

Impact of an early mobilization protocol on outcomes in trauma patients admitted to the intensive care unit: a retrospective cohort study

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Introduction

- Research into the effect of early mobilization (EM) in the ICU setting has shown improvements in length of stay (LOS), ventilator free days, delirium, and functional mobility at hospital discharge.
- These studies have largely focused on the general ICU population; few studies have examined the effect of EM in trauma ICU patients.
- In 2014, an EM protocol (EMP) was implemented in the ICU at the QEII Health Sciences Centre (Halifax). Previously, mobilization was performed ad hoc by allied health providers & physiotherapists (PTs).
- The EMP at the QEII HSC involves a multidisciplinary, stepwise approach where PTs and the clinical team decide which mobilization activities are appropriate to use on a case by case basis.
- Objective:** To determine the effect of implementing an EMP in the ICU on the outcomes of major trauma patients.

Methods

- Retrospective cohort study of adult (>18 yrs) major trauma patients admitted to ICU at the QEII HSC over a 2-year period before/after EMP implementation, allowing for a 1-year transition period.
- Data were collected from the Nova Scotia Trauma Registry.
- Patients were grouped based on admission to the ICU during the pre-EMP or post-EMP periods.
- Student's t-tests and chi-square analysis were used to compare characteristics and outcomes between the 2 groups.
- Primary outcome:** In-hospital mortality
- Secondary outcomes:** ICU mortality, ICU LOS, # of ventilator days
- Binary logistic regression and generalized linear models were used to assess for factors associated with each outcome; the following independent variables were included: period (pre-EMP, post-EMP), age, sex, ISS, GCS at the scene, cause of injury, and comorbidities.

Early Mobilization Protocol at the QEII HSC

Department of Critical Care (QEII 3A & 5.2) Mobility Protocol

The Purpose of this Protocol is to provide the Team with guidance on safe mobilization of ICU patients. It is adapted from Fraser Health (2009, 2016). It is evidence informed and where there is insufficient evidence, expert opinion was sought (additional references available). It has been trained and evaluated as a safe, effective tool by our Department. It is not intended to replace the clinical judgment and interdisciplinary collaboration.

Definition: Mobilization is the progression of activities which facilitate movement. It is sequential in nature and can vary from range of motion exercises, sitting on edge of bed, to standing and walking.

What to Assess to Safely Mobilize and Minimize Falls Risk

The chart

- Medical history (incl. diagnosis, medications, risks factors, previous falls)
- Pre-morbid level of function (e.g. mobility aids), activity & exercise response
- Investigations, lab results (e.g. Hgb, RBC, plt, blood sugar, ECG, fluid/electrolytes)
- Physician orders re: specific restrictions on mobilization
- Excessive weight which may require resources and equipment to safely manage RN / PT documentation of previous assessment and interventions

The patient & team

- Multisystem review (e.g. cognition, respiratory, cardiac, musculoskeletal & neuro systems)
- Ability to follow directions and / or physical cueing
- Impact of illness / medical procedures & medications on mobility (e.g. weakness from disuse, incision, trauma, pain, equipment needs, restrictions etc.)
- Coordinate with timing of treatment of medication, availability of equipment, personnel to optimize effectiveness and safety

When to Seek Further Clarification

NOTE: the cited values are not absolute criteria for withholding mobilization but are within the range of benefiting from team discussion. If unable to mobilize as per the Protocol, review with Medical Team

Cardiovascular status

- Mean arterial pressure: less than 50 mmHg
- BP: A drop in systolic pressure (greater than 20 mmHg) or below pre-exercise level OR a disproportionate rise i.e. greater than 200 mmHg for systolic or greater than 110 mmHg for diastolic
- HR: less than 40 bpm or greater than 130 bpm requiring temporary pacer
- Hemodynamic: New vasoactive agent, use of two or more agents or frequent increases; uncontrolled systemic hypertension, or acute bleeding
- Platelet count: less than or equal to 20
- Acute or unstable cardiac status: New MI, dysrhythmia requiring new medications, active ischemia, unstable rhythm, intra-aortic balloon pump.
- Pulmonary embolus: Discuss with MD to determine suitability
- Deep vein thrombosis: May mobilize as tolerated immediately after low molecular weight heparin is given. If patient is on any other form of anticoagulation (e.g. IV heparin) confirm mobility orders with MD.

