Record: 1

Alarm Fatigue: A Concept Analysis

Abstract

Alarm fatigue has emerged as a growing concern for patient safety in healthcare. There is a need for a clear and common understanding of the concept to assist in the development of effective strategies and policies to eradicate the multi-dimensional aspects of the alarm fatigue phenomena affecting the nursing practice arena. The concept of alarm fatigue will be examined based on the method developed by Walker and Avant (1995) that identifies the attributes, antecedents, and consequences of alarm fatigue constructed upon the findings of the literature review.

Additionally, empirical referents are identified and illustrations of the concept are presented in model, borderline, and contrary cases.

Keywords: concept analysis; alarm fatigue; nursing; technology; distractions

Contextual Information of Alarm Fatigue

Many background noises and disruptive sounds echo through hospitals today. Many of the sounds heard by patients, families, and staff are derived from a blend of human and mechanical sounds. As technology has advanced over the years, the multiple medical device systems used to monitor patients for potential problems have increased along with the sensitivity of the alarm signals contributing to the noisy hospital environment. Unfortunately with the growing number of patients requiring medical technology monitoring, the alarm sounds echoing in the clinical practice area are increasing at a colossal rate resulting in nurses subjected to too many alarms triggering an issue for concern called alarm fatigue. Alarm fatigue, defined in the literature is the desensitization of a clinician to an alarm stimulus that results from sensory overload causing the response of an alarm to be delayed or missed (McCartney, 2012).

Alarm fatigue is acknowledged as a contributor to clinicians' environmental distractions and interferes with the ability of clinicians to perform critical patient care responsibilities resulting in patient safety issues. Thus, alarm management has emerged as an increasing concern in health care, and is currently the focus of a National Patient Safety Goal (NPSG) for 2014 (TJC, 2013, June). According to The Joint Commission (TJC) between 2009 and 2012 there were reports of 98 alarm-related sentinel events, in which 80 resulted in death, 13 in permanent loss of function, and five in unexpected prolonged care conditions (TJC, 2013, April). Of these incidences, the majority were associated with alarm malfunction, alarm misuse, or inadequate alarm settings leading to the most common contributing factor- alarm fatigue.

Additionally, the TJC indicates that the number of alarm signals per patient per day can reach over several hundred depending on the specific unit in the hospital, and it is estimated that between 85-99 % of the alarm signals do not require clinical intervention (TJC, 2013, April). These false alarm occurrences could be related to a multitude of conditions, but the most common reasons cited in the literature are the wide range of parameter settings of the alarms, the lack of adjustment of alarms to individual patient conditions for a specific patient population, the improper positioning of a sensor on a patient or the lack of proper skin preparation prior to application of the sensor (AACN, 2013; Cvach, 2012; TJC, 2013). As a result, a high occurrence of alarm noise is heard by clinicians resulting in a possible "cry wolf" effect leading to reductions in clinician responses to alarm signals.

Alarm fatigue is a growing problem in health care that needs to be addressed. Likewise, alarm fatigue is an increasingly common term used in the health care environment, but its meaning is ill defined. A more constructive and comprehensive definition of alarm fatigue in healthcare is needed. A clear and common understanding of the concept will assist in future research and help to more clearly articulate the dimensions of alarm fatigue in the practice arena. The concept of alarm fatigue therefore will be the focus of this concept analysis paper.

Method

The method of Walker and Avant (1995) was used as the framework for the concept analysis of alarm fatigue. The method presented in this paper includes the following steps: (a) select a concept, (b) determine the aims or purposes of the analysis, (c) identify all uses of the concept, (d) determine the defining attributes, (e) identify a model case, (f) identify additional cases, (g) identify antecedents and consequences, and (h) define empirical referents (Walker & Avant, 2011). This method was chosen because it is the easiest to understand and master, especially for the novice. Each of these eight steps will be addressed as part of the concept analysis of alarm fatigue, and then summarized at the conclusion.

Data Sources

A literature search on alarm fatigue was conducted with the assistance of a reference librarian to identify the uses of the term from various disciplines and to establish a clear conceptualization of the concept. As discussed in Walker and Avant (2011), this search was not limited to nursing literature so as not to bias the understanding of the nature of the concept. A series of key searches using the terms such as alarm, fatigue, alarm and fatigue, clinical alarms, fatigue or stress, auditory or mental fatigue in CINAHL, PUBMED, MEDLINE, and Web of Science databases, respectively. Additionally, definitions published in English dictionaries were sought. Literature between 2008 and 2013 was included in the search, and it was limited to papers published in English. The resulting literature was initially screened by reviewing titles and abstracts for relevance, and the selected materials were subsequently retrieved and reviewed in full.

