



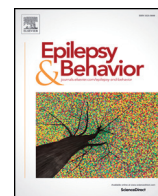
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A description of Canadian epilepsy monitoring units: An initial step toward developing nursing practice consensus guidelines

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ABSTRACT

Objective: The epilepsy monitoring unit (EMU) is a well-established resource for investigating patients' seizures but is known to be heterogeneous in organization and clinical practice. The purpose of this study was to gain a better understanding of similarities and differences in EMU characteristics across Canada, with specific emphasis on EMU organization and nursing resources, which were currently unknown. Results would be used to develop a consensus on best nursing practice guidelines in EMUs with the goal to improve patient care and safety during epilepsy monitoring admissions.

Methods: An 18-item survey was developed addressing EMU locations, types, nursing ratios, nursing roles, and other allied health resources. Surveys were distributed to lead nurses, physicians, and administrators in 29 EMUs across Canada. Results were tabulated and presented for each question in the survey.

Conclusion: All EMUs were located in urban, teaching centers and divided similarly by patient age. The survey demonstrated considerable variability in EMU bed location and organization with the majority of EMUs being smaller, open units embedded in wards rather than larger, closed units. Independent of patient acuity, variability also existed in nurse-to-patient ratios, nursing skill level, specialty nursing support, and EEG technician availability. These findings highlight that EMU heterogeneity contributes to the challenges in the development of standardized safe care practices and that nursing education and nursing best practice recommendations need to be developed with baseline EMU nursing competencies, skills, and knowledge in mind.

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1. Introduction

The epilepsy monitoring unit (EMU) is where long-term video electroencephalography (VEEG) monitoring occurs, making it an essential resource in the comprehensive diagnosis and management of seizures [1,2]. The EMUs are recognized as mainstays in specialized epilepsy centers [3], and long-term VEEG monitoring is generally considered a safe procedure [4–8]. However, a paucity of research exists regarding the management of patient care during EMU monitoring, illuminating a significant lack in patient safety guidelines and standardized care practices [2,4,7–9]. Heterogeneity in EMU composition, access to technology, and human health resources further complicate the process of developing standardized care. Additionally, variations in health care systems make EMU comparisons difficult, sometimes even within the same country. This diversity negatively impacts the development of care standardization, which may ultimately constrain patient care and safety [10,11].

Recently, research has emerged with expert consensus recommendations about standardizing EMU practice in order to improve patient

outcomes, with a particular emphasis on patient safety [2,4,7,9,12,13]. Although injury is reported to be rare in EMUs, little evidence exists on death and adverse event rates; thus, the true impact on patient safety is not well understood [5,6,12]. Variations in EMU settings, individualized management practices (administration of rescue medication, drug withdrawal, patient supervision), differences in health care providers, and lack of protocols and policies [1,2,8,9] further illuminate the need for standardized clinical practice protocols as possible solutions for enhancing patient safety, a critical element in ensuring excellence in patient care.

The Canadian Epilepsy Nursing Group (CENG) is a group of expert epilepsy nurses and nurse practitioners across Canada. Created in 2011, the purpose of CENG is to share expert knowledge and resources about the collective clinical care of patients in EMUs to strive for optimal safe patient-centered care. This was in direct response to the paucity of literature on standardized practices in EMUs and existing research that identified variations and gaps in unit organization and care, reinforcing that information for nursing care for epilepsy patients is “sparse and... on EMUs is even more so...with no consensus on quality care” [1]. Current literature suggests general nursing recommendations for seizure assessment and monitoring [14] and provides some guidelines for services, personnel, and facilities in US tertiary and quaternary epilepsy centers [3], but additional data are needed to continue to

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improve care for EMU patients. As others have noted, when systematic review known to influence standardization is absent, a broader expert consensus may be key in the development of best practices to promote patient safety [2,4,13]. As such, CENG members identified the need for a national project to develop EMU nursing practice consensus recommendations. Members believed that each hospital where long-term VEEG monitoring was occurring could be identified in Canada and that a national perspective of EMU characteristics would best inform this endeavor.

