**Research Article**

**Early Mobility for the Mechanical Ventilated Patient: Quality Improvement Project**

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**How to cite this article:** Peters LL (2023) Early Mobility for the Mechanical Ventilated Patient: Quality Improvement Project. Int J Nurs & Healt Car Scie 03(01): 2023-180.

**Submission Date:** 04 January, 2023; **Accepted Date:** 16 January, 2023; **Published Online:** 23 January, 2023

**Abstract**

**Introduction:** Patients requiring mechanical ventilation are at risks for developing complications related to immobility. Ventilator Associated Events (VAE) and Intensive Care Unit Acquired Weakness (ICUAW) can start to develop within the first few days of intubation due to the decrease or absence of physical activity. The development of VAE and ICUAW increases the mortality rate of the patient and overall hospital cost.

Immobility can have effects such as decreased physical function and lessened perceived quality of life that last months or years beyond hospitalization.

**Objectives/Aims:** The facility in this quality improvement project was not using any mobility activities on their Mechanical Ventilated Patients (MVP). To reduce the risks of these patients developing VAE/ICUAW, evidence based best practice standards must be integrated to assure high quality patient care. The aim of this project was to implement an early mobility team-based program guided by best care practice standards to reduce the risks of VAE/ICUAW complications and increase mobility.

**Methods:** Following national best care practice guidelines, a multidisciplinary team, mobility readiness screen, mobility level screen and an algorithm was developed and tailored to meet the facilities needs and resources. Implementation of the project was scheduled for 10 weeks along with audits three times a week.

**Results:** There was a 99.6% compliance of screening MVP for mobility readiness within the first 24 hours of intubation. RN assessment of the patients’ mobility level was congruent with the multidisciplinary team’s assessment 99.3% of the time. Out of 287 opportunities, only a third of the patients were eligible to advance to mobility levels past range of motion. Patients progressing to higher levels of mobility fell below expectation, but early mobility was achieved on a unit with an ambulated MVP patients in a unit that had not engaged in early mobility prior to this project.

**Conclusion:** This improvement project provided a helpful guide of executing best care practices in the form of implementation of an early mobility program. Due to the early Covid-19 patients that were not recognized, and the overwhelming pandemic that impacted this urban facility the project was abruptly stopped. However, the intradisciplinary team development that occurred because of this QI project was invaluable learning for future endeavors.

**Keywords:** Early mobility; Intensive care unit weakness; Mechanical ventilated patients

**Abbreviations**

MVP : Mechanically Ventilated Patients

ICU : Intensive Care Unit

ICUAW : Intensive Care Unit Acquired Weakness

VAE : Ventilator Associated Events

SCCM : Society of Critical Care Medicine

AHRQ : Agency for Healthcare Research and Quality

QMC : Quality Care Model

RN : Registered Nurse

RT : Respiratory Therapy

PT : Physical Therapy

SBT : Spontaneous Breathing Trials

SAT : Spontaneous Awake Trials

RASS : Richmond Agitation Sedation Score

**Introduction**

Mechanically Ventilated Patients (MVP) in the Intensive Care Unit (ICU) are vulnerable to complications such as Ventilator Associate Events (VAE) and Intensive Care Acquired Weakness (ICUAW) [1-4] VAE includes pneumothorax, pulmonary edema, pulmonary embolism, acute respiratory distress syndrome, pneumonia, and sepsis [1,2]. ICUAW can develop in the MVP due to immobility within the first few days of admission. Immobility has been shown to heighten a protracted inflammatory response that lowers the immune system, causing muscle atrophy, and limiting physical functioning. Complications of ICUAW increases skeletal and diaphragm muscle weakness, muscle wasting, and possible peripheral nerve damage [3,4]. The development of VAE increases the mortality rate of MVP as much as 24%-60% [1-3]. VAE also adds a $19,000-$80,000 to hospital cost per visit, the combined events of both increases the mortality and cost of care to the MVP [1-4]. To reduce the risk of MVP complications in the ICU, evidence-based practice standards must be implemented to assure high quality care.

