Chemotherapy-Induced Peripheral Neuropathy: Assessment of Oncology Nurses' Knowledge and Practice

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Purpose/Objectives: To explore oncology nurses' practice behaviors and knowledge of chemotherapy-induced peripheral neuropathy (CIPN) in the assessment of patients with cancer.

Design: Cross-sectional, exploratory.

Setting: Two hospital-based outpatient chemotherapy clinics in Baltimore, MD.

Sample: Self-selected convenience sample of 39 oncology nurses.

Methods: Completion of the principal investigator–developed questionnaire consisting of 16 knowledge and 16 practice-behavior items, 8 instruction and perception items, and a 9-item demographic survey.

Main Research Variables: CIPN assessment practice behaviors and knowledge; tool reliability.

Findings: The mean CIPN knowledge score of 12.6 (SD = 1.7) demonstrated knowledge deficits (maximum score of 16). All respondents indicated CIPN assessment is essential in their oncology role, but 75% rated their CIPN assessment skills as fair to poor. Assessment practices did not routinely include neurologic physical assessment. In addition, 82% believed CIPN is a significant problem for patients. Cronbach alpha for the tool was 0.84.

Conclusions: Results indicated participants had knowledge deficits pertaining to CIPN and lacked training, proficiency, and confidence in neurologic physical assessment. Education and training programs are needed to improve knowledge and neurologic assessment skills.

Implications for Nursing: To date, CIPN nursing assessment guidelines do not exist. Practice guidelines for CIPN nursing assessment and management should be efficient and appropriate to the role of the chemotherapy infusion oncology nurse working in a busy setting where chair turnover time, accuracy, safety, and quality service are competing priorities.

Oncology nurses involved in the administration of chemotherapy are in an ideal position to assess chemotherapy-induced peripheral neuropathy (CIPN). CIPN is defined as damage to peripheral, motor, sensory, and autonomic neurons as a result of exposure to toxic chemotherapy agents that inactivate the mechanisms necessary to maintain the metabolic needs of the axon (Postma & Heimans, 2000). Clinical manifestations of CIPN may include burning, tingling, numbness, and electrical shock sensations; impaired muscle tone, coordination, and position sense; altered sense of touch, pain, and temperature; constipation; postural hypotension; and diminished deep tendon reflexes, among others. Neuropathic pain may be a consequence of CIPN but is seldom assessed as a unique component of the chemotherapy experience. Detecting early symptoms of CIPN may prevent patient injury, minimize progression of symptoms and complication rates through earlier interventions, and alleviate patient anxiety related to symptoms and sensations associated with CIPN. Patients may not spontaneously report CIPN symptoms and related pain without being prompted; therefore, oncology clinicians should incorporate assessment of neuropathy and neuropathic pain into routine practice (Smith, Beck, & Cohen, 2008). The impact of CIPN on a patient's activities of daily living and quality of life also should be considered in the evaluation. For ease of discussion, neuropathic pain and CIPN are used interchangeably in this article.

Research specific to nurses' knowledge and assessment of CIPN and neuropathic pain is limited. Neuropathy and neuropathic pain often are included under the more generalized topic of pain. Nurses' practice behaviors and knowledge pertaining to neuropathic pain should be isolated and studied because the etiology of neuropathic (nerve) pain differs from that of nociceptive (tissue) pain; therefore, nursing assessment and management of CIPN also require a different approach.

Physicians, pharmacists, and other healthcare team members rely on nurses' ability to accurately assess pain to improve pain management (Xue, Schulman-Green, Czaplinski, Harris, & McCorkle, 2007). Identifying whether knowledge and practice deficits exist in this assessment process can assist in the development of educational interventions to address those learning needs and help establish practice guidelines that ultimately impact clinical oncology nursing practice. Improving nurses' knowledge and assessment skills related to neuropathic pain can significantly contribute to the well-being of their patients (Herr, 2004).