Canada has a publically funded, socialized health care system and large national nursing presence allowing for comparisons of EMU organization and nursing roles across the country. The current study reports on a national descriptive survey of current EMUs in Canada in order to identify general characteristics such as unit location, types of monitoring, nursing support, nursing-to-patient ratios, EEG technician and other allied health support, and imaging resources. The survey was undertaken as part of an initial evaluation in preparation for a larger project (in progress) being conducted by several members of the CENG to develop best practice consensus nursing guidelines to promote excellence in care and protect patient safety.

2. Methods

The CENG network identified 31 possible EMUs, which were defined as units that had hospital inpatient beds dedicated to the prolonged VEEG monitoring of patients. Epilepsy monitoring services were not occurring at two centers, resulting in a final sample of 29 EMUs. Between July 2014 and January 2015, e-mails were sent to all centers inviting participation in the study, outlining project intent, and containing an 18-item focused questionnaire (Appendix 1). Although ethics approval was not required as it was a program evaluation study, Canadian federal research policy [15] was complied with and relevant quality improvement reporting guidelines [16] adhered to. Participation was voluntary, and all participants provided consent for their data to be used for program evaluation purposes.

3. Results

Twenty-eight questionnaires were returned for a 97% response rate. Twenty-seven questionnaires were completed by expert epilepsy nurses, and one was completed by a hospital director. Responses were not anonymous.

3.1. General characteristics of EMUs

The participating EMUs were located within eight of the ten provinces [Fig. 1]. Ontario, Quebec, and Alberta accounted for the majority (68%) of epilepsy monitoring services in the country. This was reflective

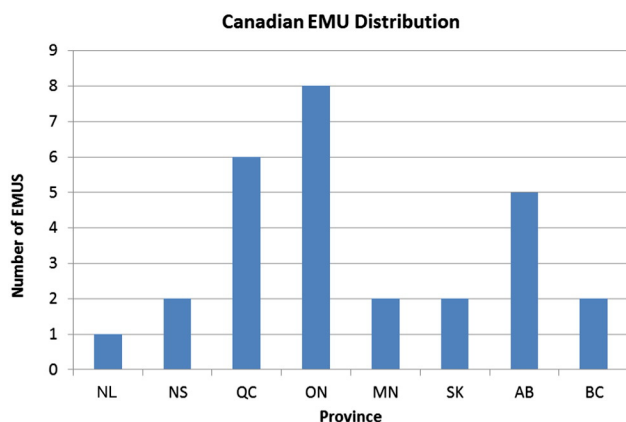


Fig. 1. Canadian EMU geographic distribution. BC: British Columbia, AB: Alberta, SK: Saskatchewan, MN: Manitoba, ON: Ontario, QC: Quebec, NS: Nova Scotia, NL: Newfoundland.

of the population distribution in Canada, in which Ontario and Quebec account for 62% of the national population [17]. No EMUs existed in New Brunswick, Prince Edward Island, or the three Northern Territories. General EMU characteristics are summarized in Table 1.

3.2. Bed allocation

The EMU bed capacity ranged from one to eleven beds (mean = 2). Twenty-one EMUs (75%) reported operating 1–2 beds, three (11%) reported 3–4 beds, and four (14%) reported 5–11 beds. Overall, telemetry bed location was variable. Four centers (14%), all with four or more beds, had closed (stand-alone) EMUs. One larger epilepsy monitoring service (>5 beds) was embedded in a general neuroscience ward. The majority of EMUs (24 centers or 86%), ranging in bed size from 1–7 beds, were open units, embedded in general neuroscience, neuro-observation, medicine, surgery, general pediatric wards, or pediatric intensive care units (Fig. 2). One 3-bed surgical EMU reported that, during the daytime, patients would move to beds located in the outpatient epilepsy clinic and then return to the inpatient neurology unit for overnight supervision. Three medical EMUs (≤ 3 beds) reported being embedded in either step down or intensive care units. Results suggest that unit size and location were at times independent of each other.

