Journal of
Clinical Nursing WILEY

A practice-based model to guide nursing science and improve the health and well-being of patients and caregivers

Sherry S. Chesak PhD, RN, Nurse Scientists[1] ⬤ | Lori M. Rhudy PhD, RN, Nurse Scientists[1] ⬤ | Cindy Tofthagen PhD, APRN, AOCNP, FAANP, FAAN, Nurse Scientists[2] ⬤ | Linda L. Chlan PhD, RN, ATSF, FAAN, Associate Dean for Nursing Research[1] ⬤

[1]Nursing Research Division, Mayo Clinic, Rochester, MN, USA

[2]Nursing Research Division, Mayo Clinic, Jacksonville, FL, USA

Correspondence
Sherry S. Chesak, Nursing Research Division, Mayo Clinic, 200 1st St SW, Rochester, MN 55905, USA.
Email: chesak.sherry@mayo.edu

Abstract

Aims and Objectives: The purpose of this paper is to describe a model to guide nursing science in a clinical practice-based setting. Exemplars are provided to highlight the application of this nursing research model, which can be applied to other clinical settings that aim to fill evidence gaps in the literature.

Background: Nurse scientists are well positioned to develop new knowledge aimed at identifying global health solutions to multiple disparities. The generation and application of this knowledge are essential to inform and guide professional nursing practice. While a number of evidence-based practice models exist to guide the integration of literature findings and other sources of evidence into practice, there is a need for additional models that serve as a guide and focus for the conduct of research in distinct scientific areas in practice-based settings.

Design: Model development and description.

Methods: Mayo Clinic is a large, comprehensive healthcare system with a mission to address unmet patient needs through practice, research and education. PhD-prepared nurse scientists engage in practice-based research as an integral component of Mayo Clinic's mission. A practice-based nursing research model was developed with the intent to advance nursing research in a clinical setting.

Results: The components of the Mayo Clinic Nursing Research model include symptom science, self-management science and caregiving science. The generation of nursing science is focused on addressing needs of patients with complex health conditions, inclusive of caregivers.

Conclusions: While clinical settings provide rich opportunities for the conduct of research, priorities need to be established in which to focus scientific endeavours. The Mayo Clinic Nursing Research model may be applicable to nurses around the globe who are engaged in the generation of knowledge to guide practice.

Relevance to Clinical Practice: The Mayo Clinic Nursing Research model can be used by nurse scientists embedded in healthcare settings to address clinically relevant

questions, advance the generation of new nursing knowledge and ultimately improve the health and well-being of patients and caregivers.

1 | INTRODUCTION

Nursing is the largest profession in health care, with continued growth expected over the next several years (Grady & Hinshaw, 2017). Nursing science plays a critical role in addressing health challenges, generating new knowledge and translating evidence to practice to improve patient outcomes (Grady, 2017; Powell, 2015). Furthermore, nursing science integrates biobehavioural approaches to better understand patients' needs and preferences, develop individualised symptom management interventions (Trego, 2017), advance interventions to promote self-management of chronic conditions and thus promote well-being and quality of life (Grady, 2017; Powell, 2015). Patients' healthcare needs are becoming increasingly more complex, giving rise to the need for practice-based research. The clinical practice setting provides an opportunity to conduct research, by which patients' and caregivers needs and outcomes may be addressed and improved.

The purpose of this paper is to present the Mayo Clinic Nursing Research (MCNR) model (Figure 1)—a model developed to guide and focus nursing science generation in a practice-based setting with an emphasis on promoting the health and well-being of patients and caregivers with complex needs. The components of the model are described, and exemplars of the generation of practice-based nursing knowledge are presented.

2 | BACKGROUND

Over a century ago, Florence Nightingale recognised not only the need for formal training for nurses but also the power of the nurse to improve patient outcomes (Nightingale, 1992). This is still true in today's healthcare environment. Nurses can help fill a critical need not only for the education and training of healthcare workers, but also for the design and testing of solutions to common health problems (National Institutes of Health, 2015). As noted by Dr. Patricia Grady, director emeritus of the National Institute of Nursing Research (NINR), '…nurse scientists can use their expertise in clinical research and their understanding of the relationship between behaviour and biology to further expand the reach and impact of nursing science in the larger community' (National Institute of Nursing Research, 2016, p. 6). However, recommended models for the structure and organisation of nursing research in clinical settings are scarce.