Nurses' ability to assess for CIPN and educate patients has been hindered because the nervous system and neurologic assessment have not been the focus of education and training for most oncology nurses (Armstrong, Almadrones, & Gilbert, 2005). Evaluating manifestations of CIPN is pertinent to patients and clinicians because neurotoxicity may result in functional and safety issues, reduction of effective chemotherapy dosing, delays in treatment delivery, or discontinuation of the offending chemotherapy agent, thereby reducing the potential for cure.

Several reviews, expert opinions, and recommendations by professional organizations (Backonja & Galer, 1998; Herr, 2004; Johnson, 2004; Oncology Nursing Society, n.d.; Portenoy, 1997; Visovsky, Meyer, Roller, & Poppas, 2008; White, 2004; Wickham, 2007; Williams, 2006; Wilson, 2002) specify monitoring parameters for clinical assessment of CIPN. However, in clinical practice, many oncology nurses appear to have limited knowledge, training, skill proficiency, and time required to effectively elicit a thorough history and perform neurologic assessment (Armstrong et al., 2005; Patiraki et al., 2006; Puls-McColl, Holden, & Buschmann, 2001; Wickham, 2007; Xue et al., 2007). As a result, the purpose of this study was to explore oncology nurses' practice behaviors and knowledge of CIPN in the assessment of patients with cancer.

Literature Review

Several studies explored nurses' knowledge and assessment of nociceptive pain; however, a dearth of literature has evaluated nurses' knowledge and assessment skills specific to neuropathy and neuropathic pain. Previous research (Bernardi, Catania, Lambert, Tridello, & Luzzani, 2007; Mackrodt & White, 2001; Tafas, Patiraki, McDonald, & Lemonidou, 2002; Tanabe & Buschmann, 2000) has demonstrated significant knowledge deficits within the domain of pain assessment and pain management. CIPN and neuropathic pain often are subsumed in general pain assessment studies. By evaluating oncology nurses' knowledge and practice behaviors specific to the assessment of CIPN, a parallel knowledge-practice deficit may be revealed and would provide groundwork for the development of feasible CIPN assessment practice guidelines.

In a study exploring professional nurses' knowledge of pain assessment and interventions, Puls-McColl et al. (2001) identified education, assessment, and intervention as three potential problem areas for nurses providing pain management to patients. The results indicated deficits in five of six domains of knowledge (barriers to treatment; use of terminology; medication, actions, and side effects; treatment interventions; and RNs' pain management role). The domain of pain assessment had a surprising 100% correct response rate. This finding suggested that although nurses have assessment knowledge, they may not apply it clinically in intervention efforts toward pain relief. Perceived barriers to adequate treatment of pain also were identified and may contribute to this lack of clinical application. The most significant barrier indicated was nurses' responsibility for caring for other acutely ill patients, followed by inadequate assessment, nurses' time constraints to adequately assess and control pain, and patients' unwillingness to report pain.

Xue et al. (2007) compared pain attitudes and knowledge among nurses, physicians, and pharmacists. Eighty-eight percent of medical oncology nurses completing the survey indicated that they most frequently used the 0–10 pain scale for pain assessment. Xue et al. (2007) also found that 60% of medical oncology nurses in their sample rated their education and training in cancer pain as fair, 20% as poor, 16% as good, and only 4% as excellent. Oncology nurses scored an average of 60% correct responses on overall knowledge of pain management questions. Two areas identified as needing improvement were pharmacologic knowledge of pain control and knowledge of options for alternative therapies used to palliate pain.

Patiraki et al. (2006) explored the effectiveness of an educational intervention on nurses' attitudes and knowledge pertaining to cancer pain management. Preintervention scores demonstrated limitations with regard to cancer pain assessment and management. The percentage of incorrect answers was 56% for the majority of assessment items (22 of 39 items). Participants in the educational intervention groups demonstrated significant improvement in post-test knowledge scores compared to the mock-intervention groups ($p = 0.0001$).

Theoretical Framework

Complexity Integration Nursing Theory[a] (Van Sell & Kalofissudis, 2001) was applied to explain the relationship between nursing knowledge and clinical nursing practice (Meintz, Yfantis, & Graebel, 1994; Sapountzi-Krepia, 2001). The theory purports that nursing knowledge has four main components.

