

Early Mobilization in Critically Ill Children: A Survey of Canadian Practice

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Objectives: While early mobilization is safe and enhances functional recovery in critically ill adults, rehabilitation practices in critically ill children are not well characterized. The objective of this study was to evaluate the knowledge, perceptions, and stated practices of early mobilization among physicians and physiotherapists practicing in Canadian pediatric critical care units.

Design and Measurements: A self-administered survey was mailed to 102 physicians and 35 physiotherapists. Survey domains included barriers to early mobilization, the timing, nature and thresholds for rehabilitation, and staffing workload. We assessed for associations using chi-square tests.

Main Results: The overall response rate was 64.2% (88 of 137), representing 59.8% (61 of 102) physicians and 77.1% (27 of 35) physiotherapists, respectively. Key institutional barriers to early mobilization included a lack of practice guidelines (75.4% physician, 48.1% physiotherapist respondents; $p = 0.01$) and the need for physician orders prior to initiating physiotherapy (26.2% physician vs. 55.6% physiotherapist, $p = 0.008$). Only 3.4% of respondents reported having local guidelines for early mobilization. Conflicting perceptions regarding the clinical

thresholds for early mobilization and the safety of early mobilization were the most commonly reported patient-level barriers. Increasing illness severity was associated with decreased clinician comfort with early mobilization. Respiratory physiotherapy and passive range of motion were the most frequently applied rehabilitation interventions (77.8%), while pre-gait physiotherapy and ambulation were only sometimes or infrequently (70.4%) used. The type and extent of physiotherapy varied depending on the time of day and week.

Conclusions: There are numerous perceived institutional, patient- and provider-level barriers to early mobilization in Canadian pediatric critical care units, and diverse opinions on the appropriateness of early mobilization. Limited awareness of existing literature and the lack of practice guidelines on early mobilization are not surprising in light of the paucity of pediatric-specific evidence. These results strongly support the need for further research, evaluating the feasibility, safety, and efficacy of early mobilization in critically ill children. (*Crit Care Med* 2013; 41:XX-XX)

Key Words: early mobilization; pediatric critical care; rehabilitation; survey

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and increasing proportion of pediatric critical care unit (PCCU) admissions, which has important implications for demand and access to rehabilitation resources in this setting (14).

Rehabilitation practices in Canadian PCCUs are currently not well understood. The extent to which critically ill children are immobilized and the nature of, and barriers to, acute rehabilitation in these patients have not been systematically evaluated. The primary objective of this national survey was to probe the knowledge, perceptions, and stated practices of physicians and physiotherapists with respect to early mobilization (EM) in critically ill children. We hypothesized that potential sources of practice variation among clinicians would include institutional, patient, and provider factors. This study was approved by the Research Ethics Boards at McMaster University (Hamilton, Ontario) and University of Western Ontario (London, Ontario) and conducted on behalf of the Canadian Critical Care Trials Group.

METHODS

Sample

We conducted a cross-sectional, self-administered survey of all consultant pediatric intensivists and physiotherapists working in Canadian PCCUs, from December 2010 to February 2012. We identified potential physician and physiotherapist respondents through contact with the individual department chiefs and unit managers in each of the 17 academic PCCUs across Canada. Clinicians were asked to answer the survey if their primary area of practice was in the PCCU.

Questionnaire Development

We generated questions by searching medical (MEDLINE, EMBASE, and Cochrane) and allied health-specific databases (CINAHL and PEDro) in duplicate till March 2010 for relevant literature on mobilization in critically ill patients. Information regarding ongoing studies was solicited from investigators in this field. We developed content areas of interest (domains) and specific questions (items) within each domain. We engaged content and survey methodology experts (26 experts at the 3rd International Physical Medicine and Rehabilitation meeting [New Orleans, LA, May 2010], 25 clinician scientists from the Canadian Critical Care Trials Group, and six experienced critical care clinicians) in focus-group discussions for further domain and item generation until redundancy (15) and, subsequently, for item reduction. We defined EM as mobilization that is initiated as soon as possible following PCCU admission. The definitions of nonmobility and mobility interventions used in this survey are provided in **Appendix 1**.

Questionnaire Testing

Twelve physiotherapist and physician content experts assessed the comprehensiveness, clarity, and face validity of the questionnaire. Ten formally trained researchers assessed the methodologic rigor of questions as framed (16). Ten additional clinicians assessed administrative ease, flow, and salience. Finally, after administering the survey to 20 respondents on two separate occasions, 2 wk apart, we estimated intrarater reliability of responses using Cohen's kappa.

