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Staffing, teamwork and scope of practice: Analysis of the association with patient safety in the context of rehabilitation

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Abstract

Aims: To describe the organization of nursing services (staffing, scope of practice, teamwork) and its association with medication errors and falls, in rehabilitation units.

Background: The healthcare system is greatly impacted by the ageing population and the complexity of care associated with chronic diseases. It is therefore necessary to have enough staff who are using their full scope of practice and who are operating in a favourable working environment. However, these conditions are not always met, which can lead to threats to patient safety.

Design: A correlational descriptive study.

Methods: Staffing data and reported safety incidents were collected by shift from 01 October 2019 until 15 January 2020 in five rehabilitation units. In addition, a total of 75 nursing staff members responded to a missed care and teamwork survey. Descriptive analysis and logistic regression analysis were performed.

Results: The mean staff hours per patient shift was 1.39 (SD = 0.60). The teams reported a global missed care score as 'rarely missed' at 1.14 (SD = 0.07) and a moderate teamwork score at 3.36 (SD = 0.58) on a five-point scale. The safety incidents decreased 10-fold with a predominance of bachelor compared with technician nurses and decreased by 67% when there was an increase of 1 h of care per patient shift.

Conclusions: This study showed that the organization of nursing services in the observed rehabilitation units is characterized by a moderate staffing intensity, a moderate perception of teamwork level and a relatively low level of missed care. It indicated the key role of the staffing in reducing the risk of occurrence of safety incidents. Future research specific to rehabilitation hospitals are greatly needed to improve patient outcomes in this setting.

Impact: Nurse Managers should consider all the aspects of the organization of nursing services (staffing, scope of practice and teamwork) in their efforts to improve patient safety in rehabilitation settings. A central finding of this study is that the staffing intensity, the proportion of bachelor prepared nurses and the proportion of agency staff were positively associated with a reduction of safety incidents.

KEYWORDS
falls, medication errors, missed nursing care, nursing, patient safety, rehabilitation, safety incidents, scope of practice, staffing, teamwork

1 | INTRODUCTION

Inpatient rehabilitation facilities aim to promote patients' autonomy and quality of life (World Health Organization [WHO], 2011). The evidence for the association between organizational factors of nursing services and patient outcomes is extensive (Driscoll et al., 2018; Dubois et al., 2012; Kalisch & Lee, 2010). Multiple studies have indicated that an adequate number of qualified personnel, an optimal scope of nursing practice and teamwork improve patient outcomes (Chapman et al., 2017; Griffiths et al., 2018; Kalisch et al., 2012). These studies have mainly been conducted in long-term care, acute and critical care settings. However, studies specific to inpatient rehabilitation facilities are still greatly needed (Nelson et al., 2007).

2 | BACKGROUND

The current healthcare system is greatly impacted by the growth of an ageing population and the complexity of care associated with chronic diseases (Government of Canada & Statistics Canada, 2020). Healthcare professionals, including those in rehabilitation hospitals, must provide increasingly complex care. To face this challenge, it is therefore necessary to have enough staff who are using the full scope of their practice and who are operating in a favourable working environment (Dubois et al., 2012). However, these conditions are not always met which can lead to omissions of nursing care and other breaches of patient safety. Patients hospitalized in rehabilitation units' benefit from specialized care aimed at reducing their disabilities and promote their independence (WHO, 2011). However, during their hospitalization, they can be the victims of safety incidents that may complexify their recovery process (Baernholdt et al., 2018).

The present study used the nursing care organization framework (Dubois et al., 2012). This framework integrates three streams of research (human resources management, nursing administration and economics) and provides a broad vision of the organization of nursing services. This theoretically based framework, tested empirically, stipulates that the organization of nursing services is defined by three main factors: staffing, scope of practice and the characteristics of the environment in which the care is provided, and specifies that these factors impact patient safety. Even if this framework was initially developed in the context of acute hospital units, there are no identified limitations as to its application in the context of rehabilitation (Dubois et al., 2012).

2.1 | Staffing

Staffing is the process of determining and deploying the necessary nursing resources in terms of number, types and combination of personnel with various levels of education (Association des infirmières et infirmiers du Canada [AIIC], 2012; Dubois et al., 2012). The level of education makes it possible to distinguish between bachelor nurses

with a bachelor's degree in nursing, technician nurses with college training, licensed practical nurses (LPN) and healthcare attendants (HCA) with a professional studies diploma. There is an agreement that nurse staffing is a critical factor for patient safety (Aiken et al., 2017; Driscoll et al., 2018). Examining nurse staffing is the first step towards understanding the realities of rehabilitation hospitals and improving patient safety.

Two key factors in the nurse staffing are to be considered: the composition and the quantity of human resources (Dubois et al., 2012). A variety of staffing measurement approaches have been identified in the literature to respond safely to patients' needs (Bridges et al., 2019; Clarke & Donaldson, 2008; The Shelford Group, 2013), and each of these measures presents it is own limitation (Alghamdi, 2016; Fenton & Casey, 2015). The quantity of human resources is often measured by considering the patient-nurse ratio, the total number of nursing care hours per patient day or the number of equivalent full-time positions compared with the average total number patients (Clarke & Donaldson, 2008). In all cases, the nursing activities must be aligned with the patient needs to deliver safe care.

Identifying how patients and care are assigned to nurses is an effective way to understand how the nursing services are designed and delivered. This practice refers to the staffing models of nursing care. Staffing models are often identified using four models: *functional nursing* (task-oriented), *team nursing* (task-oriented under the responsibility of a nursing team leader), *comprehensive or integral nursing* (nurse providing the whole care during an assigned shift) and *primary nursing* (nurse carrying out all the patient care needed, for the duration of the hospital stay) (AIIC, 2012). According to the type and quantity of staff, other models were also identified in the literature: *professional models (innovative and basic)* which relies largely on nurses and *functional models (adaptive and basic)* which relies on licensed practical nurses (LPN) and healthcare aids (HCA) (Dubois et al., 2012). The basic models in this last classification include the least amount of staff (Dubois et al., 2012). Answering the question, 'who are the nursing staff in rehabilitation and how do they practice?' is an important step towards optimizing patient safety.