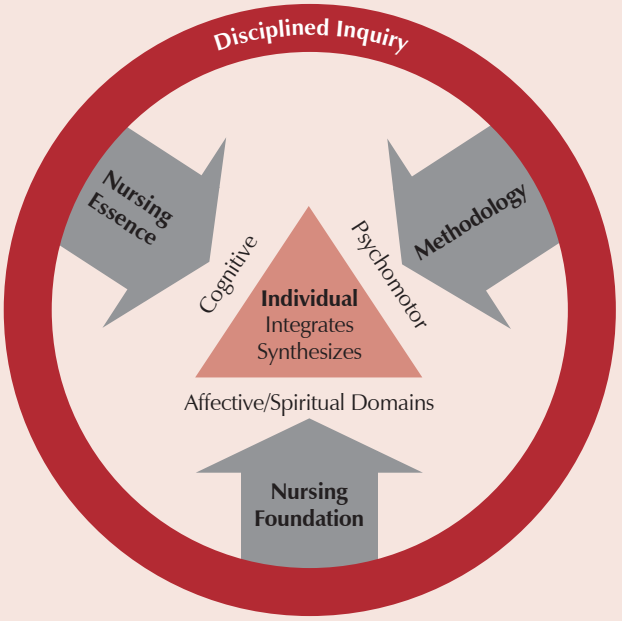
- Nursing foundation: knowledge from sciences and the humanities
- Methodology: provides the process for critical problem-solving used in the clinical setting
- Nursing essence: various aspects of nursing practice such as legal guidelines, standards of practice, nursing conceptual models and frameworks, and technical skills
- Disciplined inquiry: refers to research, investigation, or experimentation that contributes to nursing's body of knowledge and evidence-based practice

The individual nurse must integrate and synthesize nursing knowledge through cognitive, psychomotor, and affective/spiritual domains of self, which impacts the

[a] Copies of Van Sell and Kalofissudis's (2001, 2002) work on this theory are available on request to Sharon Van Sell, BSN, MEd, MS, EdD, at svansell@twu.edu.

depth and breadth of nursing practice. This relationship is expressed as the following equation: nursing knowledge x individual nurse = nursing practice. Therefore, the individual represents the nurse's integration and synthesis of nursing knowledge; the greater the knowledge and its integration, the greater the impact on nursing practice. The relationship is one directional; however, this theory may aid in explaining why a knowledge-practice gap may exist in clinical practice. Nurses may possess the knowledge and skills to assess CIPN but have not necessarily integrated them to impact their clinical practice. According to Van Sell and Kalofissudis (2002), "The degree of change in practice which an individual nurse emits is directly related to the degree of integration and synthesis of nursing knowledge, which includes: nursing foundation plus nursing essence plus methodology plus disciplined inquiry" (slide 47).

The current study of CIPN knowledge and practice behaviors focused on describing the nursing foundation component of nursing knowledge as it relates to CIPN; in addition, the study explored the clinical practice behaviors of nurses in the assessment of CIPN (see Figure 1). The authors posited that application of the theoretical framework to the current study would produce three possible outcomes: (a) best practices, indicating knowledge of CIPN assessment with integration into practice; (b) knowledge-practice gap, indicating knowledge of CIPN assessment without integration into practice; and (c) knowledge deficit with practice deficit, indicating lack of CIPN knowledge with no integration into practice.



Note. Nursing knowledge components: nursing foundation plus nursing essence plus methodology plus disciplined inquiry equals nursing knowledge. Knowledge domain focuses on nursing foundation; practice domain focuses on the integration of scientific and humanities knowledge into nursing assessment practice behaviors.

Figure 1. Complexity Integration Nursing Theory: Theory of Nursing Knowledge With Application to Nursing Practice

Note. From *Socialization Into the Nursing Profession* [Slide presentation], by S. Van Sell and I. Kalofissudis, 2002, slide 55. Copyright 2002 by Van Sell and Kalofissudis. Used with permission.