Questionnaire Administration

We mailed the questionnaire with a gift card incentive to 102 physicians, and 35 physiotherapists, and followed up with two additional hard copy and electronic reminders. Participation was voluntary and all responses were confidential as respondents were identified only by code.

Analyses

Descriptive statistics are presented as counts and percentages, with means (standard deviation [_{SD}]) or medians (minimum [min], maximum [max]). For all descriptive analyses, we used the actual number of respondents in the denominator. We collapsed response options where appropriate, to summarize responses in a meaningful manner. Cohen's κ was used to measure test-retest reliability for each survey item (17). Kappa values ≥ 0.40 represented moderate to good agreement (18). For test-retest reliability, 97% of the κ scores were ≥ 0.40 (range, 0.36–0.93). We compared physician to physiotherapist responses using chi-square test or Fisher's exact test where appropriate, and $\alpha = 0.05$ (two sided) level of statistical significance. We did not correct for multiple significance testing because the analyses were primarily exploratory. All analyses were performed using SAS 9.2 (SAS Institute, Cary, NC).

RESULTS

Respondents

We received responses from all 17 sites, with an overall rate of 64.2% (88 of 137), representing 59.8% (61 of 102) physicians and 77.1% (27 of 35) physiotherapists. Most respondents (64.8% [57 of 88]) worked in combined cardiac and medical-surgical PCCUs, while the remaining 35.2% (31 of 88) worked in medical-surgical PCCUs.

Knowledge and Skills

The majority of respondents (82% [50 of 61] physicians and 74.1% [20 of 27] physiotherapists) were not familiar with any trials or literature evaluating EM in critically ill children. **Table 1** displays the respondents' reported understanding of the current evidence. Most respondents (66.7% [58 of 87]) reported that they had sufficient knowledge and training to provide EM in critically ill children. Significantly more physiotherapists than physicians perceived that they were well trained and informed on this subject (33.3% [9 of 27] vs. 11.7% [7 of 60], $p = 0.01$).

Perceptions and Barriers to EM

Clinicians (76.1% [67 of 88]) perceived that EM is important or very important in critically ill children (**Fig. 1**), with a significant difference between physicians and physiotherapists ($p = 0.02$). The most prominent stated that *institutional* barrier overall was the lack of practice guidelines for rehabilitation (**Fig. 2**). However, physiotherapists considered the requirement for a physician order prior to initiating physiotherapy as the most important barrier. Other commonly reported institutional barriers were insufficient equipment (48.9% [43 of

TABLE 1. Clinicians' Understanding of the Evidence for Early Mobilization in Critically Ill Children

Answer	All Clinicians ^a n (%) (n = 88)	Physician n (%) (n = 61)	Physiotherapist n (%) (n = 27)
No pediatric studies	18 (20.5)	13 (21.3)	5 (18.5)
Evidence is not supportive	16 (18.2)	13 (21.3)	3 (11.1)
Evidence suggests benefit	24 (27.3)	15 (24.6)	9 (33.3)
Don't know	32 (36.4)	21 (34.4)	11 (40.7)

^aRespondents were asked to select one answer only. One physician and one physiotherapist selected more than one option.

88]), lack of a clinician advocate or champion (52.3% [46 of 88]), and lack of physical space in which to mobilize patients (27.3% [24 of 88] respondents). The three most commonly reported *patient*-level barriers to EM were medical instability of the patient, risk of device or catheter dislodgement, and the presence of an endotracheal tube (Table 2). Table 3 displays the most frequently selected *provider*-level barriers to EM. Nursing concerns regarding safety was the commonest perceived provider barrier, followed by conflicting physician perceptions regarding patient suitability and delays in physician recognition when patients are ready for mobilization. The majority of respondents (71.6% and 60.2%, respectively) believed that nursing and physiotherapist staffing limitations were important provider barriers. Fifty-four (61.4%) respondents felt that physicians did not perceive EM as a patient care priority.

