

ORIGINAL ARTICLE

# Level of function mobility scale for nurse-driven early mobilisation in people with acute cardiovascular disease

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## Abstract

**Background:** There are currently no validated tools that are reliable and easy to use for nurses to assess mobility in people with acute cardiovascular disease in the Cardiovascular Intensive Care Unit (CICU).

**Methods:** A multidisciplinary team at an academic tertiary care centre developed the Level of Function (LOF) Mobility Scale for use in a nurse-driven early progressive mobilisation in the CICU. To determine inter-rater reliability, the prehospital and admission LOF were assessed independently by two CICU nurses. Pairwise comparisons between raters were evaluated using Cohen's kappa statistic. To determine convergence validity, the LOF and Activity Measure for Post-Acute Care 6-Clicks score upon admission were compared with Spearman's correlation. To determine feasibility, a 9-item mobility scale questionnaire was distributed to CICU nurses with and without experience using the LOF Mobility Scale. The STROBE reporting guidelines were used.

**Results:** The LOF Mobility Scale had good inter-rater reliability for assessment of LOF prior to hospitalisation ( $N = 131$ , kappa = 0.66,  $p < .001$ ) and at the time of CICU admission ( $N = 131$ , kappa = 0.71,  $p < .001$ ). There was a moderate correlation ( $N = 79$  observations; correlation coefficient = 0.525;  $p < .01$ ) between the bedside nurses LOF and the 6-Clicks score. All nurses surveyed ( $N = 54$ ; 100%) thought that the LOF Mobility Scale was clear and unambiguous, the LOFs were well-defined and the scale was an appropriate length. Nearly all of the nurses with experience using the scale ( $N = 22/24$ ; 92%) felt that the scale took less than one minute to complete, compared with about half ( $N = 14/30$ ; 47%) in the group of nurses without experience using the scale.

**Conclusion:** The LOF Mobility Scale is reliable and feasible for mobility assessment in a nurse-driven early progressive mobilisation programme in patients with acute cardiovascular disease in the CICU.

**Relevance to clinical practice:** A nurse-driven EM programme can be implemented in the CICU.

## KEYWORDS

Cardiovascular Intensive Care Unit, early mobilisation, functional status, reliability

## 1 | INTRODUCTION

Early mobilisation (EM) describes progressive mobilisation activities that start immediately upon hemodynamic and respiratory stabilisation (Adler & Malone, 2012). EM in the intensive care unit (ICU) setting is associated with increased muscle strength and physical function, decreased delirium, shortened critical care and hospital length of stay, reduced readmissions, and improved long-term cognitive and quality of life outcomes (Adler & Malone, 2012; Burtin et al., 2009; MacKenzie et al., 2016; Morris et al., 2011; Needham et al., 2010). As a result, critical care societies recommend EM programmes as part of standard ICU practice (Devlin et al., 2018; Gosselink et al., 2008).

## 2 | BACKGROUND

There are currently no validated tools that are both reliable and easy to use in assessing mobility in patients with acute cardiovascular (CV) disease. Existing ICU mobility scales were developed and tested mainly in cohorts with primary respiratory or surgical disease (Hodgson, Needham, et al., 2014; Perme, Nawa, Winkelman, & Masud, 2014; Skinner, Berney, Warrillow, & Denehy, 2009). Existing scales are comprehensive (i.e. multiple scoring items) and typically require intensive physiotherapy (PT) availability and expertise to perform, and this may limit practical use. In addition, currently available ICU mobility tools only describe functional capabilities and do not guide specific mobilisation activities, which may be a barrier to EM implementation (Hodgson, Stiller, et al., 2014; Perme et al., 2014).

Nurse-driven EM programmes have been shown to be feasible and effective at improving outcomes in the ICU setting (Klein, Bena, Mulkey, & Albert, 2018). However, a lack of published protocols describing how to practically implement and perform a nursing-led EM programme with sufficient details for replication is a noted barrier for EM programme implementation (Zomorodi, Topley, & McAnaw, 2012). Thus, our objectives were (a) to describe the development and implementation of a nurse-driven EM programme focused on patients with acute CV disease in the CICU and (b) to assess the reliability and feasibility of the Level of Function (LOF) Mobility Scale.