Methods

Design

This self-selected, cross-sectional, exploratory study used a questionnaire in two hospital-based outpatient chemotherapy infusion clinics. The researchers obtained institutional review board approval and participant informed consent. Questionnaires were numerically coded with corresponding participant names, and the coded database will remain in a locked file drawer until five years after study completion. Only the principal investigator had access to decoded identifying information to ensure participant confidentiality. The questionnaire took approximately 20–30 minutes to complete, and data were collected over a two-day period.

All data were entered into a database using Microsoft® Office Excel 2003. SPSS®, version 17.0, was used for descriptive statistical analysis. Missing data defaulted to missing value codes; missing data for the knowledge items were counted as incorrect.

Instrument

The **Chemotherapy-Induced Peripheral Neuropathy: Assessment of Oncology Nurses' Knowledge and Practice Questionnaire** was developed by the principal investigator and evaluated for content validity by three nursing experts on CIPN and two medical oncologists. The tool consists of 16 knowledge and 16 practice behavior items, a 9-item demographic survey, 1 item relating to CIPN assessment skills, and 3 questions about previous CIPN instruction. Four additional questions pertain to nurses' perception of CIPN as a significant patient problem, CIPN assessment as essential in the role of oncology nurses, routine CIPN assessment within the clinical setting, and reason if CIPN is not routinely assessed.

The overall calculated item content validity index, often referred to as the average congruency percentage, was 0.95. The content validity index for items approach was used for this calculation. Internal consistency reliability was evaluated using Cronbach coefficient alpha (0.84 for this sample).

Results

Sample Characteristics

A convenience sample of 39 oncology nurses from two outpatient chemotherapy infusion units in Baltimore,

MD, participated in this study. In those settings, patients are evaluated by a healthcare provider (doctor or nurse practitioner) prior to each new chemotherapy cycle and occasionally for ensuing cycle treatments. Therefore, nurses assess patients not seen by a healthcare provider before and during subsequent infusions of a cycle. Thirty-seven respondents were women, with a mean age of 45 years (SD = 8.9). Seventeen participants held OCN® (oncology certified nurse) status (see Table 1).

Knowledge Domain

CIPN knowledge was measured as a percentage of correct responses to 16 knowledge items. Examples of knowledge items included types of chemotherapy agents associated with CIPN, signs and symptoms related to CIPN, and pertinent information to elicit from patients (e.g., subjective symptoms, level of functional impairment, neurologic changes manifested with CIPN). The mean knowledge score of 12.6 (SD = 1.7) indicated knowledge deficits related to CIPN (maximum score of 16). Knowledge deficit areas identified included nonpharmacologic strategies to manage CIPN symptoms, autonomic neuropathy as a form of peripheral neuropathy that may manifest as orthostatic hypotension, and medical terminology used to describe specific CIPN sensations.

Practice Domain

CIPN practice behaviors and assessment frequency were measured using a four-point Likert-type scale (1 = never, 2 = occasionally, 3 = frequently, and 4 = always). Practice behavior responses revealed that nurses used basic assessment skills and practices more frequently than neurologic physical assessment skills (see Table 2). Forty-one percent of respondents indicated that they frequently screened patients for baseline presence of neuropathy prior to initiating the first dose of chemotherapy, and 44% indicated that they frequently continued the assessment process prior to each subsequent infusion. Fifty-one percent frequently assessed for patients' ability to perform fine motor skills (e.g., buttoning, zippering), and 54% documented CIPN assessment data.

Of note, 62% indicated that they never assessed deep tendon reflexes and 49% only occasionally evaluated muscle strength and gait, even though 87% correctly identified that patients do not readily report neurologic symptoms. Fifty-one percent of the nurses specified that they only occasionally provided education to patients regarding adaptation strategies to deal with consequential functional impairments associated with CIPN, and 64% often provided patient education about safety precautions to avoid injuries such as thermal injury or falls.