Timing and Thresholds for EM

Table 4 displays physician and physiotherapist opinions about when mobilization should be initiated in PCCU patients. The majority (79.5%) stated that mobilization should be initiated only after cardiorespiratory stabilization. Significantly more physiotherapists than physicians believed that mobilization

should occur as soon as possible following admission. When asked what level of mobility they would prescribe in otherwise stable intubated, ventilated patients with a variety of scenarios, 91% respondents would not mobilize children with brain injury and increased intracranial pressure. When intracranial pressure normalized, 72.1% (62 of 86) were comfortable mobilizing these patients, 40.7% (35 of 86) would start pre-gait activities, and 18.6% (16 of 86) would ambulate these children. For patients with cervical spinal injury, 51.8% (44 of 85) would not mobilize these patients, while 16.5% (14 of 85) would permit active range of motion, 22.4% (19 of 85) would engage in pre-gait activities, and 8.2% (7 of 85) would permit ambulation. Twenty percent (17 of 85) of respondents would restrict patients with an uncorrected coagulopathy to bed rest, while an equal proportion (20.0%) would ambulate, and 42.4% would allow pre-gait activities in such patients. With respect to invasive catheter location, 53.5% (46 of 86) would allow patients with subclavian or internal jugular venous catheters to ambulate; however, only 30.2% (26 of 86) respondents would ambulate patients with femoral venous catheters. Six respondents (7.0%) were unsure of what level of activity was appropriate. Figure 3 highlights the variability in responses in the perceived appropriate levels of mobilization at different levels of illness severity.

Reported Practice

Only 3.4% (3 of 88) of respondents reported having local institutional guidelines for physical therapy and rehabilitation. Sixty-seven percent (59 of 88) reported that patients were not routinely assessed by a physiotherapist unless specifically requested. Physicians perceived that registered nurses are generally the first health care provider to identify when a child is ready for mobilization (45.9%; 28 of 61), while physiotherapists thought that they were the

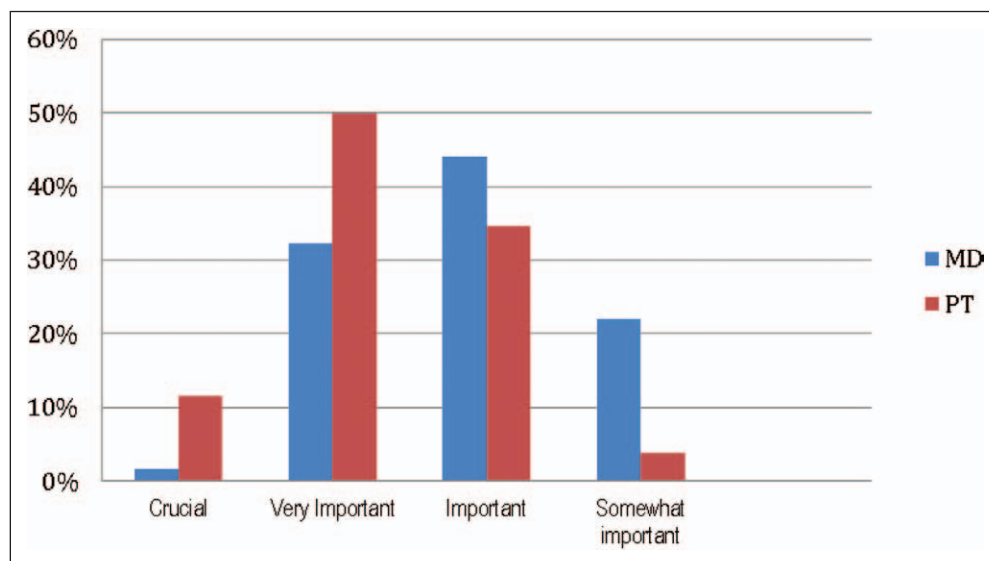


Figure 1. Perception of early mobilization in critically ill children. Fisher exact test, physician (MD) vs. physiotherapist (PT) overall perception: $p = 0.02$.