## 3 | METHODS

### 3.1 | Development of the level of function mobility scale

The CICU at the Jewish General Hospital, an academic tertiary care centre in Montreal, Quebec, is an integrated cardiac surgical unit managing patients with primary cardiac and pre- and post-cardiac surgical patients. The nurse to patient ratio in the CICU depends on patient acuity and nursing availability, but typically

### What does this paper contribute to the wider global clinical community?

- The Level of Function Mobility Scale is reliable and feasible for mobility assessment by bedside nurses in the Cardiovascular Intensive Care Unit
- The Level of Function Mobility Scale can be used to overcome common nursing barriers to patient mobilisation
- A structured nurse-driven early progressive mobility programme can be implemented in the Cardiovascular Intensive Care Unit

ranges from 1:1–1:3. There is no dedicated CICU physiotherapist, and there is limited physiotherapist availability on weekends, evenings and holidays.

A multi-professional group of experienced CICU clinicians, including physicians, nurses, PTs, occupational therapists and respiratory therapists, as well as patient and family representatives, formed an EM development and implementation team. The multidisciplinary team developed a nurse-driven EM programme, which is centred around the LOF Mobility Scale (Figure 1). The team revised the scale through an iterative process using established safety criteria, clinical experience and needs particular to patients with acute CV disease. Our team started with the CV safety parameters established by multidisciplinary ICU expert consensus, which involve a complex grid of recommendations for mobilisations in the critical care patient based on primary cardiac condition, hemodynamics and type of mobilisation activity (Hodgson, Stiller, et al., 2014). The team then simplified the exclusion criteria by removing condition-specific categories, while maintaining similar hemodynamic safety criteria. In addition, to improve ease of use by the bedside nurse and to guide clinical care, the scale has only a small number of ordinal categories, level-specific activities and a built-in mechanism for mobility progression. The team used other more complex mobility scales, such as the 11-point ICU Mobility, as the basis for selecting 6 essential mobility milestones (Hodgson, Stiller, et al., 2014). Through a series of biweekly meetings over a 6-month period, the team further revised the scale through stakeholder consultation, including feedback from bedside nurses and CICU patients. The LOF Mobility Scale involves a progression of functional capabilities from LOF 0 (lowest mobility) to 5 (highest mobility). The LOF Mobility Scale both describes the highest functional capability and then guides specific mobilisation activities.

### 3.2 | EM protocol

On admission to the CICU, the bedside nurse determines the pre-hospital LOF and the admission LOF (Figure 2). The prehospital mobility assessment is based on patient and family report of mobility capabilities two weeks prior to hospitalisation and current illness.

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| <b>Exclusion criteria for activities</b><br><br>(Apart from any nurse identified relevant issues) | <b>(a) Devices</b><br>Femoral sheath (venous or arterial)<br>IABP<br>Intubated (for levels ≥2)<br>TVP (for levels ≥2) | <b>(b) Haemodynamic</b><br>Systolic BP ≤90 or ≥200<br>HR ≤50 or ≥130 (CSx: ≥150 if not sinus tachycardia)<br>Active ischaemia <12 hr (or <24 hr if awaiting CSx)<br>New IV anti-arrhythmia meds ≤24 hr (if arrhythmia persists)<br>Increased inotrope/vasopressor dose in last 2 hr | <b>(c) Respiratory</b><br>RR≤10 or ≥35<br>FiO2>60%<br>SpO2<90% (unless ↓ target)<br>Mechanical ventilation | <b>(d) Neurologic</b><br>Seizures ≤ 24 hr |
|---|---|---|--|---|