Best care practices initiated and maintained from time of admission leads to positive patient care outcomes [1-6]. The current literature on MVP suggests that patients not receiving daily physical activity within the first 24 hours of admission are at great risk of complications from developing both VAE and ICUAW [1-13]. Prolonged immobility can have long term affects lasting months or years after discharge, decreasing the MVP’s ability to fully function mentally and physically and as a result lessens their perceived quality of life [7].

The Society of Critical Care Medicine (SCCM) ICU Liberation guidelines and the clinical guidelines for early mobility on MVP from the Agency for Healthcare Research and Quality (AHRQ), provide a detailed process to assist implementing best care practices for MVPs. In particular, the use of a multidisciplinary team approach is suggested to successfully implement an early mobility program.

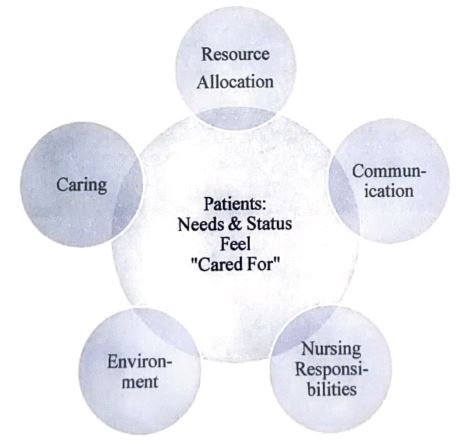
Despite the availability of evidence-based practice guidelines on early mobility, translation into practice has been limited. This project was developed for an ICU setting that was not fully implementing early mobility for MVPs. The hospital had a basic EMR mobility charting, but it was for general ICU patients and was not used or tailored to the MVP population. There was no mobility team or mobility practices being done in the ICU at the project site. The site was a 20-bed adult Medical Intensive Care Unit (MICU) in a large Midwest suburban facility associated with a national healthcare system. The aim of the project was to implement an early mobility team-based program guided by the SCCM and AHRQ standards, to reduce the risk of VAE and ICUAW complications.

**Methods**

The setting was a Medical Intensive Care unit in a large midwestern university affiliated hospital. The unit is staffed with all Registered Nurses (RN) with a patient/nurse ratio of 1:2. The patient population at the project site were adults aged 18 or older on mechanical ventilation for 24 hours or more. For the project, an early mobility team was established consisting of the project leader, intensivists, unit manager, Physical Therapy (PT), Respiratory Therapy (RT) and twelve staff RN champions.

The facility has had a long-standing RN model of care which is guided by Jean Watson’s Theory of Caring. Watsons’ theory states that meaningful relationships with patients and families is the predominant aspect of nursing work [14]. However, the facility needed a structured method to implement an evidence-based practice guideline.

Therefore, Joanne Duffy’s Quality Care Model© (QMC) which reflects associations between evidence-based practice and nursing's unique contribution to quality health care outcomes was chosen [15]. The model integrates biomedical and psychosociospiritual factors associated with quality health care which combines the relationship between quality care, collaborative relationships, caring behavior, and a healing environment (Figure 1) [15-17].



**Figure 1:** Quality Care Model©.

The QMC© reflects evidence-based practice while also representing nursing uniqueness. This project utilized each area of Duffy’s model.

**Resource Allocation:** RNs were 1:2 nurse to patient ratio, PT, RT, and residents along with administration and ICU providers were all resources.

**Communication:** was multi-modal, using EMR data, huddles, audits, and immediate verbal feedback. In addition, ICU rounds, calling in resource resident support, monthly meetings, charts, and algorithms were used.

**Nursing Responsibilities:** required that nurses were accountable for assessment of eligibility to be placed in the mobility program and daily assessment of progression on the levels, in addition to caring for the patients during the process. They participated in team planning and committed to work together.

