

Neurocritical Care Nursing Research Priorities

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Abstract The science of nursing has long been discussed as a blending of the art and science of caring, and nursing research builds the evidence of support for nursing practice. Nurses and nursing care are key to successful neurocritical care research endeavors. Ideally nursing care should be evidence based and supported by solid research. The goal of nursing research is to expand the knowledge of caring for patients. Within the scope of nursing research, the priorities for research in neurocritical care should support this goal. In this manuscript, we discuss what we believe are the priorities of neurocritical care nursing research, the obstacles, and some possible solutions.

Keywords Neurocritical care · Nursing · Research ·
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What is Nursing Research?

A major thrust of the neurocritical care society research committee is to foster collaboration in patient-oriented research and clinical trials related to critical illness in neurological and neurosurgical conditions. Embedded within this construct is the ideal that nurses and nursing care are central to any successful collaboration. The science of nursing has long been discussed as a blending of the art and science of caring, and nursing research builds the evidence of support for nursing practice [1–3]. A primary component of nursing research is the fundamental assumption that nursing practice must be evidence-based, theory based, and help build the link between theory and practice. Biobehavioral research in the neurocritical care setting is one such example of providing this vital link. Nursing research that promotes evidenced-based nursing practice through the use of qualitative and quantitative scientific inquiry will provide a vital contribution to a more comprehensive understanding of how critically ill neuroscience patients progress through the continuum of care.

Historically, nursing embraced and benefited from the contributions of disciplines outside the domain of nursing. Nursing research is similarly enhanced by embracing a multidisciplinary approach to scientific investigation. This multidisciplinary approach to research provides nursing the opportunity to improve care through the use of a larger repository of knowledge. The potential limitation to this approach would be the risk of losing the focus of nursing, essentially, becoming a part of everything and unique to nothing. By retaining a focus on the patient as an individual, nurse scientists have clearly defined their domain. Thus, nursing research is neither a better nor worse form of scientific inquiry, rather an added source of information.

The Goal of Nursing Research

The goal of nursing research is to expand the knowledge base of nursing, the knowledge of caring for patients [4]. The body of knowledge that forms the base of nursing science is unique in its scope and interpretation. Nursing research explores the individual along the continuum of health and differs from medical research in which the primary aim often is directed toward discovering the etiological factors and treatments of disease. In this manner, nursing research compliments other scientific research. Whereas the goal in medical research is to build scientific knowledge for the purpose of improving health by finding better ways of treating disease, the goals in nursing research differ in how this knowledge is to be used. Each patient is said to have an individual need and desire for his or her own health status. This knowledge base will be used to develop interventions that promote the transition of each patient to his or her own (or in the case of the comatose patient his or her families expression of personal wishes) desired state of being. Theory-guided nursing research facilitates not only a more targeted approach to inquiry, but a more coherent expansion of the knowledge base particular to nursing.

To uncover the knowledge necessary to provide this care, nursing research may take many forms. Identifying patients and populations at risk for illness and the variables associated with those patients is within the scope of nursing research. This leads to research that comprehensively describes each factor affecting any given situation or population. Explanation and exploration of a problem allows the nurse researcher to look for the hidden issues that add to the body of knowledge and allow nurses to understand the complexities of a problem. Issues of prediction and causality also are within the domain of nursing research. This research is typically non-experimental as many of the variables of interest may not be easy to manipulate by the researcher [5].

Non-experimental research builds the foundation for interventional research and in many instances careful observation is associated with advances in care and understanding of various disease states. Nursing research, to maximize the potential for effective interventional studies, should be based on established theoretical frameworks. Theory carries the advantage of linking together a group of facts [6]. Theories, and components of theories, can be tested. Over time, the accumulation of knowledge will reinforce or reduce these theories.

Biobehavioral research is a vital component to building the neurocritical care nursing knowledge base. However, groups of facts alone may be inadequate to explain any phenomenon; theory provides the means by which individual facts become a coherent whole. Cyclic by nature, the

results of research provide the framework to refine the theories [6].