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|---|---|---|
| <b>Level of Function 0</b><br>Bed Immobile (RASS -5 to -3)  | <b>Level of Function 1</b><br>Bed Activity (RASS -2 to 0)   | <b>Level of Function 2</b><br>Able to Sit   |
|  <b>Goal:</b> Maintain ROM   |  <b>Goal:</b> Maintain clinical stability and encourage patient participation                        |  <b>Goal:</b> Improve strength, tolerate upright sitting, move against gravity |
| <b>Activities:</b><br>1. Turn and position q2h<br>2. Passive ROM<br>3. HOB 30°–45°  | <b>Activities:</b><br>1. Assist patient in turn and position q2h<br>2. Assisted to active ROM exercises<br>3. Cardiac chair as tolerated  | <b>Activities:</b><br>1. Regular chair x30min<br>2. Active ROM<br>3. Sitting position or edge of bed during ADLs  |
| <b>Level of Function 3</b><br>Able to Stand   | <b>Level of Function 4</b><br>Walks < 20 m  | <b>Level of Function 5</b><br>Walks > 20 m  |
|  <b>Goal:</b> Stand with assist, OOB to chair, increase endurance                              |  <b>Goal:</b> Ambulate short distances, ADLs with assistance   |  <b>Goal:</b> Increase general endurance and mobility                          |
| <b>Activities:</b><br>1. Transfer to chair or commode with assistance X1–2 for ADLs<br>2. Regular chair X 60 min during meals<br>3. Standing as tolerated and stepping in place | <b>Activities:</b><br>1. Independent transfers to chair at least for meals and ADLs<br>2. Repeated sit to stand at bedside or chair<br>3. Short walks, including to bathroom and back | <b>Activities:</b><br>1. OOB ≥ 4 hr per shift<br>2. Assist ADLs with setup only<br>3. Progressive walking around unit   |

**Definitions of Level of Function (LOF)**

- LOF 0:** RASS -5 to -3, pt is not responsive, not able to cooperate in care and is bedbound.
- LOF 1:** RASS -2 to 0, pt may be alert, able to cooperate with some exercises in bed, despite being drowsy at times.
- LOF 2:** Pt is alert, strength allows for sitting up during prolonged periods at a time but not yet able to weight bear.
- LOF 3:** Pt is alert, strength allows for standing activities and can actively participate in transfers to chair or commode, but has yet to mobilize in the room.
- LOF 4:** Pt is alert, tolerates walking in the room, but easily and independently transfers to chair/bathroom on his own.
- LOF 5:** Pt is alert, able to tolerate increased distances in walking around the unit.



**Adverse Events** a. SpO2<85% b. Significant ↑ in RR c. Abrupt Δ in mental status d. HR ≤50 or ≥130 e. SBP<85 mmHg or >190 f. Fall g. Line dislodgement

**FIGURE 1** The level of function mobility scale for the early progressive mobility programme

The admission mobility assessment is based on the patient's mobility capability on arrival to the CICU. The nurse evaluates the current LOF during each daytime (7a.m.–3p.m.) and evening (3p.m.–11p.m.) nursing shifts until CICU discharge.

Each LOF has 3 primary activities designed to promote the patient to the next level. The nurse begins with mobility activities based on the LOF that matches the patient's current status. The nurse attempts each activity for that level once per shift. If a patient is able to complete each of the 3 activities, the nurse on the subsequent shift will assess whether the LOF can be advanced. PT and occupational therapy consultation are available if required, although not obligatory, and there are built-in triggers for referral. Nurses provide instruction to patients and families on how to perform and assist with certain activities. Descriptive pamphlets and links to online instructional videos in English and French are provided to patients and family members. Contraindications to mobilisation, EM activities performed each shift, and adverse safety events are recorded on an EM flowsheet.

**3.3 | Implementation of the EM programme**

The EM programme was implemented in three distinct phases (Figure S1). Phase 1 involved education of the bedside CICU nursing staff. The EM protocol was introduced to the nursing staff through a series of in-service training sessions. Nurses were asked to assess

and record their patient's prehospital LOF, admission LOF and LOF during each shift, but were to continue usual care and not to perform level-specific activities.

In phase 2, nurses began performing level-specific mobilisation activities according to their patient's assessed LOFs. Nurses were provided further support from a nurse educator on performing mobilisation techniques with their patients in bed, in a chair or walking around. Weekly audits were performed by the nurse leader to assess for adherence to the protocol. Reminders and further education were provided if necessary. Feedback was solicited from nurses about their experience and discussed at EM meetings.