3.3. Nurse-to-patient ratios

Nurse-to-patient ratios are shown in Table 2. The majority of EMUs ($n = 19$, 68%) reported nurse-to-patient ratios of 1-to-4 or less. Only eight EMUs (42%) reported that they reduce their nurse-to-patient ratios during invasive monitoring. Overall, nurse-to-patient ratios did not vary between daytime/nighttime shifts or days of the week with only one center (surgical) reporting that they changed from a daytime nurse-to-patient ratio of 1:3 to 1:4 at night. Two additional adult centers did not report reducing nurse-to-patient ratios at night but did indicate using a dedicated “watcher” or “sitter”, defined as either a nursing assistant or an unlicensed health care provider “trained to recognize” seizures. Centers did not show differences in nurse-to-patient ratios when comparing pediatric and adult monitoring services.

3.4. Nursing resources

Results of nursing skill mix for the provision of direct patient care and nurse specialist resources are shown in Table 3. Several centers employed expert epilepsy nurses with various specialty titles. Given this heterogeneity, three distinctions were made in the analysis based on educational requirements for nursing scope of practice in Canada: a) registered nurse (baccalaureate prepared), b) clinical nurse specialist (master's prepared), and c) nurse practitioner (master's or doctorate prepared with additional licensing to diagnose and prescribe). Only 39% (11/28) of total EMU services reported having advanced practice nursing roles (CNS/NP), with 27% (3/11) being dedicated to nonsurgical EMUs. One of the largest EMUs reported no extended nursing roles, whereas other smaller EMUs had both dedicated and shared extended nursing roles suggesting that bed census and nursing resources were at times independent of each other.

3.5. EEG technologist, interprofessional support, and imaging resources

Interprofessional support, imaging resources, and EEG technologist availability are summarized in Table 4. For interprofessional support, all 28 centers reported having neuropsychology, pharmacy, and psychiatry services with the majority being shared services. In addition, all EMUs reported having MRI availability.

After hours and weekend EEG technologist support was difficult to summarize given much variability and often determined on a case by case basis. Text examples noted that a technologist would be called in for emergencies with physician approval or scheduled in advance if an

Table 1
General EMU characteristics.

	Total N (%) of responders		
Hospital type	28 (100)	28 (100)	
	Urban location	Teaching centers	
Primary population	Adult	Pediatric	
	15 (54)	13 (46)	
Type of EMU	Stand-alone (closed)	Embedded into broader floor	
	4 (14)	24 (86)	
Epilepsy surgery done on site	Yes	Adult surgical EMU	Pediatric surgical EMU
	21 (75)	12 (43)	9 (32)
		Complex Invasive recording – 11	Complex Invasive recording – 8
		Straightforward resection/VNS – 1	Straightforward resection/VNS – 1
Epilepsy surgery done on site	No		
	7 (25)		
	Adult – 3 EMU		
	Pediatric – 4 EMU		

The numbers in the columns indicate the number and the percentage (within parentheses) of centers that responded. Complex invasive monitoring/surgery as per National Association of Epilepsy Centers (NAEC) level 4 designation straightforward resective epilepsy surgery/vagal nerve stimulation but not currently invasive monitoring as per NAEC level 3 designation [3].

ictal SPECT was needed or a surgical patient’s admission was known to extend through the weekend. Of the 9 pediatric surgical EMUs, 8 reported after-hours on-call EEG technologist support. Five of these had 24/7 on-call support, three reported weekend daytime only on-call support, and one center had no on-call support. Of the 12 adult surgical EMUs, 7 reported having 24/7 EEG technician support, 2 used a prebooking system when a surgical patient was admitted, 2 reported no after-hours coverage available, and 1 reported weekend daytime on-call support only. Of note, the two centers (1 adult and 1 pediatric) that performed straightforward resections but no invasive monitoring reported 24/7 on-call EEG coverage. These results further highlight the variability around EEG technologist resource allocation in EMUs and independent, at times, of patient acuity.

