy, physicians and advanced practice staff is necessary to determine the level of activity the patient can tolerate.

By working collaboratively several of the patients under my care have progressed faster towards extubation than the patients that “rule out” and are unable to be sat up at the bed, transferred to a chair, or ambulate while on mechanical ventilation. In the cases of these patients it is important to titrate the sedation as low as can be tolerated or to use “as needed” bolus doses to decrease the incidence of delirium. It is equally important to work with these patients to reposition frequently and to use passive exercises to maintain muscle strength and tone.
I have made it a daily goal to see which patients need orders for PT/OT and pursuing those orders when necessary. Due to the “busy” nature of the ICU setting, I have attempted to make myself available when the early mobility team is assessing my patients to assist in the process.

The importance of the program as outlined in the critical care nurse article is paramount in reducing ICU acquired delirium and weakness, which is associated with “poor long-term physical, functional, and cognitive outcomes”. These not only delay the patients’ recovery but contribute unnecessary increased cost and lengthier ICU and hospital stays. As the article states, “cost estimates of caring for delirious patients receiving mechanical ventilation in the United States alone is from $6.5 to 20.4 billion annually”. I have seen firsthand the difference that early mobility has made in the outcomes of patients and will eagerly continue to implement the program into the daily care of my patients. Early mobility is just the Right Thing to Do, both for the patient and the industry.

References