Qualitative and Quantitative Inquiry

Qualitative and quantitative research both have distinct advantages. Qualitative research in nursing allows nurses to study nurse–patient interaction in a naturalistic setting [7]. The researcher is unburdened by the deductive constraints and requirements to control for variables that is so common to scientific inquiry. However, the results of qualitative research are not generalizable as happens with the results of quantitative research. Quantitative research looks for cause and effect, and seeks reproducible results [8]. Quantitative research relies on deduction to study phenomenon in a reductionist manner. As qualitative research seeks to develop causal relationships and to understand the meaning of phenomenon for the individual, it provides a platform for theory development and construction [9]. Quantitative research in nursing provides the means to develop, test and refine theories as they apply to different patient populations [10].

Areas of Inquiry

Within the scope of nursing research, the priorities for research in neurocritical care should compliment the priorities of research for the neurocritical care community at large. To help facilitate a complimentary research program, some of the priorities of nursing research will be discussed below within the context of the medical practice.

ICP Management

Care of the neurologically injured patient often is focused on the prevention of secondary brain injury. A mainstay in this effort is the monitoring and treatment of intracranial pressure (ICP) [11]. The decision to place an ICP monitor is at the discretion of the physician. Yet once the monitor is placed, the role of continuous monitoring most often defaults to the bedside nurse [12]. Further, while treatment goals and medications to address elevated ICP are prescribed by the physician/designee, the nurse is central in determining the timing of the prescribed interventions based on information obtained from bedside monitoring. The 2008[11] consensus conference guidelines describe ICP as “a complex parameter which contains information about cerebral compensatory mechanisms and mechanisms contributing to cerebral blood flow (CBF) regulation.” A variety of medical and neurocritical care research studies cite ICP values as variables that are associated with patient outcomes [13–15]. Nursing texts and research describe the

documentation and monitoring of ICP to fall within the scope and domain of the critical care nurse [16, 17]. However, how nurses obtain, monitor and record ICP values is poorly defined in current studies. Are values recorded every 15 min adequate? Should these values be the mean across the time span, at the end of the time span or the highest/lowest value? Are trends over time and interactions between ICP and other physiological values more important than the number and in particular a specific threshold? What about waveform analysis and how this informs the bedside nurse about a patient's compensatory reserve? How can ICP monitoring be effectively integrated with information provided by other monitors such as brain oxygen, electroencephalography (EEG), near infrared spectroscopy (NIRS) or microdialysis? ICP is a dynamic value that has significant range in even a short period of time; at present there is no adequate evidence to direct nursing management of ICP.

Thermoregulation

Patients in the neurocritical care unit often have a high body temperature and a variety of studies have shown that fever is associated with neuronal damage in patients with neurological insults [18]. Several lines of evidence support a role for induced hypothermia to reduce neurologic injury associated with cardiac arrest [19–21]. However the role of thermoregulation after ischemic or hemorrhagic stroke or traumatic brain injury is far less certain despite experimental evidence that suggests a role for hypothermia for these conditions [22]. National practices for fever and hyperthermia management in the neurologically vulnerable patient reveal a wide range of temperature (37–40°C) at which fever management was initiated [23]. Many unanswered questions remain despite the research on normothermia and hypothermia for acute brain injury. For example, when should hypothermia be induced and for what duration? What is the ideal temperature goal for each type of neurologic injury? How should seizures be prevented or managed? The results from animal research are difficult to translate into clinical practice given the reality of variations in practice between physicians and nurses, family members, care routines, ancillary rounding teams, and the overwhelming differences between human individuals. Such variability results in great difficulty achieving high internal validity in the ICU setting. Consequently, despite an abundance of preclinical evidence to suggest that fever control should provide significant benefit, there is inadequate evidence from clinical trials to answer the question of whether temperature control will improve outcomes [24]. The development, design and testing of strategies to regulate temperature in the critical care setting for acute brain injury remains a significant nursing need

[25–27]. Nursing research will play a vital role to translate the success of preclinical work into the neurocritical care setting.