Respiratory Status

- SpO₂: below established baseline
- RR: less than 5 or greater than 40
- FiO₂: greater than 60%
- Ventilator issues: Decreased ventilator support that could precipitate fatigue or increased ventilator support.

Neurological status

- Patient status: Severe agitation, distress or combative
- ICP: increased i.e. greater than 20 mmHg; ICP needs to be considered in conjunction with cerebral compliance
- Uncleared and/or unstable/non fixated spinal cord injury or head injury; clarify with physician

Other

- During active hemodialysis
- Injury / surgery that mobility could cause concern eg. unstable fracture, ENT surg, open abdomen
- Other contraindications specific to patient/staff safety e.g. inadequate equipment, staffing

What to Monitor During Mobilization

Subjective: Dizziness, vertigo, shortness of breath, fatigue, nausea, pain, assessment tools

Objective: Cognition, balance, perspiration, cyanosis, HR, O₂ Sat, RR, BP & other relevant factors e.g. cardiac rhythm in those patients where ECG is essential during mobilization.

How to Safely Mobilize, Minimize Falls Risk and Progress

Step 1 Prepare

- Determine whether benefits outweigh risk, using above assessment criteria and in discussion with MD as needed.
- Discuss as a Team if any challenges exist and consider alternative interventions to progress mobility, such as using mobility aids, mechanical lift, chair position and / or bed exercises.
- Ensure pre-medication as indicated (analgesia, bronchodilators, oxygen). Prepare the physical environment including length of leads, lines and tubings.
- Obtain baseline vital signs and have objective end-points such as limits of BP, HR, O₂ Sat & level of exertion pre-determined before mobilization.

Step 2 Safety first for the patient and team

- Encourage circulation exercises i.e. foot & ankle, knee flexion/extension before commencing more demanding mobilization procedures.
- If postural hypotension is likely, monitor BP & ask about lightheadedness at each phase of the mobilization i.e. sitting on edge of bed, standing, walking, etc.
- Use proper body mechanics during transfer & allow gradual change from lying to upright position.

Step 3 When to quit while you are still ahead

- Monitor closely. Watch for signs of fatigue, pain, diaphoresis & intolerance during activity. Frequently ask how patient feels.
- Evaluate status at each progression to determine whether to continue or stop. Ensure adequate period for patient to adjust to exercise and position.

Step 4 Monitor & progress

- Determine the limiting factor of the mobilization and any undesirable response(s).
- Use objective outcome measures to monitor progress with respect to ease of transfer, sitting duration, walking distance, HR, RR, O₂ Sat, pain scale
- After mobilization, monitor patient until vital signs have returned to pre-activity level.