In phase 3, the patient and family engagement aspects of the EM programme were implemented. Family members were provided with information about the EM programme, which included links to the instructional videos. Nurses instructed family members on how to perform the EM activities. All clinicians working the CICU were now instructed on the EM programme. Physicians routinely rounding in the CICU and rotating trainees received education in the CICU via an electronic case-based online presentation. Monthly status reports were created and disseminated to the multidisciplinary EM team.

To compare with mobilisation in the CICU prior to the intervention, patients admitted with a primary diagnosis of acute coronary syndrome in the year prior to the EM programme implementation were compared to patients with an acute coronary syndrome in the six months following EM programme implementation. A mobilisation

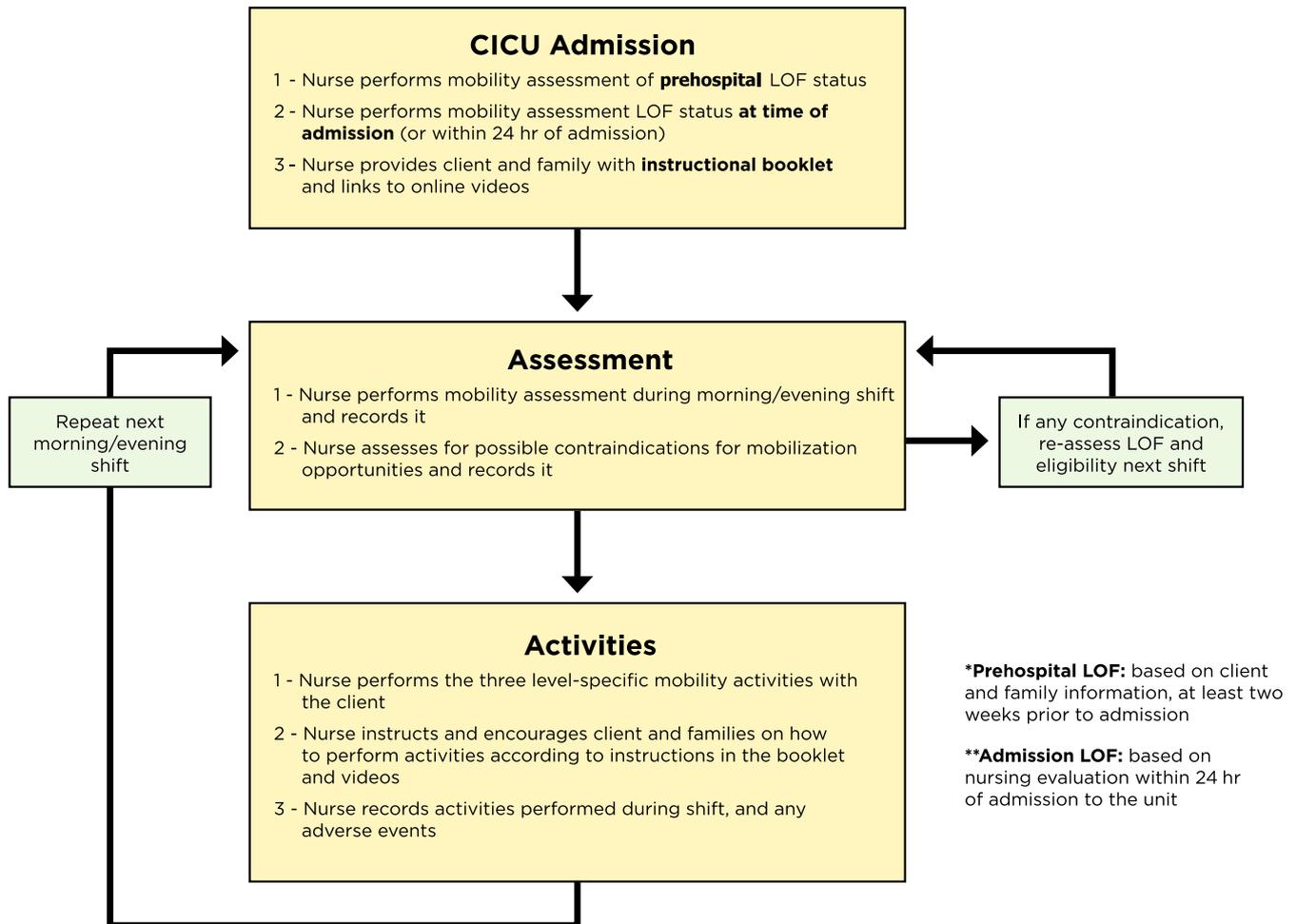


FIGURE 2 The early mobility protocol

attempt was defined as a documentation of patient mobilisation by a member of the healthcare team. A mobilisation opportunity was defined as a nursing shift (two per day; am and pm).

### 3.4 | Inter-rater reliability

To determine inter-rater reliability of the LOF Mobility Scale, two time points of LOF determination, prehospital and admission, were assessed independently by a bedside CICU nurse and by an expert clinical nurse specialist who was involved in the development of the LOF Mobility Scale (DD). Many different bedside CICU nurses participated in the LOF assessment to reflect real-world clinical practice. The LOF mobility evaluations were performed without any contact between raters on 7 nonconsecutive days over a 2-month period. Consecutive patients in the CICU on days of evaluation were included in the independent assessment by both raters. To assure that the evaluations by the bedside nurse and the clinical nurse specialist were independent, the bedside nurse did the initial mobility assessment and recorded the findings on a flowsheet that was placed in a secure document container. The clinical nurse specialist then approached the patient and, without the bedside nurse present, assessed and recorded the

mobility findings on a separate flowsheet that was also placed in the secure document container. The flowsheets were retrieved from the container by a research team member.