**Caring:** required that the team be concerned for each other during the process by showing mutual respect and collaborating with each other.

**Coordination:** with RT and PT and resolving among themselves daily barriers to care. The intensivist and the DNP project leader modeled team processes by working together with all parties.

**Environment:** assessment was important to create optimal healing. There were several environmental changes occurring simultaneously during the project including new restrictions on visitation by friends and family, emerging Covid-19 cases and concerns, and recent upgrading of spontaneous breathing and spontaneous awake protocols. Access to additional resources were needed in the unit, such as gait belts, cardiac chairs which were purchased to facilitate patient safety.

The QMC model describes associations that highlight the unique contributions of nursing and is applicable to the changes in structure process and outcomes targeted within the evidence-based early mobility program for MVP at this facility. Based on the QMC© the components of the early mobility team model were delineated within both the nursing theoretical components of Duffy’s model and the model’s change process which is aligned with the work of Donabedian [l7]. The Donabedian model of Structure Process and Outcomes has been utilized in health care process improvement projects for years. The table below represents a blending of the two models used in this project that will allow for the evaluation of outcomes (Table 1).

|  |  |  |
| --- | --- | --- |
| Quality Care Model (QMC)© (DNP Project Structure) | | |
| Staff | Caring Behaviour/Relationships | Patients |
| Mobility Team | Screen MVP for eligibility | Accurate Mobility Level Placement |
| Physical Therapy Training | Communicate/Collaboration Mobility Team | Caring Behaviour/Environment |
| Education | Implement early Mobility Protocol | Best Care practices Achieved |
| Equipment | Audits, Feedback, Adjustments to Protocol | Progression in Physical Activity |
| Staff Cared For | "Patient Cared For" | "Patient Cared For" |

**Table 1:** Early Mobility Team Model.

Driving the outcomes of the program, the following objectives were developed.

Objective I

IA: RNs will screen 85% of all MVPs for eligibility with the Mobility Readiness Screen, within the first 24 hours of intubation by the projects end.

IB: RNs will screen for the mobility level of MVPs within the first 24 hours post intubation by the projects end.

Objective II

II: The mobility level assigned by the RN, will demonstrate 85% congruency with the mobility teams’ mobility level assignment.

Objective III

III A: There will be an improvement in mobility level for eligible MVP by 50% of patients achieving level II or above by project end.

III B: There will be a 25% increase in mobility level in eligible MVP to level III or above by project end.

**Structure**

Organization of the multidisciplinary team for purposes of early mobility required that all members were informed, engaged, and educated on the project and the processes that would be followed. Nurses also needed to have the necessary equipment and human resources to assist with mobilization of MVPs. The facilities Critical Care Improvement Council approved the early mobility program as the Quality Improvement Project for 2019-2020. After approval by the council a budget was allocated for the purchase of necessary mobility aids such as gait belts, slide boards, a lift, and three cardiac chairs.

Financial support for additional staff to serve as Mobility Technicians (MT) was not approved in the budget for this pilot project but will be revisited later. The project was approved by the mobility team of the ICU where the project would be implemented and respective IRBs of the institution and Wayne State University.

Planning and collaboration with the stakeholders who are responsible for implementing a change in practice is essential. Although every person on the multidisciplinary team was a stakeholder, the nurse was the major stakeholder. A major “Staff cared for” concern for the nurses was physical support to mobilize the identified patients safely. The intensivists made the decision that the residents were to assist the nurses with mobilizing the patients. It was agreed amongst the intensivists, nurses, and residents that this was a positive reassuring approach. Not everyone was 100% sold, but all agreed to work together.

The multidisciplinary team met every month for 10 months prior to the start of the project. There was 98% team attendance throughout that time. RT and the Unit Manager sometimes had other meetings to attend but were updated via email. Concerns from all team members were resolved, along with a review of the old protocol and current literature.