2.2 | Scope of practice

The scope of nursing practice integrates a range of nursing activities based on the skills developed through training and experience (D'Amour et al., 2012). Many studies indicate that the actual scope of practice is often suboptimal resulting in loss of skills and incomplete or missed care (D'Amour et al., 2012; Feringa et al., 2018).

The literature identified two main approaches to measure nurses' scope of practice. The first is by assessing the nursing activities that are completed in the practice and the second is by assessing those missed. Missed care is the absence of an aspect of planned and required patient care (Kalisch et al., 2009). Patient care can thus be delayed, carried out at a suboptimal level, partially or wholly omitted or inappropriately delegated (Kalisch et al., 2009). In recent studies, more than half of the nurses admitted forgetting or neglecting at

least one task during their shift (Jones et al., 2015; Nelson & Flynn, 2015).

Measuring missed care has added value compared with what was performed in practice. It highlights potential unnoticed omissions that may affect patient safety without necessarily being reported. Furthermore, it may be a sensitive indicator of safety issues potentially leading to safety incidents (Ball et al., 2014). The most often identified missed care is communicating and comforting patients (Griffiths et al., 2018). Identifying the level of missed care in rehabilitation units is crucial to have a full understanding of safety in this context.

2.3 | Work environment and teamwork

A nursing work environment is defined as 'the organizational characteristics of a work setting that facilitate or constrain professional nursing practice' (Lake, 2002). No single staff member can assure that the patient will receive safe and optimal care for the whole duration of care. While delivering care, staff members are called on to delegate certain tasks, communicate patient information and collaborate with others. Patient safety is therefore the result of the interdependent work of different team members. Consequently, nurses' work requires great communication skills and close collaboration making the interpersonal factors, labelled as 'teamwork', the most critical factor in the nurses' work environment. Teamwork is defined as a dynamic process between two or more people, with different professional backgrounds and varied skills, sharing common objectives and applying joint efforts in patient care (Xyrichis & Ream, 2008).

In rehabilitation settings, the team approach is fundamental. The result of rehabilitation care is based on the integration of patients' medical, individual and social dimensions (Körner et al., 2016). This approach requires continuous communication and collaboration in the healthcare team members to establish an individualized care plan for each patient, which highlights the crucial role of teamwork in this setting. Identifying the level of teamwork in rehabilitation units is an important factor in our understanding of team functioning in this context.

2.4 | Patient safety

Patient safety is 'A framework of organized activities that creates cultures, processes, procedures, behaviours, technologies and environments in health care that consistently and sustainably lower risks, reduce the occurrence of avoidable harm, make errors less probably and reduce the impact of harm when it does occur' (WHO, 2021). A wide range of nursing-sensitive outcomes are used to measure patient safety like the medication errors, falls, pressure injuries, urinary tract infections and readmission rates (Dubois et al., 2017).

Patients admitted to rehabilitation units are encouraged to mobilize and to take an active role in their own care based on their rehabilitation goals. Consequently, they may be at equal or higher risk for falls compared with patients in acute care environments (Baernholdt et al., 2018). In fact, the highest rate of unassisted falls occurs in rehabilitation units (Baernholdt et al., 2018). A fall is defined as 'an event which results in a person coming to rest inadvertently on the ground or floor or other lower level' (WHO, 2021). In Montreal, falls and medication errors account for 63% of all reported safety incidents in rehabilitation facilities (MSSS, 2019). Other studies indicate that 10%–50% of rehabilitation patients suffer from at least one fall during their hospitalization (Aberg et al., 2009); about a third of the rehabilitation patients suffer from any type of safety incidents, half of which are preventable (Department of Health & Human Services, 2016).

Medication errors are the leading cause of injury and preventable harm in healthcare (WHO, 2020). Medication errors 'occur when weak medication systems and/or human factors such as fatigue, poor environmental conditions or staff shortages affect prescribing, transcribing, dispensing, administration and monitoring practices' (WHO, 2017). These errors can have major consequences for patients, and are multifactorial (WHO, 2016, 2021). A multitude of medication error detection systems exist, such as disguised direct observation, reporting and charts review (Saghafi & Zargarrzadeh, 2014). The reporting of medication errors appears attractive because it is inexpensive compared with the other approaches. In the literature, the medication error rates vary widely depending on the definition of medication error adopted by the authors and according to the denominator used in their calculation (Institute of Medicine [IOM], 2007; WHO, 2016). Some studies indicate a rate per 1,000 admissions, per 100 opportunities or doses, per 100 or per 1,000 patient days (IOM, 2007).

2.5 | Association between the organization of nursing services and patient safety

The evidence associating nurse staffing levels and patient outcomes is extensive. Several studies demonstrated that the quantity of staff per patient and the staff composition are associated with patient outcomes such as mortality, medication errors and falls (Aiken et al., 2017; Driscoll et al., 2018; Frith et al., 2010, 2012; Staggs et al., 2012). In the literature, there appears to be a trend indicating that an increase in the number and in the proportion of nurses is associated with better patient outcomes. However, about licenced practical nurses, there is some divergence in the findings. While some studies showed that a small rise in their number can increase the risk of medication errors (Frith et al., 2012), others claimed that they help monitor patients and can therefore prevent falls (Bae et al., 2014). Education levels and experience are both positively associated with an improved patient safety (Dubois et al., 2012; Staggs et al., 2012). About temporary personnel, some studies found an association between their presence and the occurrence of safety incidents such as falls (Bae et al., 2014), while others found that the poor care environment that they practice in is mediating the relationship with safety

incidents (Aiken et al., 2007). Our review of the literature indicates that very few studies have been conducted in rehabilitation units.

Several authors have emphasized the link between the nursing interventions performed, or not performed, in the practice and patient safety. Studies conducted in acute and long-term care units have found that missed care is associated with the occurrence of healthcare-associated infections (Ausserhofer et al., 2014; Lucero et al., 2009), falls (Kalisch et al., 2012), medication errors (Ausserhofer et al., 2014), pressure injuries (Schubert et al., 2009) and urinary tract infections (Nelson & Flynn, 2015).

The evidence convergences about the positive association between teamwork and patient safety. Better teamwork promotes a decrease in the number of falls (Spiva et al., 2014), surgical errors and morbidity (ElBardissi et al., 2008), pressure injuries (Manojlovich et al., 2009), serious errors and mortality (Mazzocco et al., 2009; Neily et al., 2010) and missed care (Kalisch & Lee, 2010).