Concept Analysis

Concept Selection: The selection of a concept to be analyzed is always the first step in the concept analysis. The concept of alarm fatigue is chosen as the area of attention presented by the author in this analysis. As described earlier, alarm fatigue is a pressing clinical issue and one that requires concerted effort to ameliorate. Efforts to address alarm fatigue are thwarted by a lack of a clear definition of the concept and diffuse understanding.

Aims of the Analysis

The second step in the concept analysis of alarm fatigue is determining the purpose of the analysis. The principle aim of this concept analysis is to clarify the meaning of the concept of alarm fatigue that will contribute a shared understanding of its use within health care and future nursing research. A common articulation of the concept will heighten the awareness of the components of the phenomenon leading to collaborative exploration efforts of nursing and health care technology research to construct evidence-based practice recommendations and policy development to aid in alarm reduction for safe patient outcomes.

Identify Uses of the Concept

Walker and Avant (2011), indicate the third step in the analysis of alarm fatigue is the identification of the many uses of the concept in literature sources. To understand how the term alarm fatigue was conceived and used, dictionary definitions were sought from various English and health-related dictionaries. As this is a two-word concept, the words "alarm" and "fatigue" were explored independently in the various dictionaries since the combined term yielded no search results. Additionally, the term "alarm fatigue" was explored independently in the healthcare and nursing literature since it has been vastly used and written about in these disciplines in relation to patient safety and noise levels in hospitals.

Alarm: According to the Cambridge online dictionary, the word alarm was referred to as, "sudden anxiety and fear especially that something very bad or dangerous might happen" (2013a). The Merriam-Webster online dictionary defined alarm as, "a device that makes a sound as a warning of signal" (2013a). In addition, the Oxford Dictionary of Nursing defined alarm as, "a device for helping people with hearing difficulties that indicates the occurrence of an event by signal" (Martin & McFerran, 2008a). The Merriam-Webster online thesaurus defined alarm as, "suspicion or fear of future harm or misfortune" (2013b).

Fatigue: The Merriam-Webster online dictionary defined fatigue as, "the state of being very tired" (2013c). Stedman's online Medical Dictionary defined fatigue as, "the state following a period of mental or bodily activity, characterized by a lessened capacity or motivation for work and reduced efficiency of accomplishment" (2006).

The Cambridge online dictionary defined fatigue as, "the condition of being extremely exhausted" (2013b). In addition, the Merriam-Webster online thesaurus defined fatigue as, "a complete depletion of energy or strength" (2013d). As well, the Oxford Dictionary of Nursing defined fatigue as, "the inability of an organism, an organ, or a tissue to give a normal response to a stimulus until a certain recovery period has elapsed" (Martin & McFerran, 2008b).

Alarm Fatigue: According to Cvach (2012), alarm fatigue is "the lack of response due to excessive numbers of alarms resulting in sensory overload and desensitization" (p. 269). The Emergency Care Research Institute (ECRI, 2012) indicates that "caregivers can become overwhelmed trying to respond to alarms, or they can become desensitized, which can lead to missed alarms or a delayed response which places patients at risk" (p. 5). These alarms may reflect the need for actual interventions from nurses or they may be false alarms requiring no nursing action. Tanner (2013) describes alarm fatigue in relation to nurses becoming anesthetized to alarm sounds as a result of excessive auditory exposure causing a slower response time of a clinician. According to Keller (2012) and Logan (2011), alarm fatigue occurs when caregivers become overwhelmed with the large number of clinical alarms such that critical or significant events can be missed or ignored. Wikllund and Kendler (2011) identifies that clinicians may ignore alarms because of frequent false auditory alarm occurrences limiting the value of the information emitted to a caregiver in a clinical situation leading to alarm fatigue.

Defining Attributes: The fourth step in the concept analysis of alarm fatigue is to determine the defining attributes. Attributes are those characteristics of a concept that appear over and over again in the literature and they are most frequently associated with the concept allowing the broadest insight into it (Walker & Avant, 2011). Therefore, alarm fatigue encompasses three defining attributes:

* an environment with excessive and repeated situations;

* a lessened motivation and interest in surroundings;

* and a diminished capacity for physical and mental work.