Pairwise comparisons between raters were evaluated using Cohen's kappa statistic. Kappa is a measure of the degree of agreement between the scores and corrects for chance agreement. Kappa > 0.4 is qualitatively interpreted as moderate, Kappa > 0.6 as good, and a Kappa > 0.8 is considered very good (Altman, 2006).

### 3.5 | Convergent validity

To determine the relationship between the bedside nurses LOF and the Activity Measure for Post-Acute Care (AM-PAC) 6-Clicks basic mobility score, we included a sample of patients in the CICU over a nonconsecutive 5-day period who received both LOF and AM-PAC 6-Clicks score assessment. The 6-Clicks mobility score has been validated and is reliable in acute hospitalised patients (Geelen, Valkenet, & Veenhof, 2018; Jette et al., 2014). It has been shown to have very good discrimination at predicting hospital discharge destination (receiver operating characteristic scores of 0.86 for basic mobility and 0.85 for daily activity) (Jette et

al., 2014, 2015). The 6-Clicks is composed of six mobility activities. Each activity receives 1 (total assistance) to 4 (independent) points based on how much help they require with a total score ranging from 6–24 with higher scores indicate better mobility. Consecutive patients in the CICU on days of evaluation were included in 6-Clicks assessment. To prevent intra-rater bias, the 6-Clicks assessment was performed by the clinical nurse specialist, whereas the LOF assessment was performed by the bedside nurse as described above. The correlation between the LOF and 6-Clicks scores was compared with Spearman's correlation.

### 3.6 | Feasibility survey

To determine the feasibility of using the LOF Mobility Scale, we distributed a survey to bedside CICU nurses. Nurses were given a 9-item questionnaire designed to assess the ease of use, clarity of design and rapidity of administering a mobility scale (Hodgson, Stiller, et al., 2014). The survey was distributed to 2 groups of nurses: (a) nurses who had already been using the LOF Mobility Scale for more than 3 months and (b) nurses who had only received a one-hour orientation on the LOF Mobility Scale, but had not yet used it on patients. Data were analysed using the SPSS 22.0 software package (IBM Corp). Institutional research ethics approval was obtained for this study. The STROBE guidelines for reporting observational studies were used (Supplementary File 1).