In conclusion, sufficient and qualified personnel practicing in teams to their full scope of practice can increase patient safety. Our literature review shows that a small number of past studies have been conducted in rehabilitation units, which highlights the importance of the present study (Jette et al., 2004, Van Den Heede et al., 2019; Kalisch & Lee, 2010, 2013).

3 | THE STUDY

3.1 | Aim

The aim of this study was to answer the questions: Who are the nursing staff members working in rehabilitation, in what environment they work and what do they do in their practice? Is there an association between these factors and patient's safety?

3.2 | Design

A quantitative descriptive and correlational design were used for the present study.

3.3 | Setting

This study was conducted in three rehabilitation hospitals of an Integrated University Health and Social Services Center (CIUSSS) in the Montreal region of Quebec, Canada. This CIUSSS was chosen because it covers a large territory serving about 18% of the total of Montreal population (Agence de la santé et des services sociaux de Montreal, 2015). In addition, it serves patients from other territories because of its specialized rehabilitation units, and it contains rehabilitation units treating patients with various rehabilitation needs (geriatric, neurological, multisystem, musculoskeletal and respiratory) (Gouvernement du Québec, 2017). In total, five rehabilitation units were included in the study.

3.4 | Participants

This study's target population consisted of all the inpatient rehabilitation units of a CIUSSS in Quebec (Canada). A total of 145 staff members including nurses, LPN and HCA were included in the study.

Since staffing, scope of practice, teamwork and occurrence of safety incidents may fluctuate from shift to shift (8-hour day, evening and night shifts), the unit of analysis of this study is the 'working shift'. To ensure sufficient statistical power, the data collection extended over 93 days period equal to 1,395 shifts analysed. For every analysed shift, the study participants were:

1. All hospitalized patients, by analysing the reported safety incidents that occurred during their hospitalization and by obtaining the total number of hospitalized patients, per shift, in each of the units.
2. Nursing staff (nurses, LPN, HCA). The inclusion criteria were (a) having practiced in the unit for at least 6 months in the previous year, and (b) able to speak and read the English language.

3.5 | Data collection

Data were collected for a period of 93 days starting on the first of October 2019 until 15 January 2020. The 2-week holiday period was excluded from this study as it was not considered as a representative period. Data were collected using administrative data, a questionnaire and risk management report data.

When the first author presented the study to the teams, a research binder containing the information and consent forms, the questionnaires and the link to these documents were made available on each unit. On the information and consent forms, staff members were asked to complete the questionnaire and to drop it in the lockbox placed on each unit. As a reminder, the letter of invitation to the study was posted on the unit bulletin boards. The managers reminded the teams of the study in staff meetings and by emails. Participants had 4 weeks to complete the questionnaire, in the 93 days of the study period.

3.5.1 | Administrative data

Two types of administrative data were collected: data on human resources and data on the number of patients.

Data on human resources were provided to the researchers by the human resource replacement activity centre. These data were collected through the Logibec® software, used by the entire CIUSSS, which collects daily data of the working staff on the unit, per shift. The collected data were transcribed by the replacement activity centre personnel into an Excel analysis grid, developed by the authors, which included the following elements: the date and the shift; the number of nursing staff present on the unit; their status (regular or replacement) and working in regular time or overtime.

To be able to calculate staffing ratios, data on the number of patients present on each unit were collected through the Clinibase[MD] software. This software makes it possible to determine the total number of patients present on the units at the start and at the end of each shift. The data collected were transcribed into the analysis grid. To be able to calculate the rate of falls and medication errors by patient days, the total number of patient days was obtained for the duration of the study period.

There are two components to consider when measuring staffing:

First, the quantity of human resources, which, in this study, was operationalized as the total staff working hours per patient and per shift (HPPS), all types of employment combined (nurse, LPN and HCA). The HPPS are first calculated by job title for each shift, by multiplying the number of staff by the number of hours attributed to their title (7.50 h for nurses, and 7.25 h for LPN and HCA), then dividing it by the numbers of patients present on the unit for that shift. Then, a total of HPPS is calculated by summing the three job titles' HPPS.

Second, the composition of human resources, which, in this study, was operationalized as the proportion of staff working HPPS by type of employment. The proportions of working hours are calculated by job title, by dividing the job title's HPPS by the total HPPS (all job titles combined). The number obtained is then multiplied by 100. The proportion of agency staff HPPS and the proportion of overtime staff HPPS (all job titles combined) are also calculated.

3.5.2 | Questionnaire

Teamwork

The Nursing teamwork Survey (NTS) (Kalisch et al., 2010) was the selected instrument to assess teamwork. This survey is designed to analyse the nursing staff teamwork. It is a valid and reliable instrument with a test-retest reliability at 0.92 and an internal consistency of $\alpha = .94$. The content validity was supported by a panel of experts (Kalisch et al., 2010). The NTS consists of 33 items grouped into five categories that measures: (a) trust (sharing ideas, receiving and providing constructive feedback), (b) team orientation (working towards the team objectives, and refers to the behaviours of the members), (c) backup (helping each other voluntarily), (d) shared mental model (knowing the roles and responsibilities of each member and working together to provide quality care) and (e) team leadership (the leader ensures a balanced workload and offers help as needed). Participants indicated the frequency by which they perceive the teamwork items listed. Each of these items were answered on a five-point scale ranging from 1 (rarely), 2 (25% of the times), 3 (50% of the times), 4 (75% of the times) to 5 (100% of the times) (Kalisch et al., 2010). For each unit, a score by category was calculated by summing the points of each item that composes it, then the total unit score on five points was calculated. For all the units, a global score by category was also calculated. High scores represent greater team cohesion. The survey questions included demographic and work-related items. In addition, participants evaluated their team's performance and their satisfaction in the team (Kalisch et al., 2010).