How to Safely Mobilize, Minimize Falls Risk and Progress Using Assessment Data

MOBILITY LEVEL	Level I	Level II	Level III	Level IV
Level of Risk*	NA	RASS -2 to 0	RASS -1 to +1	RASS -1 to +1
Strength Criteria	NA	NA	As per Level I and includes pts with neuro / SCI / trauma/bariatric/prolonged hospitalization	As per Level III
Requires PT assessment	Burns or new amputation	As per Level I and includes pts with neuro / SCI / trauma/bariatric/prolonged hospitalization	As per Level I and includes pts with poor sitting balance, requiring max assist or not following expected pathway	As per Level III
Turning & Bed Mobility	<ul style="list-style-type: none"> Q2H with nighttime sleep strategy as appropriate Patient to assist as able 	<ul style="list-style-type: none"> Q2H with nighttime sleep strategy as appropriate Encourage / instruct patient how to participate: <ul style="list-style-type: none"> Rolling / turning Bridging (lifting buttocks up) Boosting Scotching laterally in bed Same as Level I Remove obstacles to facilitate movement Assess seating needs (OT prn) 	<ul style="list-style-type: none"> Q2H with nighttime sleep strategy as appropriate Gradual withdrawal of assistance Initiation of training to promote independence. Give patient time to process instructions Same as Level II Same as Level II with more active involvement 	<ul style="list-style-type: none"> Q2H with nighttime sleep strategy as appropriate Focus on training to promote independence Same as Level III
Positioning & Devices (Is per PT/OT prn)	<ul style="list-style-type: none"> HOB greater than 30° Apply splints and/or other positioning devices 	<ul style="list-style-type: none"> Encourage patient to assist with range of motion during patient care e.g. during washing, turning, etc. Consider inclusion of: <ul style="list-style-type: none"> Breathing exercises Stretching exercises Balance/coordination exercises for head, neck and trunk 	<ul style="list-style-type: none"> Same as Level II with more active involvement. Consider inclusion of: <ul style="list-style-type: none"> Arm ergometer Lag ergometer Same as Level III with more active involvement 	<ul style="list-style-type: none"> Additional exercise as per PT Additional exercise as per PT
Exercise Program	<ul style="list-style-type: none"> Passive repositioning / ROM exercises incorporated into patient care e.g. during washing, turns, etc. 	<ul style="list-style-type: none"> Additional exercise as per PT High flow/low or chair position of bed x 30-60 minutes TID 	<ul style="list-style-type: none"> Sitting on side of bed Sitting balance exercises with PT as appropriate, 5 to 10 minutes to start initially OD, progress to BID as tolerated. May require mechanical lift to chair. Chair position of bed x 30-60 min TID 	<ul style="list-style-type: none"> Additional exercise as per PT If sitting & stand at bedside, successful, PT assesses ability to weight shift, walking in place, side-steps, ability to transfer to chair. Initial time in chair 30 minutes, progress as tolerated. Initially OD, progress to BID as tolerated.
Mobilization	<ul style="list-style-type: none"> HOB greater than or equal to 45° x 30-60 minutes BID, support to achieve midline head & trunk position 	<ul style="list-style-type: none"> Mobilization may include sitting on side of bed or to chair with mechanical lift. *Use caution if patients at risk of hypotension As per PT assessment may require individualized mobilization prescription 	<ul style="list-style-type: none"> Practice components of sit-to-stand (forward lean, some weight-bearing on arms and / or legs, push off) +/- walker as tolerated. May require individualized PT mobilization prescription 	<ul style="list-style-type: none"> If tolerating transfer to chair, PT assesses ambulation, begins gait training with appropriate aids, increasing distance & frequency as tolerated

Richmond Agitation Sedation Scale (RASS)

+4	Comatose; silent, immediate danger to staff	-1	Drowsy, not full alert, sustained wakefulness (eye-opening/contact) to voice >10 seconds
+3	Very agitated, pulls or removes tubes/lines; aggressive	-2	Light sedation; briefly awakens with eye contact to voice < 10 sec
+2	Agitated; frequent non-purposful movement, fights ventilator	-3	Moderate sedation; movement or eye opening to voice but no eye contact
+1	Restless; anxious but movement not aggressive or vigorous	-4	Deep sedation; no response to voice but movement or eye opening to physical stimulation
0	Alert and calm	-5	Unarousable; no response to voice or physical stimulation