4. Discussion

The need to have a consensus in clinical practice and EMU standardized protocols and practice guidelines to improve patient care/safety has been well identified but remains a significant challenge to implement [1,2,5,7,9,10]. As such, epilepsy care often remains fragmented without a national strategy and no clear evidence of formal best practices to inform clinical care. Much discussion to date has focused on heterogeneity in patient characteristics, clinical practice approaches, and variability in measuring adverse events [5,18,19] as challenges affecting the development of standardized processes and protocols which may impact on patient safety. Additionally, emerging data suggest that

considerable variability in EMU organization impacts the development of formal processes and guidelines in building a culture of safety [7,8,19]. This national survey mirrors these findings and adds to the body of literature by highlighting that heterogeneity in EMUs, particularly EMU bed location, nursing skill mix, and human resource allocation, exists, reinforcing that guidelines are required. The high response rate in this study suggests a fairly comprehensive multicenter national overview of Canadian EMU characteristics. The CENG plans to use these results to inform the development of national nursing practice consensus recommendations with the goal to improve patient care and safety in EMUs.

Despite some common EMU characteristics, this study showed considerable variability in EMU bed size, bed location, nurse-to-patient ratios, nursing skill mix, and nursing specialty resources. Most EMUs were small epilepsy services consisting of 1–2 telemetry beds integrated within clinical wards rather than stand-alone, larger EMUs. These data reflect findings in other studies. For instance, a European study found that close to 50% of centers had 1–2 bed units and 77% of centers had 4 or less beds [8]. In addition, Kandler et al. noted in their UK evaluation that 67% of EMUs were located on general floors with nurses caring for a variety of patients [19]. Minimal literature exists on nurse-to-patient ratios in EMUs so optimal staffing ratios remain unknown during epilepsy monitoring. One recent study reported ratios of one nurse for 6–7 patients in their integrated EMU [12]. This study found that nurse-to-patient ratio for Canadian EMUs was quite diverse (1:1–1:8) with the nurse having usually one or two EMU patients with the remainder being non-EMU patients and some centers did not reduce the nurse-to-patient ratio with invasive monitoring cases. Yet, nurse-to-patient ratios and caring for diverse patient populations have been identified

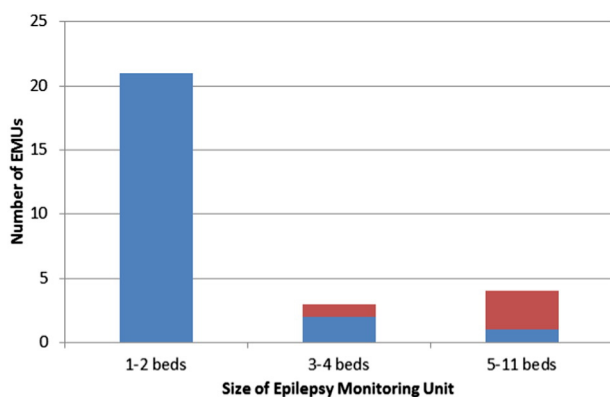


Fig. 2. Total EMU bed allocation. Bed Allocation in EMUs. Type of EMU independent at times of bed size. Blue = embedded EMU, red = stand-alone EMU. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 2
Nurse-to-patient ratios (N = 28).

Nurse-to-patient ratio	Invasive monitoring (n = 19, 68%)	Noninvasive monitoring (n = 9, 32%)
1:1	6 (32%)	0
1:2	2 (10%)	3 (33%)
1:3	4 (21%)	2 (22%)
1:4	4 (21%)	3 (33%)
1:5	1 (5%)	1 (11%)
1:6	1 (5%)	0
1:7	0	0
1:8	1 (5%)	0

The numbers in the columns indicate the number and the percentage (within parentheses) of centers that responded. Note: Nurse-to-patient ratios indicate the number of patients each nurse would care for 24 h/7 day/week.

Table 3
Nursing resources.