PhD-prepared nurse scientists (sometimes referred to as nurse researchers) design and implement research studies to improve health-related outcomes. Although most nurse scientists are

> **What does this paper contribute to the wider global clinical community?**
>
> - There is a need for additional models to guide the conduct of nursing research in clinical settings.
> - The Mayo Clinic Nursing Research Model was developed as a model to guide the generation of new nursing knowledge in a clinical, practice-based setting.
> - The model can be used in a variety of clinical settings for researchers who aim to fill evidence gaps in the literature.

employed in academic settings such as schools/colleges of nursing, there is an emerging trend for nurse scientists to have full-time appointments in practice settings (Robichaud-Ekstrand, 2016). The nurse scientist role has wide variability in how it is operationalised but can be described in three ways. First, in academic settings, Boyer's model of scholarship includes discovery, integration, application and teaching to frame the discussion of discovery and practice in nursing (Boyer, 1990; Hickey et al., 2019). Academic service partnerships have emerged as strategies to close the academic-practice gap by connecting clinical practice with academia in order to meet mutually beneficial goals (Sadeghnezhad et al., 2018). Examples of programmes in academic-service partnerships include preparation of new graduate nurses, patient safety initiatives, transitions-in-care programmes, advancement of evidence-based nursing and opportunities for clinical research (Sadeghnezhad et al., 2018). While such programmes inform the advancement of nursing research as a component of evidence-based practice in clinical settings, they are less informative in guiding the generation of knowledge among nurse scientists embedded in clinical settings.

In a second approach, a nurse scientist supports evidence-based practice, quality improvement, the conduct of research by clinical nurses and, if applicable, ANCC Magnet Recognition Program® activities (Kowalski, 2020). A third approach similarly involves embedding nurse scientists in clinical practice settings but the role is focused on the conduct and facilitation of nursing-oriented research, rather than simply providing support for research conducted by others (Chan et al., 2010). This third approach is used in the setting in which this model was developed.

Evidence-based practice models such as the Iowa Model and the Johns Hopkins Nursing Evidence-Based Practice Model have been adopted to guide translation of evidence to practice but they
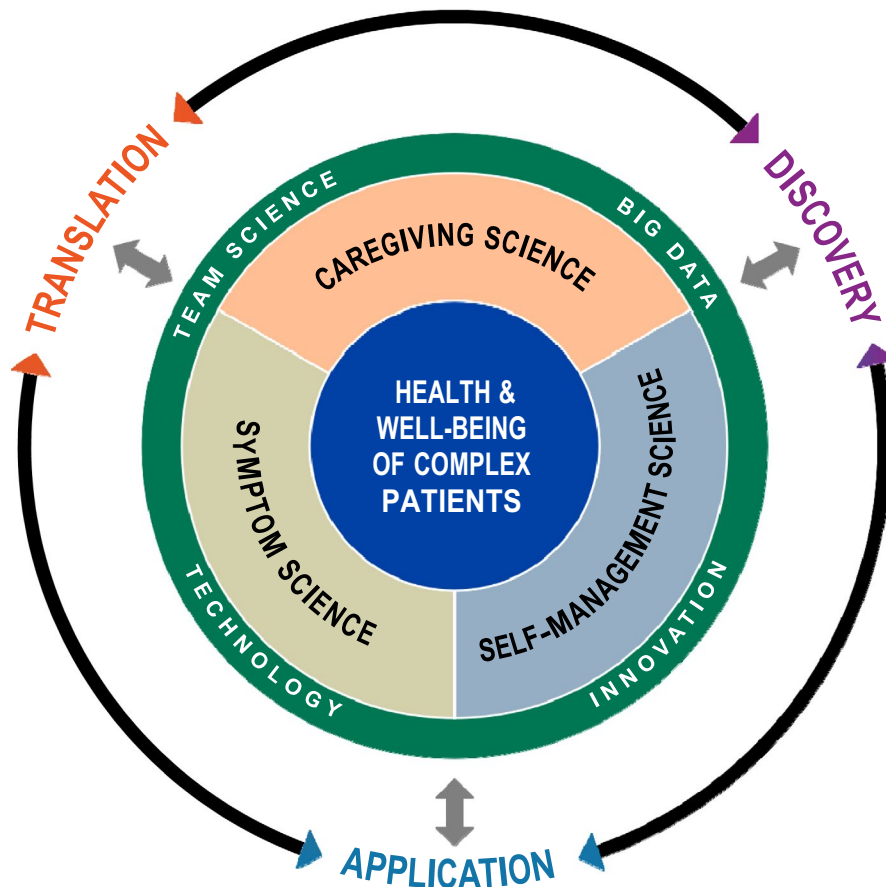
have limited utility in describing the infrastructure, focus and outcomes of nursing research in a clinical setting. The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care uses an algorithm to guide evidence-based practice processes from identification of a trigger to integrating and sustaining a practice change (Buckwalter et al., 2017). The conduct of research is included in the Iowa Model as a strategy to be used when insufficient evidence exists to recommend a practice change. The Johns Hopkins Nursing Evidence-Based Practice Model (Dang & Dearholt, 2018) includes a patient-centred approach and incorporates a continuum of Inquiry–Practice/Learning–Practice Improvement as a method to ensure that best practices are applied to patient care. However, the model is centred on an evidence-based practice approach, which differs from research in that research involves systematic investigation of phenomena to discover new information or reach new understandings and conclusions to generate new knowledge (Cohen et al., 2015; Hickey et al., 2019). The Joanna Briggs Institute (JBI) (Joanna Briggs Institute, 2016), based in the Faculty of Health and Medical Sciences at the University of Adelaide, South Australia, aims to promote evidence-based decision-making

by promoting the use of the best available evidence. JBI, through its JBI Collaboration, works with universities and hospitals around the world to synthesise, transfer and implement evidence that is culturally relevant and applicable across diverse healthcare settings internationally.