**Development of the Process**

The SCCM and AHRQ guidelines were adapted to meet the facility needs and staffing. Based on these assessments, three major support tools were designed with unanimous approval from all team members. This first tool developed was ‘Who” would be eligible patients. The SCCM [6] guidelines were clear on exclusion criteria and the team agreed that this project would use those criteria (Table 2).

|  |
| --- |
| \*Patient screen within 24 hrs. of intubation; and daily |
| Exclusion Criteria |
| 1. RASS score (≤-2 or ≥+2) |
| 2. Neurologic instability: New CVA within 24 hrs.; required intubation |
| 3. Circulatory Instability: New PE/DVT 1st 24hrs; hemodynamically compromised; Unstable arrythmia within 2 hrs.; Continuous infusion vasodilator with SBP > 180mmHg |
| 4. Patients on a paralytic agent |
| 5. Therapeutic Hypothermia |
| \*Documentation of reason for exclusion required in HER |

**Table 2:** Mobility Readiness Screen: For Mechanically Ventilated Patients.

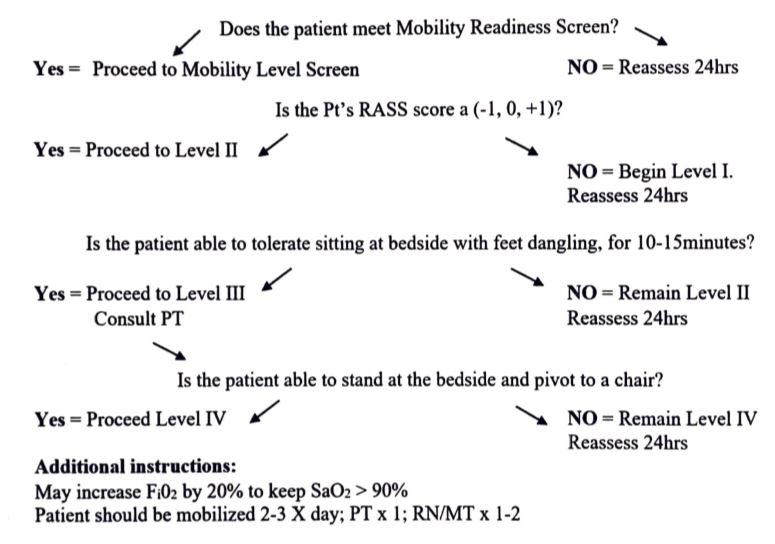
However, AHRQ [5] suggested several cautionary criteria that might be acceptable for some patients and not for others. The two intensivists selected the criteria, and it was included in the tool. Based on the cautionary criteria input would be needed from the intensivists before the patient could be automatically included in the mobility project.

The second tool describes the actual criteria for the patient to advance through levels of mobility. The physical therapists on the team had a lot of input in the transition from level to the next and when it would be appropriate to have PT consulted. After reviewing the mobility levels suggested by the AHRQ [5] and the previous mobility protocol, a revised mobility level tool was developed (Table 3).

|  |
| --- |
| Level I: RN or MT to perform PROM/ AROM; 3 X per shift. |
| Level II: Patient preforms AROM 2X per shift. Patient sits up in bed/feet dangle at beside for 10-15 minutes, 2-3X daily (RASS -1 to +1) |
| Level III: Patient stands at bedside and pivots to chair for> 20minutes, 2-3 X daily. Initiate Physical Therapy consult. (RASS -1 to +1) |
| Level IV: Patient stands at bedside walk in place 2-3 times daily. Patient takes steps to chair/bedside commode 2-3 X daily Patient may progress to out of the room ambulation with PT/RT/RN as tolerated. RASS (0 to +1) |
| \*All pts at Level IV must be OOB in chair @ 7am |

**Table 3:** Mobility Levels.

The RN was responsible for completing the initial Readiness screen within the first 24 hours after intubation, to determine the appropriate level of mobility for the patients. To improve the ease and flow of the process, a flow algorithm was created and placed within the unit to allow for ease of visualization by nurses and other team members (Figure 2).