	Total N (%) of responders			
Type of nursing care for EMU patients	RNs only 15 (54)	RN/RPN skill mix 13 (46)		
Extended nursing role support	4 medical EMUs use RN only	10 surgical EMUs use nursing skill mix		
	Nurse practitioner	Clinical nurse specialist	RN expert	No nursing support
	8 (29)	3 (11)	16 (57)	1 (3)
	Dedicated 5 (18)	Dedicated 2 (7)	Dedicated 7 (25)	
	Shared 3 (11)	Shared 1	Shared 9 (32)	

The numbers in the columns indicate the number and the percentage (within parentheses) of centers that responded. Different terms for registered practical nurses exist throughout Canada. As the RPN term is the most widely accepted, it is used in this paper. In Winnipeg, the designation Licensed Practical Nurse (LPN) is used instead of RPN, as the latter is a title-protected term for the registered psychiatric nurse designation. Quebec uses registered nursing assistant (RNA) as the RPN/LPN equivalent.

to impact nurse–patient supervision [20]. Other studies have demonstrated that improved patient supervision by nurses [18] and timely attendance to seizures [19] are of key importance in improving patient care in the EMU. This study adds support to the current literature in terms of identifying variability in unit characteristics and nurse-to-patient supervision across EMUs. The impact of this variability highlights that nurses, who have to care for several patients at the same time including specialized EMU patients, may be challenged to provide the level of dedicated supervision needed for EMU patients, which may impact on patient safety. In fact, others have noted that nurses dedicated to telemetry beds, whether in a dedicated unit or on a general ward, were significantly more likely to attend seizures and more rapidly [19] suggesting improved patient safety. Without specific nursing best practice recommendations for the level of nursing supervision EMU patients may require, the quality and safety of patient care in EMUs may be affected. Our study findings suggest that EMU nursing best practice consensus guidelines need to be developed ensuring that basic EMU nursing knowledge, skills, and competencies are accounted for and recommendations made for optimal nurse-to-patient ratios based on patient acuity. However, further research is needed to investigate the impact of unit characteristics and nurse-to-patient ratios on patient supervision and safety.

This study highlighted the variability in nursing skill mix in EMUs across the country. Just slightly more than half of EMUs reported employing RNs, which suggests that EMUs are staffed almost equally by both RNs and RPNs. When evaluating centers by surgical or medical designation, less than half the surgical centers used RNs only, whereas some medical EMUs employed RNs only. Results showed that nursing skill was variable across similar EMUs, even in those where complex epilepsy monitoring occurred. This finding suggests that skill mix was also independent of EMU patient acuity and that, when developing nursing practice consensus guidelines, one must be cognizant of the variability in knowledge and scope of practice of nursing delivery staff, thereby reinforcing that baseline epilepsy nursing competencies are addressed.

Supportive tools such as clinical checklists, nursing care process algorithms, and standardized protocols [21] may need to be incorporated into guidelines to enhance patient safety. Additionally, this study highlighted the lack of nurse specialist support, such as a NP or CNS, which may be important for patient care and safety. These roles have been recognized to provide (a) advanced clinical expertise to both patients and team members, (b) continuity across the patient continuum of care, (c) patient and staff education, and (d) program development and leadership resulting in improved patient care [11,22–25]. Although the NAEC document [3] recommends nurse specialists as essential personnel for tertiary/quaternary epilepsy care centers, the current study found that this nursing resource is usually not available, with only 25% of EMUs having a dedicated NP or CNS. As such, the majority of EMUs in this study had either no access (61%) to the nurse specialist role or shared the NP or CNS (14%) with other neuroscience subspecialties. This may be reflective of the current climate of significant fiscal restraint in health care where allocation of the specialist nurse for smaller dedicated programs, such as EMUs, may be difficult. However, given the nurse specialist role has demonstrated a reduction in the EMU length of stay [22] and has core competencies aligned with aspects linked to developing a culture of safety in EMUs, such as a) dedicated staff education, b) care delivery evaluation (e.g. review of adverse events), and c) clinical practice guideline development for improved patient care [7,18], it might be speculated that the inclusion of a nurse specialist in all EMUs is essential, as previously recommended.

Similar to previous research [8,9,19,26], this study found national variability in EEG technologist coverage. Slightly more than half of EMUs had 24/7 EEG technologist support, despite three-quarters being identified as surgical centers. Additionally, some nonsurgical centers had full EEG technologist coverage. These findings add to the body of literature that EEG technologist support is at times independent of patient acuity and may be deemed as a supportive service rather than an essential, specialty program resource. Additionally, text responses suggested that nurses are required periodically to trouble shoot equipment issues

Table 4
EEG technologist, interprofessional support, and imaging resources.