Table 1. Sample Characteristics

Characteristic	$\bar{X}$	SD	Range
Age (years) (N = 38)	45	8.9	31–67
Years in nursing	19.7	9.2	3–40
Years in oncology	13.3	8.8	0–31

Characteristic	n
Gender	
Male	2
Female	37
Highest education	
Diploma	2
Associate degree	12
Bachelor's degree	21
Master's degree	3
Doctorate	1
Basic nursing education[a]	
Diploma	2
Associate degree	16
Bachelor's degree	20
Master's degree	1
Oncology certified	17

N = 39 unless otherwise noted
[a] Program used to obtain RN status

When asked how often nurses assessed patients for the presence of other risks factors associated with peripheral neuropathy, 49% indicated never or occasionally. In contrast, 100% of the nurses responded correctly to the knowledge question relating to patients with cancer who also have diabetes or alcoholism being at greater risk for developing CIPN, thus acknowledging diabetes and alcoholism as increased risk factors. However, almost half do not routinely screen for those risk factors in clinical practice. Nurses having knowledge of those risk factors for CIPN in patients with cancer but not routinely integrating screening into practice represents a knowledge-practice gap.

Questionnaire results revealed that nurses were not confident in their physical assessment skills when performing deep tendon reflexes, tuning-fork vibration, and Romberg testing and only somewhat confident when evaluating muscle strength (see Table 3). All respondents indicated that CIPN assessment was essential in their oncology role, but 75% rated their CIPN assessment skills as fair or poor. Although 82% believed that CIPN is a significant patient problem, only 15% reported receiving previous instruction in CIPN assessment (see Table 4). Nurses with no previous instruction in CIPN assessment represented a significant knowledge deficit with a practice deficit.

Reasons cited for not routinely performing CIPN assessment included limited proficiency in neurologic assessment skills, time constraints, and feeling that the documentation form was not conducive to streamlining the assessment process. Nurses indicated they would welcome more education in and the development of

Table 2. Chemotherapy-Induced Peripheral Neuropathy (CIPN) Practice Behavior Frequency

Behavior	Never		Occasionally		Frequently		Always	
	n	%	n	%	n	%	n	%
Screen for baseline peripheral neuropathy.	4	10	13	33	16	41	6	15
Assess fine motor skills (e.g., buttoning, zippering).	3	8	6	15	20	51	10	26
Document CIPN assessment data.	1	3	9	23	21	54	8	21
Assess deep tendon reflexes.	24	62	14	36	1	3	–	–
Assess muscle strength.	12	31	18	46	9	23	–	–
Assess risk factors associated with peripheral neuropathy.	2	5	17	44	16	41	4	10
Assess gross motor function (e.g., gait, balance).	8	21	19	49	11	28	1	3
Assess CIPN prior to each subsequent neurotoxic chemotherapy infusion.	4	10	5	13	17	44	13	33
Elicit patient symptoms related to CIPN.	–	–	4	10	27	69	8	21
Teach patient strategies for adapting to CIPN functional impairment.	2	5	20	51	14	35	3	8
Teach patients safety precautions to prevent injuries associated with CIPN (e.g., thermal injury, falls).	1	3	7	18	25	64	6	15

N = 39

Note. Because of rounding, not all percentages total 100.

neurologic physical assessment skills to better assess CIPN. Example comments follow.

> I work with multiple myeloma patients receiving Velcade® [bortezomib], so CIPN is an important part of my patient's assessment. Thank you for your interest in this topic.
>
> Nurses need more education on orthostatic changes, testing, etc., if this is important in treating CIPN. I thought I was fairly competent with assessing until this survey.
>
> I would welcome a uniform assessment tool and grading scale to assess patient's status and responses to intervention.
>
> Don't know what Romberg test is. Don't know what proprioception is.
>
> Thank you. Would like inservices on assessment techniques.

The comments reinforced the result of 87% of responses indicating the need to approach neuropathy and neuropathic pain assessment differently than when assessing nociceptive pain.