## 4 | RESULTS

The inter-reliability assessment was performed on 131 patients admitted to the CICU. The LOF Mobility Scale had good inter-rater reliability for assessment of LOF prior to hospitalisation ( $\kappa = 0.66$ ,  $p < .001$ ) and reliability at the time of CICU admission ( $\kappa = 0.71$ ,  $p < .001$ ). There was a moderate correlation (79 observations with both values available; Spearman's correlation coefficient 0.525; a two-tailed  $p < .01$ ) between the bedside nurses LOF and the 6-Clicks score upon admission.

There were 24 nurses with experience using the LOF Mobility Scale ( $11.7 \pm 4.1$  years of nursing experience) and 30 nurses without experience using the LOF Mobility Scale ( $10.2 \pm 4.0$  years of nursing experience). Both groups thought that the LOF Mobility Scale was clear and unambiguous, the levels were adequately defined, the scale was an appropriate length and there were no inappropriate or irrelevant levels (Figure 3). Nearly all of the nurses with experience using the scale ( $N = 22/24$ ; 92%) felt that the scale took less than one minute to complete, compared with half of nurses ( $N = 14/30$ ; 47%) in the group without experience using the scale. All nurses ( $N = 54$ ; 100%) thought that it took less than 5 minutes to complete the scale.

There were 208 patients (age  $68.7 \pm 11.0$  years old; 54 (26%) female) admitted for an acute coronary syndrome prior to implementation of the EM programme and 112 patients (age  $71.6 \pm 12.4$  years

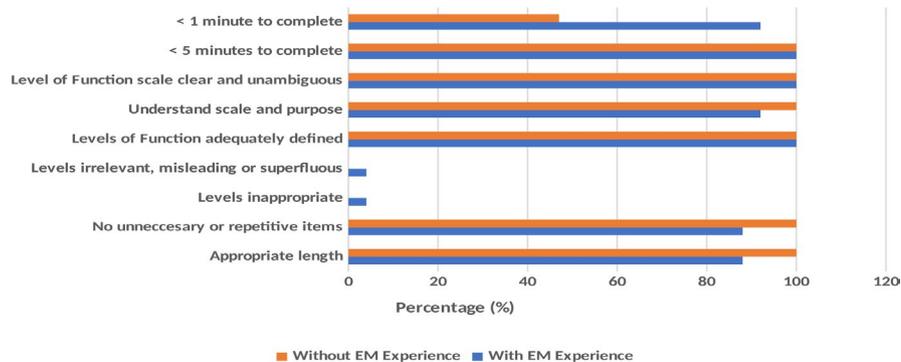
old; 35 (31%) female) after implementation. There was an increase in documentation of mobilisation activities per opportunity from 45.5% (95/208) prior to EM implementation to 99.4% (111/112) after EM implementation.

## 5 | DISCUSSION

To date, there are no validated tools that are both reliable and easy to use for nurses to assess mobility in patients with acute CV disease in the CICU. Our multidisciplinary team developed the LOF Mobility Scale to be simple, cardiac-focused and reliable for bedside nurses in a nurse-driven early progressive mobility programme in the CICU. The scale was reliable for determining the prehospital and current level of function in patients with acute CV disease. Nurses felt that the scale was clear, adequately defined and appropriate to document mobility. Importantly, nurses with experience using the scale reported that it required minimal time to document.

Critical care professional societies consider mobility a basic nursing care and advocate for implementing the ABCDEF bundle, where "E" stands for "Early mobility", into standard nursing care (Balas et al., 2013). In the ICU setting, nurse-driven EM programmes have been shown to be effective at improving outcomes (Klein et al., 2018). However, there are a lack of published protocols describing how to practically implement a nursing-led EM programme with sufficient details for replication (Zomorodi et al., 2012). A lack of written protocols or guidelines has been identified as a barrier to implementing EM in critical care units (Koo et al., 2016). Our nurse-driven EM programme includes a protocol on how to implement and perform the mobility scoring and activities. Detailed description of the EM programme and education materials are also freely available on a dedicated website.