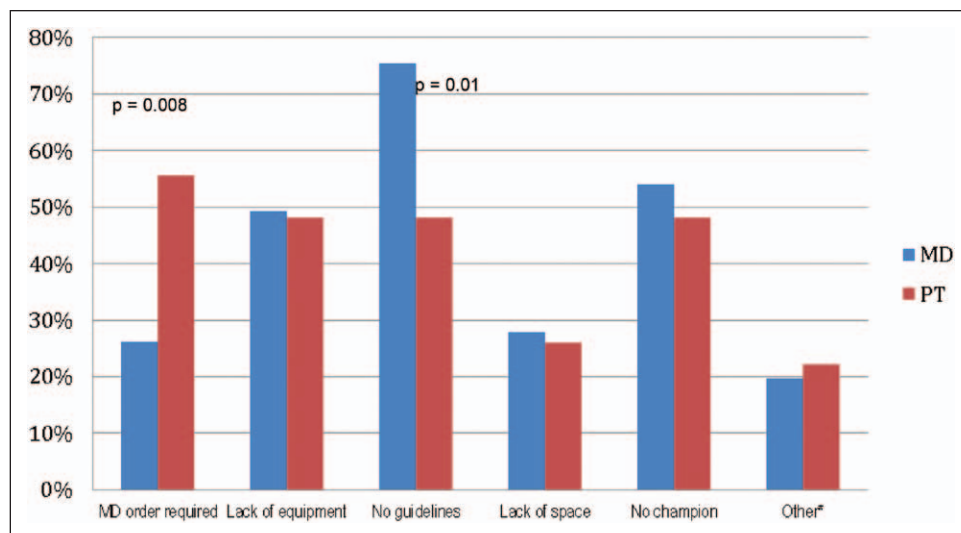


Figure 2. Institutional barriers to early mobilization. *Other reported barriers include lack of staffing, institutional culture, and lack of support for early mobilization. MD = physician; PT = physiotherapist.

first to identify readiness for mobilization (48.1%; 13 of 27). A physician order is required prior to any physiotherapist assessment, according to 70.0% (42 of 60) of physicians and 81.5% (22 of 27) of physiotherapists. Only 16.0% (9 of 56) physicians routinely or frequently applied sedation protocols (Table 5). Thirty-one of eighty-five (36.5%) respondents reported that children with suspected ICU-AW are routinely referred for rehabilitation following PCCU discharge. The most common service to which these patients were referred was physiotherapy (46.6%), followed by rehabilitation medicine (37.5%), neurology (26.1%), and occupational therapy (19.3%).

Physiotherapist Workload

Four (14.8%) of the 27 physiotherapists worked full time in the PCCU, while 23 (85.2%) worked part time. The mean duration of physiotherapy shifts was 7.6 hr (SD 0.07), and their daily workload involved a mean of 2.8 (SD 2.2) PCCU and 7.0 (SD 2.3) ward patients, respectively. All physiotherapist respondents reported that there is a physiotherapist available in their PCCU during regular weekday hours and weekends, while 61.5% of physiotherapists are available on weekday evenings. However, the type and extent of therapy provided varied depending on the time of day and week. Specifically, 92.6% of physiotherapists perform full

assessments and mobilization during regular weekday hours, while this proportion decreased to 11.1% and 22.2%, respectively, on weekday evenings and weekends. Physiotherapists (68.8%) reported that they focus on respiratory physiotherapy during evening shifts.

Frequency and Duration of Physiotherapy

Respiratory physiotherapy and passive range of motion were the most frequently or routinely applied interventions (77.8%), while pre-gait and ambulation were only sometimes or infrequently used by 70.4% of respondents. The frequency

TABLE 2. Patient Barriers to Early Mobilization

Barrier	All Clinicians n (%) (n = 88)	Physicians n (%) (n = 61)	Physiotherapists n (%) (n = 27)
Medical instability	80 (90.9)	55 (90.2)	25 (92.6)
Endotracheal intubation	55 (62.5)	42 (68.9)	13 (48.1)
Risk of dislodgement of devices or catheters	66 (75.0)	53 (86.9)	13 (48.1) ^a
Excessive sedation	46 (52.3)	31 (50.8)	15 (55.6)
Cognitive impairment	24 (27.3)	17 (27.9)	7 (25.9)
Inadequate analgesia	11 (12.5)	6 (9.8)	5 (18.5)
Physical restraints	8 (9.1)	7 (11.5)	1 (3.7)
Obesity	5 (5.7)	3 (4.9)	2 (7.4)
Inadequate nutritional status	1 (1.1)	1 (1.6)	0 (0)
No patient barriers	3 (3.4)	2 (3.3)	1 (3.7)
Other patient barrier ^b	3 (3.4)	2 (3.3)	1 (3.7)

^ap < 0.001 for difference between physician and physiotherapist opinion. The comparisons for the rest of the perceived barriers were not significant, using a chi-square test with df = 1.

^bOther reported patient barriers: paralytic use, critical airway, and IV tubing. Respondents were asked to select all that apply.