Identify a Model Case: The fifth step in the concept analysis of alarm fatigue is the construction of a model case which is a "pure" illustration of the use of the concept that includes all of its critical attributes (Walker & Avant, 2011). In other words, the model case is a "real-world" extraction of the concept. An example model case of alarm fatigue is presented here.

Kathy is a school nurse at a local elementary school in which over 500 children attend kindergarten to fifth grade. On average, Kathy sees over 35 children regularly in the clinic during the 90 minute lunch period for general medication administration and first aid management. It is difficult for Kathy to concentrate on the competing daily demands of care for the children. Additionally, for the first several weeks of school a kindergartener named Nicholas visited the school nurse's office every day after the lunch period recess. Nicholas shared his playground "adventures" and injury status with Kathy repeatedly during this very busy time period. Each day Nicholas requested a bandage and talked constantly about how he had wounded himself at recess. One day, Nicholas entered the clinic and Kathy did not make eye contact with him or acknowledge him verbally. She went into the refrigerator to get her lunch, and began to sit and eat. Quite some time had elapsed, and she heard Nicholas' soft voice say, "Can you look at my arm now? ☐ I don't think it is supposed to bend this way."

This example illustrates the three critical attributes of alarm fatigue previously described in this analysis. The school nurse is emerged in a work environment with repeated and excessive interruptions by the same student over and over again. After constant visits from Nicholas, the nurse develops a decreased awareness of the student's situational presence. Eventually Kathy is unaware of a significant clinical event that occurred in her surroundings, which in turn hindered her nursing interventional response to the student's fractured arm.

Identify Additional Cases: The sixth step in the concept analysis of alarm fatigue involves constructing borderline and contrary cases. According to Walker and Avant (2011), a borderline case contains most of the defining attributes, but not all of them. Additionally, a contrary case is a clear example of what a concept is not (Walker & Avant, 2011). The scrutiny of other cases presented in a concept analysis helps to tease out defining attributes that have the "best fit" for alarm fatigue (Walker & Avant, 2011). The borderline and contrary cases presented here are constructed by the author.

Borderline case. The medical unit had been very busy with influenza-like patients for the last month especially around the Christmas holiday. The unit was constantly at its patient capacity limit, and when a patient was discharged another patient from the community flu-like crises was admitted within in a short duration. The nursing staff on the unit had been working countless extra shifts to help cover the escalating incidence of patient care needs. The staff looked tired, but they worked well together to manage the level of care needed for the patient and families.

This case illuminates the presence of only two of the three defining attributes of alarm fatigue presented in this concept analysis. For example, there is the existence of a recurrent patient care population with excessive turnover rate. This causes a stressful and tiring clinical environment for nurses leading to the manifestation of a second attribute of alarm fatigue. Consequently, the staff displays signs of physical fatigue, but they did not develop a lessened capacity to manage patients' clinical necessities. Instead the staff established collaborative mechanisms to complete the clinical care duties that needed to be accomplished for the particular patient population on the unit. Thus, the case example did not illustrate the third attribute of the concept of alarm fatigue since there was not a reduction in the nurses' capacity to complete their work.

Contrary Case: Kathy is a school nurse that enjoys traveling to 10 different schools within a two week time period. Kathy sees many children of various ages with a diverse need for countless assorted nursing interventions. Additionally, Kathy is always excited about participating in classroom health teaching opportunities for students, and collaborating with various teachers on health related projects in the school district. Kathy is constantly prepared and excited about her school nurse practice activities and events.

This example describes none of the three defining attributes of alarm fatigue that were identified by the author. The school nurse is exposed to a variety of clinical environments with multiple and diverse clinical encounters as opposed to repeated excessive situational stimuli. Additionally, Kathy is clearly motivated and attentive to her surroundings creating an increased work capacity which is contrary to two of the attributes of the concept of alarm fatigue presented in this analysis.