Published EM protocols have typically involved intensive mobilisation activities led by PTs (Zomorodi et al., 2012). These EM programmes were largely independent of other key team members, such as physicians, nurses, occupational therapists and family members/caregivers. There are a number of limitations to this approach, such as limited availability of PTs in most institutions during evenings, weekends, and holidays and evidence that more than 80% of potential mobilisation opportunities are missed even when PTs are available (Anekwe et al., 2017; Hodgson et al., 2015; Hodgson, Needham, et al., 2014). Only one observational study of 63 patients in a surgical ICU reported that PTs were able to mobilise patients to a higher level than nurses and there was possible selection bias in the study groups (Garzon-Serrano et al., 2011). In our nurse-driven EM programme, PTs were instrumental in the design and implementation phases of the EM programme. PTs continue to play an active role as consultants and in direct patient management as needed. In addition, since patients requiring mechanical ventilation are initially excluded from our nurse-driven EM model, PTs lead the process of mobilising mechanically ventilated patients. However, only one in 10 patients require mechanical ventilation



**FIGURE 3** Level of function mobility scale feasibility survey. EM, early mobility

in the CICU, as compared to one in 3 in the medical ICU, and the duration of mechanical ventilation is considerably shorter in the CICU than in the medical ICU (Goldfarb et al., 2017). Thus, nurses lead mobilisation in the vast majority of CICU patients.

Beside nurse-led EM programmes have the potential to increase opportunities for mobilisation. The lack of time required for nurses to perform mobilisation activities has been cited as a barrier to nurse-led EM (Young et al., 2018). There is evidence, however, that despite a busy clinical workflow, ICU nurses have the time available for mobilising patients and miss potential mobilisation activities during almost one-fifth of the nursing shift (Hunter et al., 2017; Young et al., 2018). The burden of documentation is another barrier to nurse-led EM. We found that mobility activity documentation improved with the implementation of the EM programme and that nurses with EM experience felt that it required minimal time to document.

The LOF Mobility Scale was found to have good reliability, which is particularly important as the LOF serves as a guide for level-specific activities. In addition, since nurses are required to re-evaluate functional status on each shift, even if the LOF is not correctly assessed on one shift (i.e. rated as an LOF of 3 when actually an LOF of 4), there is an opportunity for adjustment on the subsequent shift. The frequent reassessment also allows patients to progress more rapidly through the functional levels as their physical capabilities improve following medical stabilisation.

There was only a moderate correlation between the LOF and 6-Clicks scores. There are several possible explanations for this finding. The 6-Clicks score has been validated in an acute care setting amongst patients with a wide diversity of admission diagnoses but has not been studied exclusively in an acute cardiac or intensive care setting (Jette et al., 2014). Measurement tools need to be calibrated for the setting that they are used in. Thus, it is possible that the 6-Clicks may not be properly calibrated for the acute cardiac or intensive care setting. In addition, the 6-Clicks score provides more granularity with a scoring range of 19 points compared with 6 points for the LOF score. In attempt to simplify the bedside mobility assessment, it is possible that some of the precision in the measurement was lost. However, there is a need in routine patient care for a pragmatic scale that can easily assess and guide mobility efforts. Further studies are needed to determine whether the LOF scores correlate with clinical and patient-centred outcomes.

There were limitations to our study. The nurses surveyed were at a single academic institution, so the results may not be generalisable to other healthcare centres. However, the participating nurses had a wide range of nursing experience and nurses with less years of nursing experience still thought the LOF Mobility Scale was simple to use. The analysis of the mobilisation documentation prior to implementation of the EM programme was retrospective. It is possible that undocumented mobilisation activities occurred. Thus, a conclusion cannot be drawn from these data whether the EM programme resulted in an increased number of actual mobilisation attempts. However, a key objective of the EM programme was to ease the burden of documentation for nursing and there was near-universal documentation of mobilisation in the nursing chart using the LOF Mobility Scale.

## 6 | CONCLUSION

The LOF Mobility Scale is a feasible and reliable tool to measure the patient's functional level and to guide appropriate mobilisation activities in an early progressive mobility programme focusing on patients with acute CV disease in the CICU.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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