Neurological Examination

The neurological exam is another area in which nursing has an integral role in caring for the critically ill neuroscience patient. Many members of the healthcare team perform the basic components of the neurological exam. However, the nursing staffs routinely perform sequential neurological exams to identify baseline neurological status and potentially detect any deterioration in a patient's condition. As such, this area remains a priority for nursing research in neurocritical care. A key portion of any neurological exam is to assess level of consciousness (LOC) or degree of coma. Level of consciousness is frequently reported using the Glasgow Coma Scale [28]. However, research indicates that the reliability and validity of this scale is less than ideal to assess LOC, identify subtle changes in a patient's condition, and predict patient outcome [29–34]. More recently, alternative scales such as the Full Outline of Unresponsiveness (FOUR) score were created and used with generally favorable results among all levels of healthcare providers [35–37]. Collaboration with nurse researchers to further determine the feasibility and predictive value of this tool and other assessment scales including those associated with sedation and arousal among specific patient populations can help implement this tool as part of standard nursing and interdisciplinary practice.

Nursing Variables in Outcome Measures for TBI/Stroke

The intensive care unit (ICU) care of the patient with traumatic brain injury (TBI), or severe ischemic or hemorrhagic stroke is complex and requires multiple physiological and psychological parameters be monitored and managed [38, 39]. Physiological parameters such as ICP, blood pressure, cerebral perfusion pressures, brain tissue oxygenation, heart rate, arterial oxygenation and temperature all may influence mortality and morbidity of TBI and stroke patients [40]. How best to integrate this information from multiple sources and link the information with the patient medical record remains a challenge. Often it is the bedside nurse who first notices fluctuations in values and the formation of trends, matching those trends to the clinical assessment of the patient to intervene accordingly. Further research must focus on quantifying the ideal nursing interventions to prevent or reduce the consequences of secondary injury in all forms of TBI and stroke. In addition, techniques to identify potentially reversible secondary brain insults before they become reversible is a

challenge for neurocritical care research and multimodal monitoring in particular. In TBI and stroke, brain tissue oxygenation is one of several newer monitoring techniques with the potential to give the bedside nurse a reliable parameter to titrate nursing interventions (turning, suctioning, bathing, etc.), and this is fertile ground for nursing research in the next decade [41]. Care of the subarachnoid hemorrhage (SAH) patient also is an area in need of additional nursing research. The nursing care of the SAH patient is often complex and patients often endure a long ICU length of stay. The nurse's role in recognizing and preventing aneurysm rebleeding, in vasospasm surveillance and application of appropriate therapy has yet to be scientifically quantified [42]. In all forms of stroke and TBI, dysphagia and aspiration pneumonia significantly impact outcomes. Dysphagia assessment and management is often the responsibility of the bedside nurse and further research to guide adequate nursing assessment and interventions to minimize aspiration and pneumonia is necessary [43]. Finally, TBI and stroke patients are at increased risk for deep vein thrombosis (DVT), malnutrition, and hyperglycemia. As we move towards evidence based nursing care, studies should focus on quantifying the effect of nursing interventions aimed at DVT prevention, promotion of early and adequate nutrition and appropriate glycemic control [38, 39].

Communicating with the Family in the NCCU

The need for communication is consistently listed as one of the top priorities for the families of critically ill and also for the patients [44]. As in other ICU settings, neurocritical care is unique in how and when the medical and nursing staff communicate. As with many ICU environments, patients arrive at every hour of the day. However, the neurological patient often arrives with impaired communication that may be associated with their neurologic injury or efforts to treat their neurological injury [45]. New care and treatment paradigms support a more open environment in critical care [46–48]. The out-of-date style of medical paternalism has been replaced with an understanding of the rights of the patients to know their medical status and the definition of patient has been expanded to include the patient's support system [49, 50]. Renewed interest to bring the family back to the bedside has staff struggling to define and test strategies that balance the need to protect the rights of patients as individuals with the need to provide the families of those individuals with vital information. The care paradigm in the neuroscience ICU is changing. Nurses are more apt to be involved with families as they are constantly at the patients side managing interactions with families needing information. Research in communication is extensive in other fields such as oncology and pediatrics [51, 52]. Available research