	Total N (%) of responders				
EEG technologist availability	Weekday daytime	24 h/7 day/week	Modified on call	No after hours or general on call	
	28 (100)	15 (54)	5 (18)	8 (29)	
Sub-analysis	Pediatric – 9	Peds – 5	Peds – 3	Peds 4	
	Adult – 12	Adult – 7	Adult – 3	Adult 4	
SEM EEG technologist availability	Neuropsychologist	Social worker	Pharmacist	Psychiatrist	
	28 (100)	27 (96) – shared 1 (4) none	28 (100) – Shared	28 (100)	
	12 (43) – dedicated			5 (18) – dedicated	
Interprofessional team resources	17 (57) – shared			23 (82) – shared–consult required	
	Shared or dedicated?			MEG 9 (32)	
Neuroimaging availability	MRI 28 (100)	fMRI 16 (57)	SPECT 19 (68)	PET 22 (79)	

The numbers in the columns indicate the number and the percentage (within parentheses) of centers that responded.

when EEG technologists are not available, placing an additional level of care on them. Previous literature suggested constant supervision be implemented by either an EEG technician or nursing staff member to maximize patient safety [3,19], but with formal guidelines currently lacking, individual institutions are left with little guidance around what may be the necessary resource allocation of EEG services for EMUs. Evaluation of neuroimaging identified that nurses encounter a variety of imaging technologies for which they are required to provide patient education about and at times intervention during. The results from the current study suggest that nursing practice consensus recommendations should also include education about basic EEG and imaging technology and clinical practice algorithms for dealing specifically with video-EEG equipment/technology malfunctions so that patients continue to receive well-supervised, uninterrupted video-EEG monitoring to ensure safe patient care.

5. Conclusion

This study was an initial step in identifying similarities and differences in Canadian EMU composition, nurse–patient supervision, and human health resource allocation. It illuminated that small, open, integrated medical, and surgical EMUs were the norm in Canada where long-term video-EEG monitoring is carried out by differently skilled nurses caring for a cross-section of patients at the same time. Variability existed across centers with nurse–patient supervision, EEG technologist availability, and nursing and allied human health resource allocation remaining periodically independent of patient acuity, which may impact patient safety. Interpretation of these survey results must consider that survey methodology relies on self-report and no anonymity, which allows the potential for inaccuracy or bias. Study findings are not generalizable beyond the Canadian context. Nevertheless, findings from this study speak to the importance of developing a national strategy for the creation of standardized EMU nursing practice recommendations to provide coordinated care and improve patient safety. As others have recognized [13], an expert panel may be an effective strategy to inform practice. As such, there is currently a project underway by the CENG to develop nursing practice consensus guidelines focusing on patient care, safety, and education in Canadian EMUs informed by findings from this survey. The goal of this initiative is to improve the care of patients in Canadian EMUs by developing nursing guidelines that are systematically applicable, readily accessible, and easily implementable.

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Disclosure

The author has no conflict of interest to disclose.

Appendix 1. Survey of epilepsy monitoring units in Canada

Province
 City
 Hospital Name
 Hospital Type (teaching, community?)
 Population (Adult, Pediatric, mixed?)
 Type of epilepsy monitoring. Example: Part of a regular unit or as a stand alone unit.
 Number of beds?
 Is Epilepsy Surgery done on site?
 Do both RNs and RPNs care for EMU patients?
 Nurse to Patient ratio during Medical monitoring?
 Nurse to Patient ratio during Invasive/Surgical Monitoring?
 What Extended Dedicated Nursing Roles are in the EMU? E.g. Nurse educator, Nurse Clinician
 Nurse Specialist, Nurse Practitioner, others?
 Which ones are dedicated?
 Which ones are shared?
 EEG Technologist availability? (e.g., 24/7, daytime only, on call at night or weekends?)
 Neuroimaging availability? Please list all: E.g.
 MRI, fMRI, SPECT, PET, MEG
 Others?
 Neuropsychology? Dedicated or Shared?
 Social Work? Dedicated or Shared?
 Pharmacist? Dedicated or Shared?
 Psychiatry? Dedicated or Consult?
 Additional information?

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