**Figure 2:** Early Mobility Protocol: For Mechanically Ventilated Patients.

Spontaneous Awakening Trials (SAT) and Spontaneous Breathing Trials (SBT) are considered standard of practice for MVP, by SCCM to reduce sedation and increase alertness and patient participation [6]. The policy and protocol for SAT/SBT were reviewed and met SCCM standards. It was discovered that there were inconsistencies with the daily practice of SAT/SBT by the nurses and RT. It took two months prior to the start of the early mobility program, to reinforce this practice. The RNs were required to initiate SAT/SBT starting at 05:00am allowing RT to attempt weaning daily on appropriate patients prior to ICU rounds. This delayed the initiation of the project but was a required step in the process.

Another staff “Cared for” concern for the nurses was how to make time for the training without compromising patient safety. After discussions, it was decided that it was best to hold the education sessions at shift change huddle. Shift change huddle was mandatory, and this gave the greatest chances of getting the most staff participation without taking the nurses away from the unit and their patients. Finally, during the last program process review, all known barriers involving staff concerns and potential issues, such as manpower, were discussed and modifications to the plan were made, so that the staff felt they too, were “Cared for” and that these issues would not derail the success of the program.

**Process**

Education and training enhance and encourages compliance. Nursing Administration supported mandatory comprehensive education on the early mobility protocol, which was achieved two weeks prior to the start of the project. The education was held at the nurses' station during shift change huddle. The sessions lasted 20 minutes and were available at multiple times for the AM/PM shifts for RNs. Thirty-six nurses were educated during the fourteen sessions. The remaining six contingent nurses were educated by the nurse champions at later dates. There was also a skill check off facilitated by PT for proper patient transfer and use of transfer equipment. Once the education and training were completed, the pilot for the program rolled out for seven weeks.

On day one of the project, all patients were initially evaluated with the Mobility Readiness Screen to determine inclusion/exclusion and thereafter this was completed within the first 24 hours of intubation. The mobility level was established by the RN based on the criteria and completed daily at 6am. The mobility screen and level of activity were shared at shift change between the RN’s and daily during ICU rounds. PT was present at ICU rounds to facilitate progression in the patient’s mobility level. It took a tremendous amount of effort and collaboration between the multidisciplinary team to focus on caring for these patients to promote an optimal healing environment.

Audits were performed three days a week using an audit tool (Appendix A). Information for audits were obtained from observation and the patients Electronic Medical Records (EMR). During the audits, if any variation in the protocol was noted, education was reinforced by the DNP student coordinator and corrections were made at that time. Bi-weekly shift huddles were held with the nurses to review feedback and share audit results. Suggestions for improvement were taken and if minor, changes were made, as well as any questions were addressed. A monthly mobility team debriefing for all team members was done to review generated data and discuss any issues related to the goals and progress of the project.

**Results**

**Outcomes**

When caring behaviors/practices are implemented in conjunction with healthcare procedures, the patient has a greater chance to obtain positive outcomes [15]. The overall goal of this project was to provide quality care in the form of a progressive mobility program for the MVP. The pilot was planned for 10 weeks, it was abruptly cut short to seven weeks because the number of patients being admitted who were gravely ill, were suspected Covid-19 patients. There were 298 opportunities for screening MVP patients in seven weeks. The average age range for these patients that were included, was 55-63 years of age. The top admitting diagnosis for these MVP were Sepsis (n= 18), Pneumonia (n= 13) Vent dependent respiratory failure (n=9), COPD Exacerbation (n=9), Cardiac Arrest (n= 8), Congested Heart Failure (n= 7). There were multiple comorbidities, but only the admitting diagnosis was collected. The outcomes of the project objectives were:

Objective I A: RNs will screen 85% of all MVP for eligibility with the Mobility Readiness Screen within the first 24 hours of intubation. **MET**. There were 298 opportunities and 297 = 99.67% screens completed.