Discussion

This study explored the knowledge and practice behaviors of oncology nurses assessing for CIPN. The results suggested that nurses demonstrated knowledge deficits related to CIPN and that assessment practice behaviors did not necessarily include neurologic physical assessment and patient education pertaining to strategies for adapting to functional impairments associated with CIPN. Previous studies evaluated nurses' knowledge and practice behaviors of pain assessment, but not specifically neuropathy or neuropathic pain. Distinguishing neuropathic pain from nociceptive pain during assessment is essential because interventions are based on etiology of pain. Use of a 0–10 pain scale to assess CIPN is one-dimensional and does not capture the unique sensations and motor alterations usually associated with peripheral neuropathy. In addition, patients often indicate that not all symptoms associated with CIPN are "painful." In the literature, nurses are expected to be capable of assessing and monitoring parameters for both types of pain. However, the current study's findings suggest nurses lack instruction in this area.

The confidence level ratings and the frequency of specific practice behaviors showed that study participants were not confident in their ability to perform neurologic physical assessment skills. However, 100% of respondents identified that CIPN assessment is essential to the role of the oncology nurse administering neurotoxic chemotherapy. Seventy-five percent of nurses in the current study rated their CIPN assessment skills as fair to poor. This corresponds with Xue et al.'s (2007) study, in which 80% of nurses rated their education and training

Table 3. Skill Confidence Level of Neurologic Assessment Skills

Skill	Not at All Confident		Somewhat Confident		Confident		Very Confident	
	n	%	n	%	n	%	n	%
Deep tendon reflexes	19	49	16	41	4	10	–	–
Vibration testing (tuning fork)	24	62	10	26	3	8	2	5
Sharp versus dull	3	8	16	41	17	44	3	8
Romberg testing (N = 38)	28	72	5	13	4	11	1	3
Muscle strength assessment	5	13	17	44	15	38	2	5

N = 39 unless otherwise noted

Note. Because of rounding, not all percentages total 100.

related to cancer pain as fair to poor. Lack of confidence in skill proficiency may be a factor in the knowledge-practice gap in CIPN assessment.

Wickham (2007) reported, "Comprehensive neurological assessment is clinically impractical and outside many nurses' scope of practice" (p. 371). This study's sample characteristics included two diplomas and 12 associate degrees in education frequency. Historically, comprehensive physical assessment and CIPN (neurologic) assessment are not taught in diploma or associate degree programs. Therefore, 14 participants, based on educational level, would be considered to have a knowledge deficit with a practice deficit because comprehensive physical assessment and CIPN assessment would not have been taught in the participants' nursing education programs.

The study participants represented all three of the theoretical categories: best practices, knowledge-practice gap, and knowledge deficit with practice deficit. According to the theory of nursing practice within the Complexity Integration Nursing Theory, practice behavior reported as "always" represents best practice, indicating knowledge with integration into practice. For example, 15% responded that they always screen for baseline peripheral neuropathy, which indicates knowledge with integration into practice. Practice behavior reported as "occasionally" or "frequently" represents a knowledge-practice gap, indicating the nurse has knowledge without integration into practice. For example, 33% responded that they occasionally screen for baseline peripheral neuropathy, which indicates knowledge of screening for baseline peripheral neuropathy but failure to integrate into practice at least 67% of the time. Practice behavior reported as "never" represents a knowledge deficit with a practice deficit. For example, 10% responded that they never screen for baseline peripheral neuropathy, which indicates a knowledge deficit as well as a practice deficit.

In the skill confidence level, responses reported as "very confident" represent best practice, indicating knowledge with integration into practice. A skill confidence level reported as "confident" or "somewhat confident" represents a knowledge-practice gap, indicating the nurse has knowledge without integration into practice. A skill confidence level reported as "not at all confident" represents a knowledge deficit with a practice deficit, which indicates lack of knowledge and no integration into practice.

An important component of CIPN assessment includes checking large sensory fibers, which may cause damage to deep tendon reflexes. However, 62% responded that they never assess deep tendon reflexes, indicating a knowledge deficit with a practice deficit regarding an expected assessment component for CIPN. In addition, no one responded as always assessing deep tendon reflexes, which indicates an absence of best practices regarding knowledge with integration into practice. Likewise, no one responded as "very confident" regarding neurologic assessment skill for deep tendon reflexes, indicating an absence of best practices for knowledge integrated into practice. In addition, 49% responded as "not at all confident" in neurologic assessment skill for deep tendon reflexes, indicating a knowledge deficit and a practice deficit.