Identification of Antecedents and Consequences: The seventh step in the concept analysis is the identification of antecedents and consequences (Walker and Avant, 2011). Antecedents are events that must occur prior to the manifestation of a concept, and consequences are events that occur as a result of it. Identifying antecedents and consequences can shed light on the context in which a concept is generally used (Walker & Avant, 2011). Thus, the antecedents of alarm fatigue are:

* involvement of a healthcare professional;

* the ability to subjectively evaluate feelings;

* a patient care environment with excessive stimuli

The consequences of alarm fatigue are:

* a lessened capacity to give a normal response to a signal;

* a significant clinical event missed or ignored that could lead to a potentially harmful patient situation;

* limited perception of the clinical significance of the alarm signal.

Defining Empirical Referents: The final step in the concept analysis of alarm fatigue is the identification of the empirical referents. The empirical referents are categories of the actual phenomena that demonstrate the existence or presence of the concept in its contextual framework (Walker & Avant, 2011). They are useful in practice because they provide a way in which the concept can be observed and measured by a researcher. Therefore, the literature on alarm fatigue suggests a multidimensional approach to the phenomenon. The empirical referents for alarm fatigue include the following:

* excessive alarms and effects on staff and patients (Burgess, Herdman, Berg, Feaster, & Hebsur, 2009; Cvach, 2012; Gross, Dahl & Nielsen, 2011; Hassanein, Raggal, & Shalaby, 2013; Okcu, Ryherd, Zimring, & Samuels, 2011; Welch, 2011),

* alarm audibility and identification (Cvach, 2012; King, Fortino, Stevens, Shah, Fortino-Mullen, & Lee, 2012; Konkani, Oakley, & Bauld, 2012; Okcu et al., 2011),

* nurses' response to alarms (Creighton Graham & Cvach, 2010; Cvach, 2012; Gross et al., 2011; King et al., 2012; Welch, 2011),

* alarm settings (Burgess et al., 2009; Cvach, Frank, Doyle, & Stevens, 2013; Edworthy, 2013; Gross et al., 2011; King et al., 2012; Li & Clifford, 2012; Welch, 2011),

* nurse's perception of alarms (Creighton Graham & Cvach, 2010; Cvach et al., 2013; Okcu et al., 2011).

Implications for Research

The intent of the concept analysis was to provide clarity surrounding the concept of alarm fatigue. Health care organizations and clinicians need to understand the concept phenomenon so that future research in medical alarm technology and management can complement nurses' work environments to provide safe patient care outcomes. Consequently, alarm fatigue is a complex health care problem that needs an interdisciplinary team approach to tackle the multifaceted issue. There are many areas of alarm management where nursing, biomedical engineering, medicine, and clinical informatics research is indicated. For example, recommendations for improved audible alarm notification design needs further clarification as well as alarm setting standardizations. Additionally, research is necessary on alarm sensitivity and false alarm suppression algorithms. The overall impact of alarm fatigue has significant ramifications for patient safety issues, and nurses have an obligation to promote best practices to the public, by promoting the discovery and application of research to the care of individuals or groups of patients (Ingersoll, 2000).

Implications for Policy

Hospital noise is an increasing problem of the health care environment for patients, families, and staff. The variety of disruptive sounds is a growing concern that hinders communication and poses significant safety risks for patients. Even 150 years ago, Florence Nightingale identified "unnecessary noise as the most cruel absence of care which can be inflicted either on the sick or well" (1860, p. 44). Today, a large majority of the unwanted noise in hospitals is from medical devices, and has led ECRI to identify alarm hazards as a "top ten" health technology safety concern (Keller, 2012). Additionally, TJC has heightened the awareness of the issue in the 2014 NPSG for alarm management.

Hence, the growing concern for health care organizations is to find solutions to alarm management issues. The solutions to the alarm fatigue issue are dense and essential policies, strategies, and standardizations in alarm management lie within the work of a collaborative interdisciplinary team. Health care organizations need to develop deliberate policies surrounding alarm management for specific patient populations and define alarm parameters for particular medical device equipment. Additionally, nurses must be involved in the establishment of initial and ongoing educational policies on training for new medical devices. Increasing the knowledge base of clinicians utilizing medical devices is essential for the reduction in false alarms, a known contributing factor to alarm fatigue.

Conclusion

In summary, nurses are essential to the patient care experience team, and have a social responsibility to influence and change health care policy through theory development and research. According to Page (2004), nursing care is central to achieving good patient outcomes and healthcare organizations should construct nurses' work environments so that they are conducive to safe patient care. Therefore, it is the hope of these authors that an enhanced understanding of alarm fatigue can contribute to future collaborative multidisciplinary research efforts and continued policy progression to create positive and safe patient care outcomes with clinical alarm systems.