Objective I B: RNs will screen for the mobility level of MVPs within the first 24 hours post intubation by the projects end. **MET**. There were 298 opportunities for placement on a mobility level. All but one opportunity was taken resulting in a 99.67o/ » compliance in selecting at least Level I (passive ROM).

Objective II: The mobility level assigned by the RN, will demonstrate 85% congruency with the mobility teams’ mobility level assignment. **MET**.

Out of the 297 opportunities, 295 were agreed upon by RN/mu1ti-disciplinary team a 99.3% congruency.

Objective III A: There will be an increase in mobility level for eligible MVP by 50% achieving level II or above. **NOT MET**. There were 31% of the total opportunities eligible (n=92) for advancement to Level II or above. Out of 92 opportunities only 22 opportunities for advancement were taken. Leaving level II or above advancement to a 23.9%.

Objective III B: There will be a 25% increase in mobility level in eligible MVP to level III or above. **NOT MET**. Of the 31% advancing to level II, 15 achieved this level at 16.3%.

**Discussion**

A “Patient is Cared For” attitude was used for data collection, as everyday a patient should have a mobility assessment, all the data is therefore reported as opportunities. This project was initiated in the third week of January 2020 in Detroit, Michigan. During implementation of the project the acuity of the patients admitted increased exponentially in a relatively short time. These patients' conditions were more severe than normal and may have been early COVID-19 cases. They required more sedation and less activity to maintain proper oxygenation to perfuse the body, therefore limiting potential progression in mobility well beyond the norm. Within this context the results of the study are discussed.

In objective IA/IB, the nurses did an excellent job on screening the patients, MVP screens revealed that about a third of the patients were eligible for mobility level advancement past Level I, which included range of motion. The acuity level of patients admitted to the unit increased significantly during January and respiratory compromise resulted in the necessity to maintain or increase ventilatory support at a much more aggressive level than usual.

Many of the patients either had a Richmond Agitation and Sedation Scale (RASS) score of-2 or greater which meant that they were either highly agitated or their condition required significant amounts of sedation to maintain oxygen levels. Patient acuity was exemplified by the need requirement for heavy sedation to decrease the work of breathing and decrease the progressively worsening hypoxemia that patients were experiencing. Prolonged and worsening ventilator requirements with 60- l00% oxygen levels were needed. Patient response to treatment was failing at a high rate and many patients were quickly transitioned to comfort care only. Looking back at the time frame, these were more than likely early cases of COVID 19.

Only seven out of the planned 10 weeks of the project was completed. The first week of March 2020, the facility had several confirmed COVID cases, and the project abruptly stopped as the patients were too severely ill for the nurses to prioritize early mobility. This limited the number of patients for whom mobility protocols could be advanced safely. All these unexpected circumstances placed a large percentage of patients in the exclusion category for mobility advancement. However, nurses maximized this time to establish the daily assessment protocols for advance mobility by incorporating the screens into their daily routine for care, and some non-Covid patients made progress according to protocol.

Objective II was met. There was a strong congruency between the nurse's assessment and the mobility team, with agreement on the patient placement on the appropriate mobility level. During the daily rounds, the mobility level of eligible patients was presented by the nurse. The team would discuss each patient to seek consensus on the mobility level identified and if PT involvement was appropriate at the time. Also, during this time, care management options to facilitate advancement in mobility levels were discussed. The communication and collaboration between the nurse and the mobility team during rounds helped to create an optimal caring and healing environment for the patient. The positive aspect of this objective was “Caring behavior/environment”, influencing the “Patient cared for” outcome. This aspect of the project also helped to facilitate interprofessional collaboration on the care of patients and respect for different provider insights.