Table 4. Nurses' Self-Reported Instruction

Topic	n
Chemotherapy-induced peripheral neuropathy assessment	6
Cranial nerve assessment	12
Deep tendon reflex assessment	10
Lhermitte sign	1
Muscle strength assessment	28
Orthostatic blood pressure assessment	32
Romberg testing	7
Temperature sensation testing	18
Dull versus sharp sensation testing	27
Vibration testing (tuning fork)	14
Pharmacologic management	21
Nonpharmacologic management	21

N = 39

Study participants engaged in self-learning to gain CIPN knowledge and skills; 10 participants (26%) rated as good on the self-evaluation of CIPN assessment skills, and only 6 (15%) indicated prior instruction in CIPN assessment. The theoretical framework stated that the depth and breadth of practice is directly related to the integration and synthesis of nursing knowledge through the cognitive, psychomotor, affective, and spiritual domains of self (individual nurse). Participants provided a fair (54%) or poor (21%) rating on the self-evaluation of CIPN assessment skills, and only 6 of 39 received prior instruction in CIPN assessment, strongly indicating that the foundational nursing knowledge necessary for CIPN assessment was limited. Nursing knowledge must be present for integration into practice.

To facilitate best practices, the foundational knowledge of CIPN assessment and an opportunity to demonstrate application of the knowledge through practice behaviors are necessary. Development of clinical guidelines for CIPN assessment would clarify the foundational knowledge necessary for oncology nurses for integration into practice. If neurologic physical assessment is to be included in nursing practice CIPN assessment guidelines, nurses must first develop proficiency in performing those skills.

Limitations

Limitations of this research require consideration. A self-selected sample is an inherent limitation in study design and restricts the generalizability of the results. Practice behavior items may have served as prompts for respondents that would not otherwise have been contemplated; the responses may be an indication of how participants believe they should practice rather than actual practice. In addition, the small sample from

academic hospital-based clinics with 54% of participants holding a bachelor's degree and 44% with oncology certification may not be representative of oncology nurses in other populations.

Conclusion and Implications for Nursing Practice

To date, no guidelines or standards of nursing practice exist for the assessment or management of CIPN. By exploring nurses' practice behaviors and knowledge of CIPN, the development of practical, meaningful standards and guidelines for oncology nursing practice may be possible. Results indicated participants were somewhat knowledgeable about CIPN but lacked proficiency in neurologic physical assessment skills. Additional training is needed for oncology nurses to develop a comfort level and competence in performing these skills if neurologic assessment is indeed essential in evaluating patients for CIPN. Oncology nurses should have a working knowledge of the neurologic examination and interpretation of findings to enhance communications between patients and providers and improve patient outcomes.

Oncology nurses apparently have basic nursing knowledge related to CIPN but have not necessarily integrated this into practice patterns. Reasons for this may include lack of training, proficiency, and confidence in neurologic assessment skills; clinical time constraints; and lack of a well-organized approach to assess patients in an area where chair turnover time, accuracy, safety, and quality service are competing priorities. To minimize those barriers in practice, a streamlined approach to CIPN assessment may be most appropriate for oncology nurses working in a busy chemotherapy infusion unit.

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References

Armstrong, T., Almadrones, L., & Gilbert, M.R. (2005). Chemotherapy-induced peripheral neuropathy. *Oncology Nursing Forum, 32,* 305–311. doi:10.1188/05.ONF.305-311

Backonja, M.M., & Galer, B.S. (1998). **Pain assessment and evaluation** of patients who have neuropathic pain. *Neurologic Clinics, 16,* 775–790.

Bernardi, M., Catania, G., Lambert, A., Tridello, G., & Luzzani, M. (2007). Knowledge and attitudes about cancer pain management. *European Journal of Oncology Nursing, 11,* 272–279. doi:10.1016/j.ejon.2006.09.003

Herr, K. (2004). Neuropathic pain: A guide to comprehensive assessment. *Pain Management Nursing, 5*(4, Suppl. 1), 9–18.