on how nurses can improve communication with families of neurologically injured patients in the era of open visitation is limited [48]. Further, the relationship between outcomes and communication patterns in the neuroICU is almost non-existent. A more robust exploration of how and when nurses and families communicate will serve to improve a collaborative understanding of the role and contributions of nursing in the neuroICU.

TBI and Agitation

Agitation frequently occurs as survivors of traumatic brain injury and other acute brain injuries regain responsiveness. Agitation is a challenge for nursing in the neurointensive care unit. The development of agitation in the brain injured patient is often associated with the diffuse injury to the fronto-temporal area of the brain and changes in the neurotransmitter systems. Several factors are known to be associated with the incidence of agitation: social class, education, GCS score, disability, severity of TBI, and age [53]. The agitated behavior scale is an objective scale-based measurement for agitation following brain injury. It is a useful tool but can be difficult to institute in an acute care setting [53]. Implementation of agitation management can be provided in four domains including environmental, behavioral, medications, and staff/family education. Management of environmental, behavioral, and educational interventions most often fall within the scope of nursing practice and thus a prime area for nursing research aimed at the most effective measures for decreasing agitation. Environmental strategies include reducing stimuli, establishing and maintaining a consistent schedule, and frequent reorientation. Behavioral strategies include tolerating the patient's restlessness as much as possible, allowing mobilization, and considering bed adaptation such a net bed to increase patient safety. Several randomized trials conducted to establish ideal medication management of the agitated brain injured patient only begin to describe adequate care of this patient population. The more common medications to help control agitation include: antiepileptics, dopamine agonists (amantadine), antidepressants, antipsychotics (haldol), and beta blockers (inderal) [54]. However, little research is available to answer significant nursing questions regarding patient management of the agitated neuroscience patient. Are these medications ideal for the brain injured patient? How do the medications influence long term outcome? In general, benzodiazepines are not recommended for long term agitation treatment since they may reduce cognitive function and slow recovery from brain injury. More randomized studies are needed to determine the optimum and targeted individualized pharmacologic intervention for the brain injured patient [53]. A better understanding and more evidence on the treatment of

agitation of the brain injured patient will result in an effective management plan.

Nursing Care of the SCI Patient

Care of the spinal cord injury (SCI) patient is multi-faceted. Members of the healthcare team, particularly the nursing staff, are responsible for ensuring physiologic stability, preventing secondary injury, preserving neurologic function, providing emotional support to patients and families, and preventing complications associated with immobility [55, 56]. A key priority for acutely ill SCI patients is to ensure supportive care to optimize blood pressure and oxygenation to prevent additional injury [57, 58]. While the prescribed interventions to regulate blood pressure and oxygenation are at the discretion of the physician, ICU nurses are responsible for the continuous monitoring of these values and determining the timing and delivery of prescribed interventions. Such interventions include but are not limited to titrating vasoactive medications, administration of as needed medications, titrating oxygen levels and suctioning. In addition, independent nursing interventions such as positioning, limiting environmental stimuli, and providing comfort measures may can impact physiological values. Currently, little research evidence documents the type and frequency of interventions performed, the factors that influence which interventions are chosen, and the effect of these various interventions on patient outcomes. This information is necessary to move towards an evidence based, standardized approach to the acute nursing care of the SCI patient.