References

AACN (American Association of Critical-Care Nurses). (2013). Practice alert: Alarm management. Retrieved from http://www.aacn.org/wd/practice/docs/practicealerts/alarm-management-practice-alert.pdf

Burgess, L., Herdman, T., Berg, B.,, Feaster, W., & Hebsur, S. (2009). Alarm limit settings for early warning system to identify at-risk patients. Journal of Advanced Nursing, 65(9), 1844-1852. doi:10.111/j.1365-2648.2009.05048.x

Cambridge Advanced Learner's Dictionary & Thesaurus. (2013a). Retrieved from http://dictionary.cambridge.org.regiscollege.idm.oclc.org/us/dictionary/american-english/alarm%5F1?q=alarm

Cambridge Advanced Learner's Dictionary & Thesaurus. (2013b). Retrieved from http://dictionary.cambridge.org.regiscollege.idm.oclc.org/us/dictionary/american-english/fatigue?q=fatigue

Creighton Graham, K., & Cvach, M. (2010). Monitor alarm fatigue: Standardizing use of physiological monitors and decreasing nuisance alarms. American Journal of Critical Care, 19(1), 28-34. doi:10.4037/ajcc2010651

Cvach, M. (2012). Monitor alarm fatigue: An integrative review. Biomedical Instrumentation & Technology, 46(4), 268-277.

Cvach, M., Frank, R., Doyle, P., & Stevens, Z. (2013, August). Use of pagers with an alarm

escalation system to reduce cardiac monitor alarm signals. Journal of Nursing Care Quality, 1-9. doi:10.1097/NCQ.0b013e3182a61887

Edworthy, J. (2013). Medical audible alarms: A review. Journal of American Medical Informatics Association, 20, 584-589. doi:10.1136/amiajnl-2012-001061

ERCI (Emergency Care Research Institute). (2012). Health devices: Top 10 health technology

hazards for 2013. Plymouth Meeting, PA: Author. Retrieved from https://www.ecri.org/Documents/Secure/Health%5FDevices%5FTop%5F10%5FHazards%5F2013.pdf

Gross, B. Dahl, D., & Nielsen, L. (2011). Physiologic monitoring alarm load on medical/surgical floors of a community hospital. Horizons, 29-36.

Hassanein, S., Raggal, N., & Shalaby, A. (2013). Neonatal nursery noise: Practice-based learning

and improvement. The Journal of Maternal-Fetal and Neonatal Medicine, 26(4), 392-395. doi:10.3109/14767058.2012.733759

Ingersoll, G.L. (2000). Evidence-based nursing: What is and what it isn't. Nursing Outlook, 48(4), 151-152. doi:10.1067/mno.2000.107690

Keller, J.P. (2012). Clinical alarm hazards: A top ten health technology safety concern. Journal of Electrocardiology, 45, 588-591. doi:10.1016/j.jelectrocard.2012.08.050

King, A., Fortino, K, Stevens, N., Shah, S., Fortino-Mullen, M., & Lee, I. (2012). Evaluation of a smart alarm for intensive care using clinical data. Conference IEEE English Medical Biological Society, 166-169. doi: 10.1109/EMBC.2012.6345897

Konkani, A., Oakley, B., & Bauld, T. (2012). Reducing hospital noise: A review of medical device alarm management. Biomedical Instrumentation & Technology, 46(4), 478-487

Li, Q. & Clifford, G. (2012). Signal quality and data fusion for false alarm reduction in the intensive care unit. Journal of Electrocardiology, 45, 596-603. doi:10.1016/j.jelectrocard.2012.07.015

Logan, M.K. (2011). A roundtable discussion alarm safety: A collaborative effort. Horizons, 45, 8-15.

Martin, E., & McFerran, T. (2008a). Alerting device. In A Dictionary of Nursing. Oxford

University Press. Retrieved from http://www.oxfordreference.com.proxy1.cl.msu.edu/view/10.1093/acref/9780199211777. 001.0001/acref-9780199211777-e-9864.

Martin, E., & McFerran, T.(2008b). Fatigue. In A Dictionary of Nursing. Oxford University Press. Retrieved from http://www.oxfordreference.com.proxy1.cl.msu.edu/view/10.1093/acref/9780199211777. 001.0001/acref-9780199211777-e-3179.