Missed care

The Basel Extent of Rationing of Nursing Care (BERNCA) (Schubert et al., 2007) was the instrument selected to measure missed care. The internal structure of the questionnaire and the validity of the construct was confirmed by a panel of experts and the Cronbach's alpha is 0.93 (Schubert et al., 2007). The BERNCA is composed of 20 tasks grouped into five categories: (a) activities of daily living (assisting in daily self-care activities like hygiene care and mobilization), (b) caring and support (communicating and offering emotional and psychological support), (c) rehabilitation, instruction and teaching (performing rehabilitation care, toilet training, self-care education and preparing patients for discharge), (d) monitoring and safety (adequate monitoring, responding promptly to calls and performing hand hygiene) and (e) documentation (reading the documentation at the beginning of the shift and documenting the care) (Schubert et al., 2007). Participants indicated the frequency by which they were unable to perform the tasks listed in the last seven days of work. Each of these tasks was answered on a 3-point scale ranging from 0 (care never missed), 1 (care rarely missed), 2 (care sometimes missed) to 3 (care often missed) (Schubert et al., 2007). For each unit, a score by category was calculated by summing the points of each item that composes it, then the average unit score on 3 points is calculated. For all the units, a global score by category was also calculated. Higher scores indicate more frequent missed care on the unit (Schubert et al., 2007).

3.5.3 | Risk management report data

Two indicators have been used in this study to measure patient safety:

1. The occurrence of the two most prevalent safety incidents in rehabilitation: reported falls and medication errors.
2. The level of severity of each safety incident determined by the managers based on the absence or the presence of consequences for the patient. The MSSS severity scale of the AH-223 form was used to document and identify the severity level of an incident (MSSS, 2019). For the purpose of this study, safety incidents were grouped into two categories: incidents with no consequences (gravity A to D) and incidents causing consequences to patients (gravity E1 to I).

3.6 | Ethical consideration

Ethics approval was obtained from the university and the CIUSSS under study (number 19–078-D). Participants' free and informed consent were obtained. The protection of participants from any harm was ensured by having completely anonymous and confidential

responses. The confidentiality of personal information was preserved by accessing data that excludes the names of patients and staff. The authors had only access to the anonymous data that is conserved in a locked cabinet and will be destroyed 7 years after the study ended.

3.7 | Data analysis

A data analysis framework was set up to identify the different variables to be used in the present study. This framework contains three types of variables: the independent variables (staffing, scope of practice and teamwork); the dependent variables (falls and medication errors) and the moderating variables (working shift, rehabilitation care unit).

The data analysis included two parts that allowed to reach the research objectives. To meet the first objective, which is to analyse the configurations of the organization of services in the three rehabilitation hospitals, a descriptive analysis of central tendency (frequencies, mean) and dispersion (standard deviation) was performed for each of the independent variables. In addition, based on the distributions, the continuous variables were grouped into categorical variables. Then, significant differences were calculated between each of the three independent variables and the rehabilitation units, shifts, employment status and other characteristics. For all analysis, the results reaching the significance thresholds of 0.10 and less were reported.

For the second research question, which is to examine the association between the nursing organization and patient's safety, a multilevel logistic regression analysis was performed. In this analysis, the work shifts were nested in the units because the variance of the dependent variable can be explained both by the characteristics of the shifts and by contextual factors (units). As mentioned previously, the unit of analysis for this study is the shift. Although the data were able to identify the shift assigned to the position of each participant, almost 30% worked on a shift rotation (day evening, day night) which precluded us to group by shift the missed care and the teamwork scores to the staffing data. As a result, the missed care and teamwork scores were both excluded from the logistic regression analysis model and the main independent variable included was the staffing.

The rehabilitation units were used as a variable offset to compensate for the bias due to the unequal size of the units under study. The analysis used a binary dependent variable where 0 indicated no incident and 1 indicated the occurrence of one or more incident. Data analyses were performed using IBM SPSS Statistics for Windows, version 25 (IBM Corp.).

3.8 | Validity, reliability and rigour

The administrative data collection tool, developed by the authors, captured by shift the staffing data required for this study. It included risk management data that were based on the reported safety

incidents. Therefore, no psychometric evaluation of validity or reliability was required for this collection tool. The selected instruments used to measure the teamwork and the missed care were validated tools with high psychometric properties (Kalisch et al., 2010; Schubert et al., 2007). Statistical methods using IBM SPSS Statistics for Windows were used to analyse the data.

4 | RESULTS

4.1 | Participants' characteristics

A total of 75 staff member completed the survey for an overall response rate of 51.8%. The lowest response rate by unit was 41%. Almost one-third of the participants (29.3%) reported working rotation shifts. Those on rotation were asked to indicate the shift that they were assigned to work on most often, and their survey data were associated with that shift. For more details, see Table 1.

4.2 | Staffing characteristics

4.2.1 | Hours per patient per shift (HPPS)

Patients admitted in the rehabilitation units received a mean of 1.39 total HPPS or 4.16 h of total nursing care per 24 h (nurses, LPN and HCA combined). On average, each patient received 2.10 h of care on day shifts, 1.29 h on evening and 0.77 hours on night shifts. The average total HPPS for unit A, B, C, D and E are 1,27 (SD = 0,49), 1,32 (SD = 0,50), 1,39 (SD = 0,65), 1,54 (SD = 0,64) and 1,40 (SD = 0,68) HPPS, respectively. The mean of the nurses working hours per shift accounted for a third (33.1%) of the total HPPS, the LPN accounted for 26.6% and the HCA accounted for 40.3%.

4.2.2 | Proportions of working hours

Most of the shifts (69.7%) had nurses' proportion between 20 and 39%, and almost half of the shifts (52.9%) had LPN's working hour's proportion between 20 and 39%. A high HCA proportion of more than 40% was found in almost half (50.6%) of the shifts. Almost a fifth of the shifts (21.7%) had at least one agency staff present and 36.2% of the shifts had at least one staff working overtime, all title combined. Most of the shifts (70%) had a predominance of technician compared with bachelor nurses. This data excludes the agency nurses as their highest education level is unknown. The proportion of these different types of staff varied significantly between the units ($p < .001$). Figure 1 shows the average proportion of working hours by unit.