TABLE 3. Perceived Provider Level Barriers to Early Mobilization

Barriers (Listed in Order of Frequency of Total Responses)	Responsible Clinician Group ^a			
	Physician (%)	Physiotherapist (%)	Registered Nurse (%)	Respiratory Therapist (%)
Safety concerns about early mobilization	55.7	20.4	68.2	40.9
Conflicting views about patient suitability	60.2	27.3	55.7	28.4
Slow to recognize when patient should begin early mobilization	68.2	21.6	50	22.7
Limited staffing to provide early mobilization	3.4	60.2	71.6	46.6
Lack of communication among clinician group during bedside rounds to facilitate early mobilization	50	31.8	38.6	25
Inadequate training to facilitate early mobilization	38.6	19.3	51.1	36.3
Not perceived as a patient care priority	61.4	12.5	20.4	7.9

^aThe frequency with which survey respondents identified specific clinician groups as responsible for the stated barrier. Each percentage represents a proportion of the 88 total respondents. For each listed barrier the respondent was asked to select the clinician group(s) they believed were most responsible for that barrier. Each respondent could select more than one responsible group.

and duration of physiotherapy appears to be influenced by the level of consciousness and cooperation of the patient (Fig. 4).

DISCUSSION

This national survey of PCCU physicians and physiotherapists revealed the following key findings. First, while the majority of clinicians perceived EM to be important in critically ill children,

there were numerous reported institutional and provider- and patient-level barriers to performing EM. Second, children admitted to Canadian PCCUs are currently not routinely assessed by physiotherapists unless the need is first identified by another clinician, and their assessments are preceded by a physician's order. Third, clinicians had varying opinions on the appropriateness and timing for instituting EM, reflecting a lack of institutional practice guidelines, and limited existing evidence in critically ill children.

TABLE 4. Timing for Initiation of Mobilization in Critically Ill Children

Criteria	All Clinicians <i>n</i> (%) (<i>n</i> = 88)	Physicians <i>n</i> (%) (<i>n</i> = 61)	Physiotherapists <i>n</i> (%) (<i>n</i> = 27)	Comparison Between Physician and Physiotherapist Respondents (<i>p</i> ^a)
Stable cardiorespiratory status ^b	70 (79.5)	47 (77.0)	23 (85.2)	NS
As soon as possible after pediatric critical care unit admission	33 (37.5)	18 (29.5)	15 (55.6)	<i>p</i> = 0.02
Patient is conscious and can cooperate	37 (42.0)	23 (37.7)	14 (51.9)	NS
Extubated	24 (27.3)	16 (26.2)	8 (29.6)	NS
Off all vasoactive infusions	28 (31.8)	23 (37.7)	5 (18.5)	NS
Off all sedatives	10 (11.4)	4 (6.6)	6 (22.2)	<i>p</i> = 0.03
Ready for pediatric critical care unit discharge	9 (10.2)	5 (8.2)	4 (14.8)	NS
Other reported criteria ^c	6 (6.8)	2 (3.2)	4 (14.8)	NS

NS = not significant.

^aChi-square test with *df* = 1.

^bStable cardiorespiratory status was defined as the point when the patient no longer requires escalation in hemodynamic or ventilatory support.

^cOther criteria reported by respondents: "when patient is on low-dose vasoactive infusion"; when patients are "awake," "strong enough," "require airway clearance," and "have stable c-spine and orthopedic status."

Respondents were asked to select all that apply.