McCartney, P.R. (2012). Clinical alarm management. American Journal of Maternal Child Nursing, 37(3), 202. doi:10.1097/NMC.0b013e31824c5b4a

Merriam-Webster. (2013a). Retrieved from http://www.merriam-webster.com/dictionary/alarm

Merriam-Webster. (2013b). Retrieved from http://www.merriam-webster.com/thesaurus/alarm

Merriam-Webster. (2013c). Retrieved from http://www.merriam-webster.com/dictionary/fatigue

Merriam-Webster. (2013d). Retrieved from http://www.merriam-webster.com/thesaurus/fatigue

Nightingale F. (1860). Notes on Nursing: What it is and What it is Not. London: Harrison and Sons.

Okcu, S., Ryherd, E., Zimring, C., & Samuels, O. (2011). Soundscape evaluations in two critical healthcare settings with different designs. Journal of Acoustical Society of America, 130(3), 1348-1358. doi:10.1121/1.3607418

Page, A. (2004). Transforming nurses' work environments to improve patient safety: the Institute of Medicine recommendations. Policy, Politics & Nursing Practice, 5(4), 250-258. doi:10.1177/1527154404269574

Stedman's Medical Dictionary (2006). (28th ed.). Retrieved from http://online.statref.com.proxy2.cl.msu.edu/Document.aspx?fxId=8&docId=14443

Tanner, T. (2013). The problem of alarm fatigue. Nursing Women's Health, 17(2), 153-157. doi:10.1111/1751-486X.12025

TJC (The Joint Commission). (2013, June). National patient safety goal on alarm management. Retrieved from http://www.jointcommission.org/assets/1/18/PREPUB-06-25-2013-NPSG060101.pdf

TJC (The Joint Commission). (2013, April). Sentinel event alert: Medical device alarm safety in hospitals. Retrieved from http://www.jointcommission.org/assets/1/18/SEA%5F50%5Falarms%5F4%5F5%5F13%5FFINAL1.PDF

Walker, L.O., & Avant, K.C. (2011). Concept analysis. In L.O. Walker & K.C. Avant (Eds.),

Strategies for theory construction in nursing (5th ed., pp. 157-179). Upper Saddle River, NJ: Pearson Prentice Hall.

Walker, L.O., & Avant, K.C. (1995). Strategies for Theory Construction in Nursing (3rd ed.).

Norwalk, CT: Appleton and Lange.

Welch, J. (2011). An evidence-based approach to reduce nuisance alarms and alarm fatigue. Horizons, 46-52.

Wiklund, M. & Kendler, J. (2011). Complementing medical device alarms with animated guidance. Horizons, 45, 67-71.

Related Content
* The Use of Virtual Mentoring in Nursing Education

* Paradigm of Prediction: Predictive Analytics to Prevent Congestive Heart Failure

* Implementation of a Standardized, Electronic Patient Hand Off Communication Tool in a Level III NICU

~~~~~~~~
By Patricia West, MS, RN; Patricia Abbott, PhD, RN, FAAN and Piper Probst, MSN, RN-BC

Patricia West is a graduate from the University of Michigan School of Nursing. Her specialization in graduate studies includes Nursing Business and Health Systems, Nursing Informatics, and Nursing Education. She received her BSN from Grand Valley State University, and currently resides in Mid-Michigan with her husband and three sons. Currently, she is the Clinical Placement Coordinator at Michigan State University College of Nursing. In her twenty-two year nursing career she has had an array of opportunities to practice nursing in the medical-surgical, orthopedic, preoperative, and school nursing specializations. In her graduate studies, Patricia participated in an internship experience at Sparrow Health System allowing her the opportunity to collaborate the nursing leadership team and UM faculty member inspiring her writing of this manuscript.

Patricia is an Associate Professor in the Division of Systems Leadership and Effectiveness Science at the University of Michigan School of Nursing in Ann Arbor, Michigan. She is widely recognized as a Pioneer in Nursing Informatics. Dr. Abbott is best known for her early work in helping to establish the Nursing Informatics Specialty. She was a member of the Author team for the original Scope and Standards of NI Practice with the ANA, and then her work on developing the first certification exam in NI with the ANCC.

Piper is the Drector of Nursing Practice Research & Outcomes for Sparrow Health Systems, in Lansing, Michigan.

Source: Online Journal of Nursing Informatics