Teamwork characteristics

The global teamwork score was 3.36 on a five-point scale. No significant differences were found between the NTS global score and the units ($p = .37$), job titles ($p = .36$), shifts ($p = .29$), education level

TABLE 1 Participant characteristics

Variables	Category	Frequency	%
Gender	Male	8	10.7
	Female	67	89.3
Age	<25 years	5	6.7
	25–34	19	25.3
	35–44	18	24.0
	45–54	24	32.0
	55–64	9	12.0
Job title	Nurse bachelor prepared	7	9.3
	Nurse	18	24
	Licensed practical nurse	28	37.3
	Healthcare aid	22	29.4
Shift assigned most often	Rotation between day, evening, night	22	29.3
	Day only	32	42.7
	Evening only	15	20
	Night only	6	8
Employment status	≤30 h/week	13	17.3
	>30 h/week	62	82.7
Number of respondents	Unit A	18	24
	Unit B	18	24
	Unit C	15	20
	Unit D	10	13.3
	Unit E	14	18.7
Highest education	University education	20	26.7
	College education	25	33.3
	Professional education or no diploma	30	40
Experience in profession	6 months to 2 years	11	14.6
	Years	13	17.3
	5–10 years	16	21.3
	>10 years	35	46.8

($p = .15$), employment status ($p = .25$), experience in the profession ($p = .77$), experience in the position ($p = .23$), satisfaction in the position ($p = .33$) and satisfaction in the profession ($p = .20$). Refer to Table 2 for more details.

Missed care characteristics

Team members reported overall missed care as *rarely missed* with a score of 1.04 on a three-point scale. A significant difference was found between the BERNCA global score including four of its categories and the units ($p < .001$). The caring and support was the only category that did not show significant difference between the units. See Table 2 for more details.

No significant differences were found between the BERNCA global score and the level of education ($p = .50$), job titles ($p = .23$), shifts ($p = .52$), employment status ($p = .90$), experience in the profession ($p = .17$), experience on the unit ($p = .65$) and experience in the position ($p = .90$). Of the 20 items from the BERNCA instruments, the identified missed care items varied between 0.57 and 1.75. See Figure 2 for more details.

Safety incidents

A total of 100 incidents were reported during the study period. Six shifts had two incidents bringing the numbers of shifts with at least one incident to 94. For the purpose of this study, for the instances where two safety incidents were recorded on one shift, the incident with the highest gravity level was used. Almost half of the incidents occurred on days (n = 49) and a third occurred on evening (n = 28). More details are presented in Table 3.

The fall rates varied between the units. Unit A had the highest rate at 16.41 falls per 1 000 patient days, while the other units had rates ranging between 2.06 and 4.37. The average fall rate for all units was 5.41 falls per 1,000 patient days.

The medication error rates also varied between the units. Unit E had the highest at 9.26 medication error rate per 1,000 patient days, while the other units ranged between 0.47 and 1.54. The average for all units was 2.79 medication error per 1 000 patient days. Almost 80% of the medication errors were reported by unit E (n = 27) and 60% of those errors (n = 16) were near misses and incidents that did not reach the patients (Gravity A and B). While unit A declared only one incident of gravity A, unit E was the unit that declared all incidents that did not reach the patients.

4.3 | Multivariate analysis model

First, bivariate correlation coefficients (Pearson's r) between the staffing independent variables were estimated to ensure no multicollinearity, a needed condition for the multivariate analysis. The variable 'proportion of LPN' had a bivariate correlation coefficient of more than .472 with the other staffing independent variables, indicating strong relationships. Therefore, this variable was excluded from the final multilevel logistic model. As previously mentioned, the missed care and teamwork variables were both excluded from the final logistic model and the main independent variable included was the staffing.

As a result, the multilevel logistic regression analyses included five staffing independent variables that can impact the occurrence of safety incidents: Total HPPS, proportion of nurses working HPPS, proportion of HCA working HPPS, proportion of agency staff working HPPS and proportion of overtime staff working HPPS. The shift variation was controlled by including the night shift as the reference.
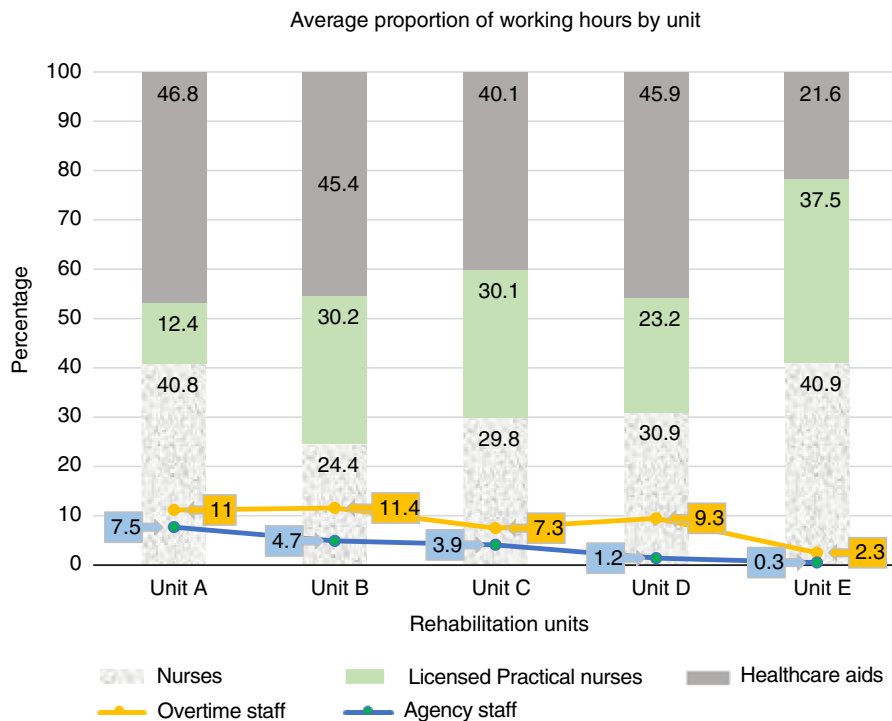
FIGURE 1 Average proportion of working hours by rehabilitation unit