Johnson, L. (2004). The nursing role in recognizing and assessing neuropathic pain. *British Journal of Nursing, 13,* 1092–1097.

Mackrodt, K., & White, M. (2001). Nurses' knowledge within the context of pain management. *Journal of Orthopaedic Nursing, 5,* 15–21.

Meintz, S.L., Yfantis, E.A., & Graebel, W.P. (1994). Future directions in computational nursing science. *Mathematical and Computer Modeling, 19,* 273–288. doi:10.1016/0895-7177(94)90199-6

Oncology Nursing Society. (n.d.). *Peripheral neuropathy: Guidelines and standards.* Retrieved from http://www.ons.org/Research/NursingSensitive/Summaries/media/ons/docs/research/summaries/peripheral/guidelines.pdf

Patiraki, E.I., Papathanassoglou, E.D., Tafas, C., Akarepi, V., Katsaragakis, S.G., Kampitsi, A., & Lemonidou, C. (2006). A randomized controlled trial of an educational intervention on Hellenic nursing staff's knowledge and attitudes on cancer pain management. *European Journal of Oncology Nursing, 10,* 337–352. doi:10.1016/j.ejon.2005.07.006

Portenoy, R.K. (1997). The physical examination in cancer pain assessment. *Seminars in Oncology Nursing, 13,* 25–29.

Postma, T.J., & Heimans, J.J. (2000). Grading of chemotherapy-induced peripheral neuropathy. *Annals of Oncology, 11,* 509–513.

Puls-McColl, P.J., Holden, J.E., & Buschmann, M.T. (2001). Pain management: An assessment of surgical nurses' knowledge. *MedSurg Nursing, 10,* 185–191.

Sapountzi-Krepia, D. (2001). The evolving essence of the science of nursing: A complexity integration nursing theory (the theory of Sharon L. Van Sell and Ioannis A. Kalofissudis). An introductory presentation. *ICUs and Nursing Web Journal, 8,* 17.

Smith, E.M., Beck, S.L., & Cohen, J. (2008). The total neuropathy score: A tool for measuring chemotherapy-induced peripheral neuropathy. *Oncology Nursing Forum, 35,* 96–102. doi:10.1188/08.ONF.96-102

Tafas, C.A., Patiraki, E., McDonald, D.D., & Lemonidou, C. (2002). Testing an instrument measuring Greek nurses' knowledge and attitudes regarding pain. *Cancer Nursing, 25,* 8–14.

Tanabe, P., & Buschmann, M. (2000). Emergency nurses' knowledge of pain management principles. *Journal of Emergency Nursing, 26,* 299–305. doi:10.1067/men.2000.108402

Van Sell, S., & Kalofissudis, I. (2001). *The evolving essence of the science of nursing: A complexity integration nursing theory.* Dallas, TX: Author.

Van Sell, S., & Kalofissudis, I. (2002). *Socialization into the nursing profession* [Slide presentation]. Dallas, TX: Author.

Visovsky, C., Meyer, R., Roller, J., & Poppas, M. (2008). Evaluation and management of peripheral neuropathy in diabetic patients with cancer. *Clinical Journal of Oncology Nursing, 12,* 243–247. doi:10.1188/08.CJON.243-247

White, S. (2004). Assessment of chronic neuropathic pain and the use of pain tools. *British Journal of Nursing, 13,* 372–378.

Wickham, R. (2007). Chemotherapy-induced peripheral neuropathy: A review and implications for oncology nursing practice. *Clinical Journal of Oncology Nursing, 11,* 361–376. doi: 10.1188/07.CJON.361-376

Williams, H. (2006). Assessing, diagnosing and managing neuropathic pain. *Nursing Times, 102,* 22–24.

Wilson, M. (2002). Overcoming the challenges of neuropathic pain. *Nursing Standard, 16,* 47–53.

Xue, Y., Schulman-Green, D., Czaplinski, C., Harris, D., & McCorkle, R. (2007). Pain attitudes and knowledge among RNs, pharmacists, and physicians on an inpatient oncology service. *Clinical Journal of Oncology Nursing, 11,* 687–695.