Objectives IIIA/IIIB technically were not met, due to the critical nature of their physical conditions and their inability to progress beyond level II. Therefore, the most frequent level of mobility achieved on Level II (dangle sitting at the side of the bed for 10-15 mins) was itself very limited. Any activity beyond level II was hard to achieve as the patients would become too weak or hypoxic to tolerate. There were only a few opportunities to reach level III or greater. These few patients were able to stand at the bedside and pivot to be up in the chair for 20 minutes. There was one patient that was able to walk around the unit with a portable ventilator for three consecutive days. This did excite the team and the nurses voiced encouragement seeing an MVP ambulating around the unit. Even though the percentage for progressive mobility was well below expectation, implementation of a progressive mobility process was achieved. The positive point of these objectives was “Patients cared for”.

The importance of caring relationships and collaboration of the multidisciplinary team was one of the most important driving forces that made the project successful. The compliance of the protocol and physical activity was implemented with the patients that met eligibility requirements. The all-hands-on deck approach that the intensivist supported by encouraging the residents to partner with the nurses, proved to be a very valuable component for the nurse buy in as well. The nurse, the driver of this protocol had enough perceived self-efficacy potential to facilitate meeting the goal [18]. Addressing the nurses concern of having enough physical support to mobilize the patient allowed the nurses to approach the project with confidence and positivity. This showed the very definition of readiness to change, “a state of being both psychologically and behaviorally prepared to take action [18].

Opportunities for improvements in the mobility program that would promote success and sustainability, would be exploring how to improve documentation of mobility assessments. Data is dependent on the consistency and quality of the documentation made by the nurses. During audits, it was often found that data was missing for mobility time or advancement in levels. Follow up with nurses on missing data, revealed that they would often state the patient was participating in the mobility, but they had not charted it. This missing data could very well have skewed the actual success of achieving the goals for patient’s progress.

The quality improvement project was implemented on one unit of the hospital. The sample size of the opportunities was small, so generalization to other areas is limited. The detailed description of the planning and barriers addressed is provided to help guide other ICU’s and facilities who are interested in replicating their own early mobility program. The commitment from stakeholders was tremendous. The nurses did an amazing job implementing the protocol. Even though these patients required so much more care than the normal ICU patient, these nurses evaluated and mobilized them based on the protocol to ensure the patients received the opportunity every day to get physical activity. Unfortunately, the quality improvement project came to an abrupt halt due to the COVID 19 pandemic and the impact on citizens in the Detroit Metropolitan area. There was no way of planning for the pandemic, or the high incidence and death rates experienced in Detroit and our population in the ICU. However, findings during implementation demonstrate a trend toward the potential for success of the mobility project after the pandemic has been resolved.

**Conclusion**

The MVP in the ICU can face severe complication from immobility resulting in the high risk of acquiring VAE and ICUAW. These conditions are complicated and can have long term effects on the patient's ability to function physically and possibly lessen their perceived quality of life. These risks can be reduced by applying high quality care, using evidenced based best practice standards. Using the SCCM and AHRQ evidenced based practice guidelines to establish best standard practices for an early mobility program for the MVP is advised.

Implementing an early mobility program requires a cohesive, efficient multidisciplinary team. Assessing the organizational culture and environment for readiness for change is essential. Effective intra professional communication, cooperation, and sharing of ideas are needed to develop the caring/collaborative relationships among the staff needed to plan and work effectively to overcome barriers. The caring behavior/ relationships that are developed within the team creates an optimal healing environment for the patient. This healing environment provides the patient a daily opportunity to improve their physical mobility effort. Thus, achieving objectives to make “Staff care for” as well as “Patient cared for”.

The quality improvement project did show that early mobility for the MVP is safe and feasible. The program will require revisions from time to time based on resources and facility need. Education will also need to be reinforced yearly as a competency to sustain and improve a successful mobility program.

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