TABLE 2 Mean of the teamwork and missed care scores by rehabilitation unit

	Total	Unit A	Unit B	Unit C	Unit D	Unit E	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	*p*
Teamwork							
Global Score	3.36 (0.58)	3.42 (0.55)	3.27 (0.40)	3.30 (0.78)	3.15 (0.42)	3.59 (0.66)	.372
Trust	3.23 (0.78)	3.10 (0.97)	3.15 (0.56)	3.26 (0.75)	3.17 (0.60)	3.50 (0.93)	.663
Team Orientation	3.02 (0.69)	3.14 (0.53)	2.78 (0.61)	3.02 (0.88)	2.77 (0.68)	3.37 (0.64)	.094
Backup	3.28 (0.76)	3.43 (0.48)	3.25 (0.57)	3.10 (1.13)	3.08 (0.58)	3.49 (0.92)	.533
Shared Mental Model	3.84 (0.60)	3.83 (0.47)	3.87 (0.50)	3.77 (0.83)	3.66 (0.56)	4.02 (0.63)	.658
Team Leadership	3.60 (0.83)	3.90 (0.54)	3.57 (0.59)	3.52 (1.26)	3.15 (0.57)	3.64 (0.91)	.235
Missed care							
Global Score	1.04 (0.07)	1.07 (0.10)	1.60 (0.16)	0.71 (0.09)	0.72 (0.14)	0.88 (0.12)	<.001
Activity of Daily Living	1.01 (0.08)	1.02 (0.14)	1.52 (0.16)	0.74 (0.14)	0.78 (0.18)	0.79 (0.17)	.002
Caring & Support	1.21 (0.09)	0.97 (0.13)	1.72 (0.20)	1.00 (0.23)	0.90 (0.27)	1.32 (0.20)	.021
Rehabilitation, Instruction & Education	0.80 (0.08)	0.76 (0.11)	1.53 (0.20)	0.38 (0.10)	0.38 (0.11)	0.64 (0.15)	<.001
Monitoring & Safety	1.03 (0.08)	0.21 (0.15)	1.51 (0.18)	0.77 (0.12)	0.72 (0.19)	0.71 (0.12)	.001
Documentation	1.33 (0.10)	1.41 (0.21)	1.93 (0.21)	0.80 (0.17)	0.90 (0.23)	1.36 (0.22)	.002

The rehabilitation units were used as a variable offset to compensate for the bias due to the unequal size of the units under study. The final model is presented in Table 4. The odds of having a safety incident are:

1. 67% reduced if the total staff HPPS increases by one.
2. 2.1% greater if the proportion of nurses' increases by one.
3. 5.8% reduced if the proportion of agency staff increases by one.
4. 14.5 times greater on days compared with nights.
5. 2.9 times greater on evenings compared with nights.

5 | DISCUSSION

This study is the first to describe the organization of nursing services in rehabilitation in terms of the staffing of the nursing team, the extent of their scope of practice and teamwork. It is also the first as per our knowledge to explore the association between the organization of rehabilitation nursing services and patient safety in the province of Quebec.

Our study found that the rehabilitation units studied were composed of various types of nursing staff: nurses, LPN and HCA.

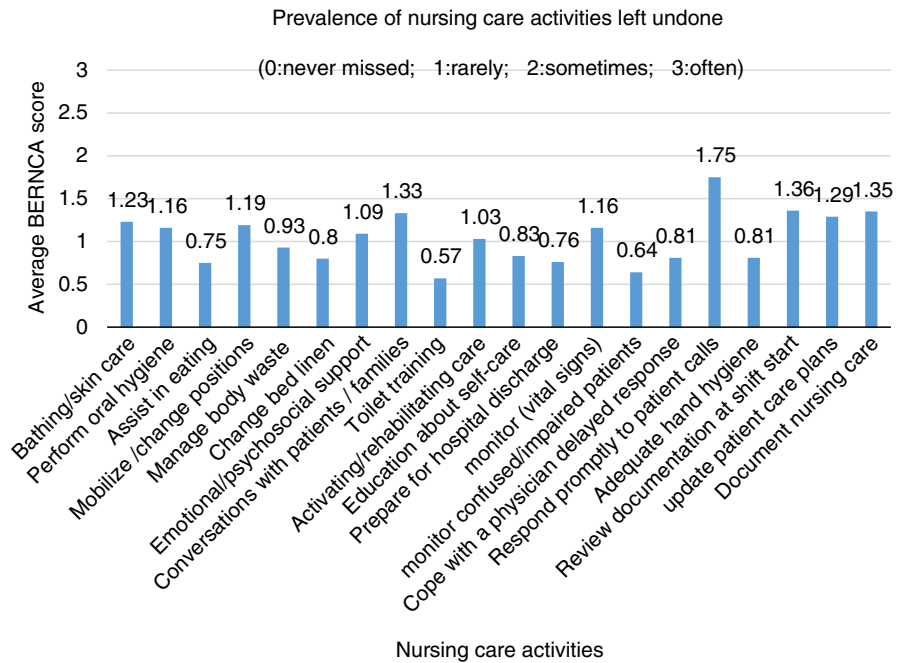FIGURE 2 Prevalence of nursing care activities left undone in rehabilitation

Prevalence of nursing care activities left undone

(0:never missed;   1:rarely;   2:sometimes;   3:often)

TABLE 3 Distribution of shifts where an adverse event occurred

	Number of shifts	%
Occurrence of an event		
No declared event	1300	93.3
At least 1 declared event	94	6.7
Care unit with at least one declared event		
Unit A	35	12.54
Unit B	7	2.51
Unit C	15	5.38
Unit D	7	2.51
Unit E	30	10.75
Type of event		
Fall	63	67.0
Medication error	31	33.0
Severity of event		
Without consequence (A to D)	78	83.0
With consequence (E to I)	16	17.0
Composition of the nursing team		
More technician nurses		
No declared event	828	68.9
At least 1 declared event	65	69.1
50 / 50		
No declared event	187	15.9
At least 1 declared event	23	24.5
More bachelor nurses		
No declared event	186	15.5
At least 1 declared event	6	6.64

All have specific roles and responsibilities to deliver care under the supervision of the nurse that leads the team, suggesting that the *team nursing* model is practiced. *Team nursing* is a classic model of care delivery defined as the assignment of a group of patients to a group of workers under the direction of a nurse, the team leader (AIIC, 2012). Newer models of care delivery distinguish between functional models and professional models (Dubois et al., 2012). According to these authors, when a variety of nursing staff deliver a variety of tasks, the model of care corresponds to the *functional model* (Dubois et al., 2012). When the care relies heavily on professional nurses, the model of care corresponds to the *professional model*. Therefore, we can imply that the rehabilitation units included in the present study followed a functional model of nursing care due to the proportion of the worked hours provided by the LPN and the HCA. However, functional models have been shown to be less ideal than professional models in achieving safe care delivery (Dubois et al., 2012). This reflection could therefore guide managers in optimizing the administrative structure of their units by increasing the number of nurses.