Results

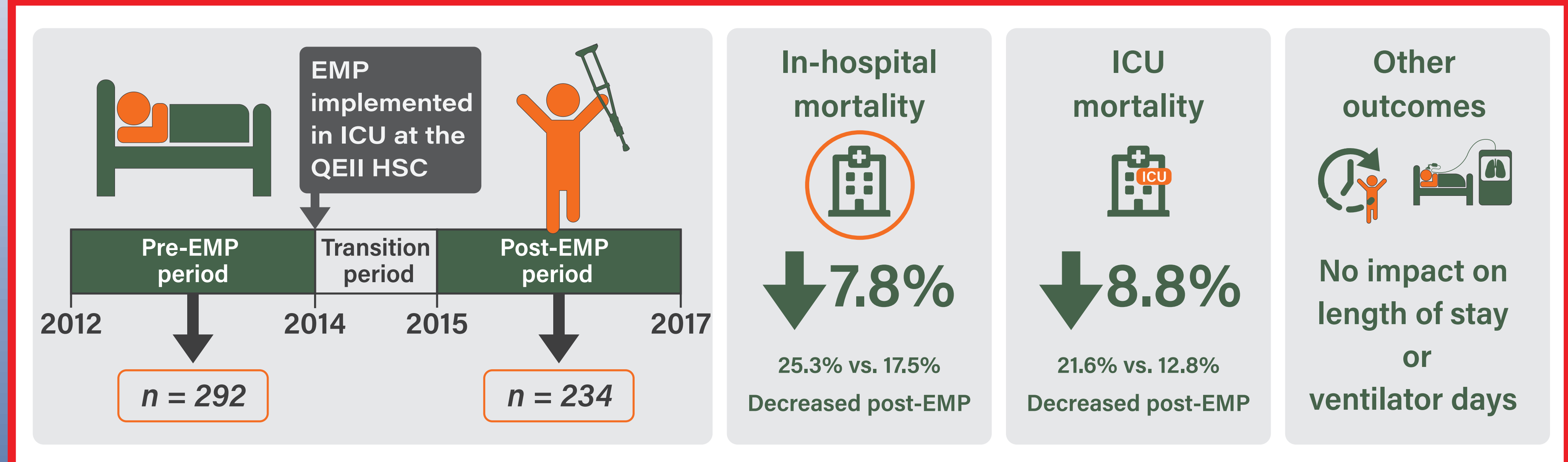


Table 1: Patient characteristics and outcomes

Characteristic/Outcome	Pre-EMP	Post-EMP	P-value
Age, mean ± SD	48.9 ± 20.2	49.1 ± 20.6	0.91
Male, n (%)	215 (73.6)	176 (75.2)	0.68
ISS, mean ± SD	22.4 ± 10.5	23.5 ± 10.4	0.21
Max AIS Head, mean ± SD	3.5 ± 1.4	3.6 ± 1.3	0.28
Scene GCS, mean ± SD	10.7 ± 4.8	10.8 ± 4.5	0.91
GCS on ED arrival, mean ± SD	12.7 ± 3.8	12.1 ± 4.1	0.31
Injury type, n (%)			0.004
Blunt	254 (87.0)	205 (87.6)	
Penetrating	16 (5.5)	24 (10.3)	
Burn/drowning/asphyxia	22 (7.5)	5 (2.1)	
In-hospital mortality, n (%)	74 (25.3)	41 (17.5)	0.031
ICU mortality, n (%)	63 (21.6)	30 (12.8)	0.009
ICU LOS (days), mean ± SD	6.9 ± 8.5	7.0 ± 9.1	0.90
Hospital LOS (days), mean ± SD	28.7 ± 46.5	30.2 ± 45.1	0.71
Ventilator (days), mean ± SD	22.5 ± 2.7	24.0 ± 2.8	0.71

EMP = early mobilization protocol; SD = standard deviation; ISS = Injury Severity Score; AIS = Abbreviated Injury Scale; GCS = Glasgow Coma Scale; ED = emergency department; ICU = intensive care unit; LOS = length of stay.

Table 2: Regression analysis

Outcome	OR (95% CI)	P-value
Independent variable = ICU admission post-EMP (Reference = ICU admission pre-EMP)		
In-hospital mortality	0.56 (0.32 - 0.96)	0.036
ICU mortality	0.46 (0.25 - 0.83)	0.01
Hospital LOS	0.98 (0.80 - 1.20)	0.85
ICU LOS	0.99 (0.84 - 1.18)	0.92
Ventilator-free days	0.94 (0.77 - 1.15)	0.57

EMP = early mobilization protocol; OR = odds ratio; CI = confidence interval; ICU = intensive care unit; LOS = length of stay.

Results were similar following a sensitivity analysis limited to patients with blunt or penetrating injuries

Discussion

- After controlling for confounders, the post-EMP group had decreased odds of ICU mortality (OR 0.46) and in-hospital mortality (OR 0.56).
- One of the largest investigations to date on the impact of a structured progressive mobility protocol on outcomes in trauma ICU patients, and the first to show a decrease in trauma mortality among mobilized patients.
- Further research is needed to examine the timing and amount of mobility trauma patients receive in the ICU in order to optimize EM interventions.
- Limitations:**
 - Unable to account for ad hoc mobilization of some patients pre-EMP, or that some patients post-EMP could not be mobilized due to their clinical condition.
 - Institutional changes and/or advances in ICU care could have contributed to improved outcomes in the post-EMP period.
 - Findings may not be generalizable to other institutions with mobility protocols or programs that differ from the EMP at the QEII HSC.

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