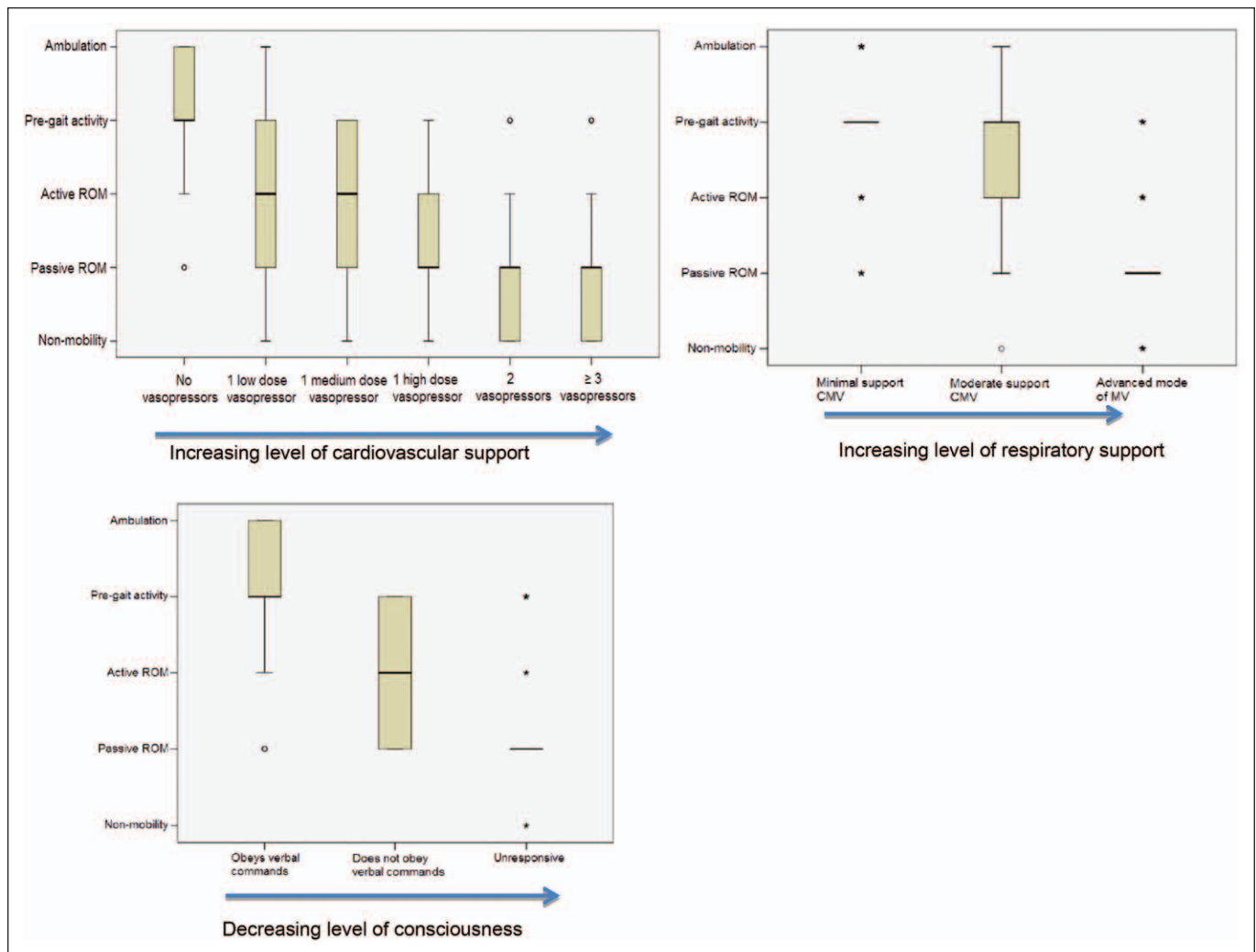


Figure 3. Permissible levels of activity in a mechanically ventilated patient. ROM = range of movement; CMV = conventional mechanical ventilation; MV = mechanical ventilation.

While many physicians and physiotherapists in this study believed that EM should occur as soon as possible after admission to the PCCU, their reported level of comfort with EM in critically ill children appears to be primarily influenced by the patient’s severity of illness and safety concerns about EM. Prospective evidence in critically ill adults demonstrates that EM is not only feasible, safe, and well tolerated (6, 19) but also results in a reduction in duration of delirium, length of stay, mechanical ventilation, and better functional outcomes at hospital discharge (7–9). However, EM has not been evaluated in critically ill children. Respondents believed that increasing levels of vasoactive drugs and respiratory support were associated with a decrease in a child’s permissible level of activity. Similarly, physiotherapists were more likely to restrict the duration and frequency of therapy, depending on the severity of illness as reflected by the amount of cardiorespiratory support, level of consciousness, or cooperation of the patient. As the latter was a determinant for instituting EM, an additional identified barrier was the use of sedatives. Sedation guidelines

were infrequently used according to the majority of physicians, which is consistent with current literature on this practice (20).