Our result indicated that each patient received a total of 4.16 h of nursing care per day delivered by nurses, LPN and HCA which is in line with previous recommendations (Jette et al., 2004; Van Den Heede et al., 2019). Specifically, it was suggested that there are 1.53 more chances to have better outcomes in rehabilitation when the total hours of nursing care per day is higher than 3.5 (Jette et al., 2004). Other rehabilitation settings have been found to benefit from an average of 5.12 h per patient day (Van Den Heede et al., 2019). Plausible explanations for this difference may include patient's characteristics, and team's characteristics and composition. The team compositions in our study indicated a predominance of technicians compared with bachelors' nurses and a high proportion of HCA.

	OR	95% CI		p value
Total hours per patient shift (HPPS)	0.332	0.135	0.820	.017
Proportion of nurses working HPPS	1.021	1.000	1.043	.046
Proportion of healthcare aids working HPPS	1.001	0.981	1.022	.907
Proportion of overtime staff working HPPS	0.992	0.973	1.012	.436
Proportion of agency staff working HPPS	0.942	0.900	0.986	.010
Shift (Reference: Night)				
Q_Day	14.524	3.943	53.505	<.001
Q_Evening	2.867	1.298	6.335	<.001
Unit (offset)				
LR test vs. logistic model Chibar2 = 7.61		Prob >= chibar2 = .003		

TABLE 4 Factors associated with an adverse event during a shift––Results of logistic regression analysis

Higher proportions of HCA have been reported in rehabilitation units compared with medical and surgical units (Van Den Heede et al., 2019), which could be explained by two factors: patients' medical stability and the rehabilitation objectives. Specifically, patients' medical stability requires less nurses' time, and the aim to promote patients' autonomy implies a need for more physical support, usually delivered by HCA, working in teams with the nurses to ensure safe care delivery.

One of the parameters used in this study to describe the rehabilitation nursing services is the teamwork. The global teamwork mean score was 3.36, which means that, on average, the members perceived the teamwork level of their teams as optimal 67% of the times. The review of the literature showed that the research exploring the nursing teamwork in rehabilitation was part of multisite studies including different types of units. Two studies found overall teamwork rehabilitation scores at 3.37 and 3.68 which have been indicated to be lower compared with other specialty units such as intensive care, paediatrics and psychiatry (Kalisch & Lee, 2010, 2013). About the dimensions of teamwork, our result indicated that the Shared Mental Model is the highest dimension and the team orientation is the lowest. These findings correlate with previous research that also identified these teamwork categories as the highest and lowest (Kalisch & Lee, 2013; Rahn, 2016). The findings about Shared Mental Model confirm that the members know their roles and responsibilities and work together to offer quality and safe care (Kalisch et al., 2010). The team orientation category implies working towards the objective of the team and refers to the behaviours of the members such as conflict avoidance, dominant personalities, defensiveness and judgmental feedback (Kalisch et al., 2010). Our findings contribute to a better understanding of the improvement strategies that managers can put forward in refining teamwork in rehabilitation settings.

Another parameter used in this study to describe the rehabilitation nursing services is the missed care. The average global missed care score was at 1.04 which indicates that, on average, the nursing team reported *rarely* being unable to perform the tasks listed on the BERNCA instrument. Our study found significant differences between the missed care score and the units ($p < .001$) which highlights the heterogeneity of the practices of the rehabilitation units examined. Previous research has reported that in medical and surgical units the average missed score using the BERNCA instrument was 1.69 (SD = 0.57) (Schubert et al., 2013). Authors found that between 55% and 98% of the staff reported missed care tasks on their last shift (Griffiths et al., 2018). It was demonstrated that a missed care score that exceeds the level of 0.5 or 1 could be a significant threat to patient safety (Papastavrou et al., 2014; Schubert et al., 2009). This is very important because all the units included in our study exceeded the score of 0.5 with one unit being particularly problematic at 1.60. Managers need to be proactive to prevent missed care even at very low levels (Schubert et al., 2009). In the present study, the category of rehabilitation, instruction and education was missed the least which is a positive finding that can be attributed to the mission of rehabilitation units. The category that was missed the most was the documentation category. However, this low score may be attributed to the fact that the documentation task is not part of the role of the beneficiary attendants. Therefore, we consider that the caring and support category, which was the second category most often missed care, is the lowest in our study. This result is in line with the findings of a previous systematic review which reported that emotional and psychological support is often missed (Griffiths et al., 2018). Therefore, our results contribute to an in-depth understanding of the areas for improvement to prevent the occurrence of missing care.

The medication error rate in our study was 2.79 per 1,000 patient days. There is no acceptable rate of medication errors (National Coordinating Council for Medication Error Reporting & Prevention [NCC MERP], 2002), and these rates vary greatly between studies (IOM, 2007; WHO, 2016). Our rate should be interpreted carefully as it relied on reported medication errors, and efforts should be deployed to identify their causes and prevent them (NCC MERP, 2002).

The fall rates per unit in the present study varied between 2.06 and 4.37 falls per 1,000 patient days with one unit being particularly problematic at 16.41 falls per 1,000 patient days. Previous single site observational studies in acute hospitals reported fall rates from 1.3 to 8.9 falls per 1,000 patient days while multisite studies reported between 3 and 5 falls per 1,000 patient days (Oliver et al., 2010). Research suggests that rehabilitation patients are at higher risk for falls than other units (Baernholdt et al., 2018; Griffiths et al., 2018; Staggs et al., 2012). Consequently, our results call on managers to continue to put in place strategies to reduce the occurrence of falls in rehabilitation.

An important objective of the present study was to explore the associations between the organization of nursing care and the occurrence of falls and medication errors in rehabilitation units. Because of the nature of our data, the analysis of these associations only included the staffing variables and excluded the teamwork and missed care variables. The following discussion will summarize the results of the univariate and multivariate analysis.

The univariate analysis provides new insights into the association between the teamwork score and the declaration of near misses and incidents that did not reach the patients (Gravity A and B). Our results showed that the rehabilitation unit with the highest global teamwork score was the unit that declared almost all incidents with gravity level A and B. A possible explanation is that a team with high cohesion is not afraid of declaring incidents. Moreover, this team had a strong safety culture and may have felt that reporting near misses and incidents could be used to prevent future events as the safety of patients is a common objective for all its members. This analysis brings forward the idea of considering incident reporting as the foundation of a safety culture and team cohesion (Levine et al., 2020). Thus, the number of incidents must be interpreted carefully as more declared incidents do not necessarily equate an unsafe environment. The managers will benefit from monitoring the reporting of incidents that did not affect the patients, as this could be an indicator of team cohesion and safety culture on their units. Since the teamwork variable was excluded from the logistic regression analysis model, these data were not confirmed by multivariate analyses and should be interpreted carefully.