In addition to ensuring physiological stability and preventing secondary injury, ICU nurses must also deliver interventions to prevent complications associated with immobility in the SCI patient [55]. Complications include the development of pressure ulcers, ventilator associated pneumonia and atelectasis, decreased range of motion, and impaired bowel and bladder function [55, 59, 60]. Previous research in nursing and other disciplines contribute information about methods to prevent these complications among ICU patients in general [17–20, 61–64]. However, more recent research suggests that acutely injured SCI patients are at higher risk for these complications and traditional preventative efforts may not be sufficient [61, 65, 66]. Further research is necessary to identify the most effective interventions to prevent immobility related complications in this special patient population.

The Nursing Role in Seizure Detection and Management

Seizure detection and management is a primary nursing function in both the neurocritically ill patient admitted with status epilepticus and in any patient that experiences a

seizure as an acute complication of another neurological or neurosurgical diagnosis [67, 68]. However, very little scientific literature exists on the effect of bedside nursing care for the seizure patient. In general, it appears the earlier a seizure is recognized and treatment is initiated, the better the patient outcome [67]. The ability of the bedside nurse to accurately identify seizure activity would be helpful to guide nursing education and competency. Within the neuroICU continuous EEG (cEEG) monitoring is common and becoming standard of care. cEEG monitoring adds another physiological variable the nurse is able to monitor and potentially use to guide intervention [69]. However, this will require research and consensus on the nurses' role in continuous EEG monitoring. Can a bedside nurse interpret computerized and compressed EEG patterns alone or is the support of an EEG technician and/or epileptologist always necessary? The introduction of trend monitoring and alert functions in continuous EEG monitoring may allow the nurse to better interpret bedside EEG monitoring to allow for earlier seizure intervention [70, 71]. Such interpretation may be important as seizures and even non-convulsive seizures contribute significantly to secondary cerebral insult. Finally, epilepsy patients increasingly spend short stays in the ICU following neurosurgical procedures for their refractory epilepsy. The role of the neurocritical care nurse in the post-operative management of these patients also must be better defined [68].

Nursing is an Inclusive Specialty

The belief that the discipline of nursing is best served by a broad and more encompassing form of knowledge acquisition does not promote nursing as the be-all end-all of the healthcare sciences. An information-inclusive model of nursing knowledge is preferred to a model in which knowledge is limited by its point of origin [72, 73]. The various views on epistemology in nursing are further summarized by Walker and Avant [9]. Knowledge development in nursing will occur as a result of the effort of nursing scientists and this knowledge development must provide for connections between practice and science, between empirical and non-empirical sources [74].

This multidisciplinary approach to investigation is not the isolated ideal of a small group of nursing scientists. The mission statement of the National Institute of Nursing Research (NINR) clearly indicates that a broader vision of research is preferred [75]. Caring for a patient is as indispensable an effort as curing the patient [49]. Other disciplines can, and should, continue to rely upon their distinct professional models. Aristotle once said, "The whole is greater than the sum of its parts." [76] This places nursing not as an opposing force to neurobiology,

medicine, or pharmacology, but as a collegial discipline with a distinct approach to solving those problems to which it finds fall within its domain. The discipline of nursing science is thereby enhanced through its distinctive modes of inquiry without detracting from other disciplines [77].

Conclusion

A model of neurocritical care nursing research that embraces both an empirical and a non-empirical approach to grow and develop the knowledge base of nursing carries the greatest potential to advance the practice, art, and science of patient care and well-being. The ability and desire to incorporate non-empirical knowledge obtained from review of biobehavioral research developed through reductionist investigations with interpreted experiential knowledge gained in practice under the singular umbrella of a theory exemplifies the paradigm of nursing research [78]. In this manner, theory does not exclude the quest to understand practice or to seek diverse sources of knowledge. Nursing theory drives this search as an effort to see the *big picture* [1]. A theory-driven model of nursing science has been established and is emerging as a driving force in practice [79]. The advantages to this approach are numerous and are well described [6, 80]. The theory-driven approach facilitates the appropriateness of not only the research questions, but of the research methods. Theory provides guidelines as to what does and does not belong to a given problem, this helps to target the research and eliminate misdirected research efforts.

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