The use of institutional guidelines for rehabilitation in Canadian PCCUs was rare according to survey respondents. This is not surprising, given that the current level of pediatric-specific evidence is not at a stage to support the development of guidelines. This reality and the need for a physician order were identified as the most important barriers to EM of critically ill children. Current guidelines for ICU physiotherapy, including those from the European Respiratory Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically Ill Patients, recommend steps for the safe mobilization of critically ill adults (21). They suggest that physiotherapy assessments should not be driven by medical diagnoses, but physiological and functional deficiencies, and that physiotherapists are well qualified to determine objectives and treatment plans for patients in the critical care setting. Interestingly, we identified a common perspective that physicians are generally not the first healthcare providers to

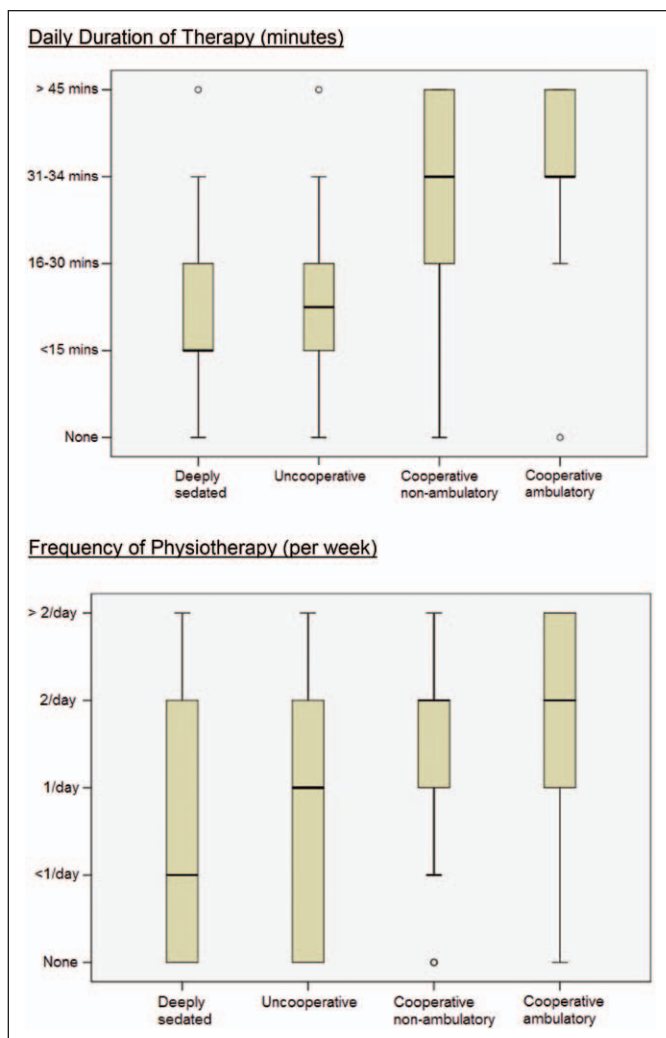


Figure 4. Reported duration and frequency of physiotherapy, according to patient's level of consciousness.

identify when a child is ready for rehabilitation, and physiotherapists consider that they have the requisite knowledge and skills to make these judgments in collaboration with the health care team. Recognizing the expertise of physiotherapists who work in the critical care environment and enabling them to assess all critically ill children as soon as possible following PCCU admission may facilitate some clinical autonomy and

TABLE 5. Physicians Reported Use of Sedation Guidelines or Protocols

Response	n (%); (n = 56)
Routinely	5 (8.9)
Frequently	4 (7.1)
Sometimes	15 (26.8)
Infrequently	18 (32.1)
Never	14 (25.0)

Respondents were asked to select only one response.

earlier identification of patients who may be at risk of prolonged recovery.

Respondents reported some discordant perceptions. For example, while the majority of physicians believed that EM was important or very important in critically ill children, they were perceived not to recognize EM as a patient care priority, or when a child was ready for EM. Second, although physicians believed that nurses were often the first to identify when a child was ready for EM, nurses were also often perceived to be a provider barrier to EM. These differences in opinions regarding the readiness of patients and concerns regarding the safety, timing, and thresholds for EM support the need for further interprofessional research in this area and the development of pediatric-specific practice guidelines.