To explore the impact of the bachelor versus technician nurses on the occurrence of falls and medication errors, univariate analysis was performed. This analysis showed that the occurrence of these safety incidents decreased 10-fold when there was a predominance of bachelor compared with technician nurses and decreased three-fold when there was an equal number of technician and bachelor nurses. Such results are in line with previous research which showed the positive impact of bachelor nurses on patient safety (Aiken et al., 2017; Dubois et al., 2013). Our data contribute to the evidence that bachelor nurses may improve patient outcomes in rehabilitation units. Consequently, their higher presence remains a safety net for better patient outcomes. Our results should be interpreted with caution as they were not confirmed by multivariate analyses.

In our study, the multivariate analyses examined the associations between the occurrence of safety incidents and the total staff HPPS, the proportion of the nurses HPPS, the overtime staff HPPS and the agency staff HPPS. A central finding in our study was that an increase in the total staff HPPS by 1 h may reduce by 67% the risk of occurrence of safety incidents. Numerous studies have also reported significant associations between human resources and patient safety (Frith et al., 2010; Kalisch et al., 2012; Staggs et al., 2012). To improve patients' outcomes, some authors suggested having more nurses (Kalisch et al., 2012; Staggs et al., 2012), more bachelor nurses or enough nurses combined with support personnel (Frith et al., 2010). However, authors did not reach a consensus about a staffing formula that could help deliver safe care in any setting, including rehabilitation. Our study indicated through univariate analyses, the positive effects of bachelor nurses on the reduction of safety incidents. Other rehabilitation studies using multivariate analyses are needed to explore the mechanisms underlying the impact of team composition on patients' outcomes.

Our study found that an increase of 1 in the proportion of nurses may increase by 2.1% the risk of reported safety incidents. We attribute this result to the fact that the professional nurses, who are involved with all aspects of patient care, are the ones who report the most safety incidents. Our study did not find significant associations between the proportion of HCA working HPPS and the occurrence of safety incidents.

Another significant and unexpected association was found between the agency staff proportion and patient outcomes. Our results indicated that an increase in this proportion by one can be associated with a 5.8% reduction in the probability of safety incidents. Controversies persist in the literature over the benefits of agency staff. While some authors highlight that the agency staff presence is beneficial (Aiken et al., 2007), others link it to more safety incidents (Bae et al., 2014). Our results suggest that the agency staff is somewhat beneficial to patient safety. Moreover, the agency staff has the same competencies and training as the regular staff (Aiken et al., 2007), and potentially could be assigned long-term replacement which can increase continuity of care, knowledge of the working environment and teamwork.

5.1 | Limitations

This study presents some limitations. The first limitation relates to the sample. The data were extracted from all the rehabilitation hospitals of the same CIUSSS. Choosing hospitals in the same regional context allows for meaningful comparisons. However, the staffing models resulting from this specific regional context may differ from those existing in other rehabilitation settings, limiting the generalizability of the results. In addition, the response rate was relatively low at 51.8%. However, the number of responses gathered was evenly distributed among the units which allowed for valid comparisons between the different teams. In addition, less than 10% of respondents reported working only night shifts and 30% reported working in shift rotation, which prevented us from getting the missed care and teamwork scores per shift.

The second limitation relates to the safety measurement indicators selected. Our data collection excluded safety incidents other than falls and medication errors. However, the latter are the most frequent in rehabilitation settings (MSSS, 2019) which makes our choice of indicator valid. A longer study period could increase the number of shifts with safety incidents which would make it possible to increase our confidence about the impact on patient outcomes.

The last limitation relates to the data collection strategy. The duration of the study was 93 days, excluding the holiday period considered unrepresentative of the rest of the year. A longer period, including holiday and vacation intervals, would have made it possible to identify staffing fluctuations and safety incidents that may occur during these times. In addition, our data collection was focused on the reported incidents. When a fall does occur, various staff members are involved, which can ensure that it will always be declared. However, medication errors can go unnoticed and may go unreported. During our study period, a relatively average number of safety incidents was reported. In addition, due to the nature of our data, it was not possible to include the missed care and the teamwork in the multivariate analyses.

6 | CONCLUSION

This study is the first to describe the organization of nursing services in rehabilitation settings and to explore its association with patient safety in the province of Quebec.

A great strength of this study lies in the conceptual framework used. This framework provides a general vision and encompasses the different aspects of the organization of nursing care leading to safe care (Dubois et al., 2012). This original study indicates that the rehabilitation units examined are characterized by a moderate staffing intensity, a moderate favourable perception of teamwork score and a relatively low score of missed care. The organization of nursing services corresponds to the functional care model that relies on a variety of staff (nurses, LPN, HCA) to deliver a variety of tasks.

A central finding in the present study is that the staffing intensity, the proportion of nurses with bachelor's degrees, and unexpectedly, the proportion of agency staff was positively associated with a reduction of safety incidents. Therefore, in shortage situation, the contribution of the agency staff in certain care sectors remains an option to be considered. Exploring the global aspect of the organization of nursing services and understanding the impact of staffing, nursing teamwork and missed care on patient outcomes is the first step towards improving safety in rehabilitation settings. Our results indicated the key role of the staffing (the quantity of resources measured by the staff HPPS, and the team composition measured by the predominance of bachelor nurses per shift) in reducing the risk of occurrence of safety incidents in rehabilitation. Therefore, it contributes significantly to the progress of nursing practice. Future research specific to rehabilitation settings are greatly needed to draw comparisons and to improve patient outcomes in this context.

AUTHOR CONTRIBUTIONS

Carla Jomaa: study conception and design, data collection, analysis and interpretation, drafting and final approval of the manuscript. Carl-Ardy Dubois: conception and analysis of the analytical plan and final approval of the manuscript. Isabelle Caron: conception and design, conception and analysis of the analytical plan and final approval of the manuscript. Alexandre Prud'Homme: statistical expertise.

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