Our results also suggest there are limited physiotherapist resources within Canadian PCCUs, which may be another significant contributing factor to delays in mobilization and rehabilitation of our sickest children. We found that 85% of the physiotherapist respondents who work in a Canadian PCCU are not dedicated to the PCCU, but are also required to cross-cover other wards. Most of the reported physiotherapist assessments and therapies in this study consisted of nonmobility interventions, as mobilization may be time consuming, and require additional resources. This resource limitation and pattern of practice is consistent with previous reports, where only 48% of neonatal and/or pediatric ICUs had access to physiotherapists, and the majority of rehabilitation visits were for respiratory therapy (14). The feasibility of EM is dependent on a supportive environment and interdisciplinary collaborative effort. Critically ill children differ from adults in many ways, reflected in the differences in morbidity and mortality outcomes. Furthermore, there are unique challenges to rehabilitation in pediatrics given the nature of underlying illness and diversity in functional and cognitive ability. Subsequently, evidence from critically ill adults cannot be extrapolated to children—we need to determine not only who may benefit from this intervention but also how EM can be safely and effectively executed specifically in the PCCU setting. Understanding the potential role that all caregivers, including family members, may have in the rehabilitation of critically ill children both within and beyond the PCCU stay is an area ripe for future research.

This national survey of physicians and physiotherapists is the first report of stated practices, perceptions, and resource utilization specific to mobilization practices within academic PCCUs across Canada. It was specifically designed to address EM in critically ill children. The sampling frame is representative of pediatric intensivists and physiotherapists currently practicing in Canadian PCCUs. The design and conduct of this study was in accordance with recent methodological recommendations for survey research (16). Weaknesses of this study relate to documenting stated practices rather than observed practices, as with all self-reported surveys. This survey allowed us to describe possible barriers and patterns of practice; however, we were unable to analyze predictors of practice variation given the limited sample size. We are currently conducting a complementary study to evaluate whether the perceptions

identified in this survey are consistent with actual observed rehabilitation practices within Canadian PCCUs. Surveys of additional members of the PCCU team, such as nurses, respiratory therapists, and family members, would provide us with an additional understanding of perceptions and barriers to mobilization in this setting.

CONCLUSIONS

The lack of practice guidelines, the requirement for a physician order, resource limitations, and safety concerns are key reported barriers to EM in Canadian PCCUs. The institution of a medical directive enabling routine consultations from physiotherapists without a physician order may facilitate earlier determination of individual patient needs for rehabilitation. This survey demonstrates a variation in stated clinical practice and supports the need for further evidence with respect to the feasibility, safety, and efficacy of EM in the PCCU, thus providing important rationale and a compelling mandate for further research in this specific population. The increasing proportion of PCCU patients with coexisting chronic health impairments and the decreasing overall mortality rates in pediatric critical care underscore how survival is not the only important gauge of the short- and long-term effectiveness of pediatric critical care (14, 22). Improved pediatric critical care, whether through acute disease-modifying interventions, or the early institution of rehabilitation may lead not only to incremental increases in survival but also to shorter time to recovery and improved health status and quality of life following admission to the PCCU.

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APPENDIX 1. Definitions of Mobility and Nonmobility Therapies

Definitions	Description
Nonmobility therapies	
Cardiorespiratory or "chest physio"	Physical methods to improve ventilation, V/Q matching, breathing mechanics, and airway secretions clearance—e.g., percussion techniques, manual facilitation of chest wall movement, and deep breathing exercises (including blowing bubbles and incentive spirometry)
Passive range of motion	Includes passive repositioning of patient or passive stretching of their limbs and joints. Passive = patient does not voluntarily participate in the activity
Mobility therapies	
Active range of motion or strengthening exercises	Muscle strengthening exercises with therapist. This may be described as "active" or "active-assisted" exercises. "Active" infers patient participation, no matter how little. This may include exercises and stretches that are taught to patient to do independently. Includes neurodevelopmental play (i.e., play activities to facilitate fine and gross motor development for infants and developmentally delayed children)
Mobility device	Activities done with a device that facilitates limb movement, i.e., cycle ergometer. May be done while patient is recumbent
Bed mobility	Activities done while patient is recumbent—but requires active participation of the patient; for example, active or active-assisted repositioning in bed; rolling from side to side; and bridging (i.e., pelvic or hip lifts)
Transfers	Patient actively transfers from one surface to the other, e.g., from bed to chair/commode, sitting or dangling on edge of bed, unsupported sitting or sitting with trunk control, and assisting from a sitting to a standing position. These activities may occur with or without therapist assistance
Pregait activities	Assisting the patient in exercises prior to ambulation, e.g., weight shifting from foot to foot, stepping in place, and sideways stepping
Ambulation	Gait training of the patient, with or without assistance by therapist or device (e.g., walker)