The NINR sets strategic funding and training priorities that advance nursing science to enhance the health and well-being of individuals across diverse populations (National Institute of Nursing Research, 2016). Current research priorities established by the NINR include four scientific foci: symptom science, wellness, self-management of chronic conditions, and end-of-life and palliative care (National Institute of Nursing Research, 2016). In addition, all areas of NINR's research programmes place an emphasis on promoting innovation and developing the nurse scientists of the 21st century (National Institute of Nursing Research, 2016). Recognising that symptoms are the primary reason patients seek care, the NINR developed the symptom science model to advance research. The symptom science model describes an analytical sequence beginning with a sequelae or cluster of symptoms, which are then characterised into a phenotype with biological correlates, followed by the

application of research methods that can be used to identify targets for therapeutic and clinical interventions (Cashion & Grady, 2015).

Nurse scientists are well positioned to develop new knowledge aimed at identifying global health solutions to social, economic, psychological and biological disparities. The generation and application of this knowledge are essential to provide the best available evidence to inform and guide professional nursing practice. While a number of evidence-based practice models exist to guide the integration of literature findings and other sources of evidence into practice, there is a need for additional models that serve as a guide and focus for the conduct of research in distinct scientific areas in practice-based settings. Therefore, the project team identified a need for the development of a model articulating the goals and strategies to advance nursing research within their institution, and which would have broad applicability to other institutions and nurse scientists embedded in the clinical practice.

3 | METHODS

Mayo Clinic is a large academic medical centre that incorporates practice, education and research into its mission, which has been emulated in the Department of Nursing and the Division of Nursing Research for over three decades. Today, the Mayo Clinic Nursing Research Division is an enterprise-wide unit providing infrastructure and support for nursing research at its sites in Mayo Clinic. A cadre of PhD-prepared nurse scientists lead independent programmes of research and provide consultation to all staff in research-related matters, including scientific review of research protocols. In addition, small cadres of registered nurses providing direct patient care conduct research studies under the mentorship of a nurse scientist. These clinical nurse scholars identify clinically relevant questions that are investigated by an independent research study (Chlan et al., 2019). Details of this programme are described elsewhere (Chlan et al., 2019; National Institute of Nursing Research, 2016).

The project team developed a model of nursing research to guide the foci for nurse scientists' research at the institution and to generate new nursing knowledge based on needs that arise from the practice setting. The model was also intended to encompass strategic priorities established both by the institution and the field of nursing science. No ethics approval was required for this project.

The team started the process of model development by conducting a literature review regarding (1) existing models of nursing research and evidence-based practice, (2) nursing science, (3) the nurse scientist role, (4) national and international nursing research strategic priorities and (5) research strategies to transform health care. In addition, the team sought input from multidisciplinary stakeholders at the institution regarding their perception of the current and potential future contributions of nursing science to the practice. Finally, organisational resources describing the research environment were used to inform the model. Thus, it is a model rooted in practice, rather than a theory-based model.

4 | RESULTS

4.1 | The Mayo Clinic nursing research model

The MCNR model is focused on three primary areas across multiple diseases, illnesses, and healthcare settings: symptom science, self-management science and caregiving science. With a focus in these areas, nurse scientists leverage team science, big data, innovation and technology to move knowledge generation quicker along the discovery, translation and application continuum to meet the needs of patients and caregivers.

The following assumptions informed the development of the model. First, nursing research is vital for the generation of new knowledge to improve the health and well-being of patients and their caregivers. Second, the health and well-being of individuals with complex conditions are enhanced by developing and testing patient-centred interventions through research that focuses on the science of symptom assessment and management, self-management and caregiving. The MCNR model was developed to guide how this vision will be implemented in a clinical setting with programmes of nursing research aligned to inform and transform health care.

4.2 | Patients and caregivers as the focal point of the model

At the centre of the model (Figure 1) are the patient and caregiver with complex needs—medical, physical or psychosocial—around which all other elements in the model centre. The nurse scientist focuses on a better understanding of those needs and the testing of interventions used to address them, with the definitive goal of improving patients' and caregivers' health and well-being. For the purposes of this model, health is defined from a holistic, phenomenological perspective of optimal overall physical, mental, spiritual, social and role functioning (Saylor, 2004; Watson, 2008); and well-being is designated as individuals' perceptions, judgements and expectations regarding their health (Saylor, 2004; Sullivan, 2003). These foci are consistent with the patient-centred model of care in which patients are viewed as a whole and their individual viewpoints and characteristics are taken into consideration when making decisions regarding care (Zhao et al., 2016). It is also congruent with the mission and values of Mayo Clinic (Mayo Clinic, 2021), as well as the profession of nursing (Spurlock, 2019).

4.3 | MCNR model scientific foci

The generation of symptom science, self-management science and caregiving science are the scientific foci that promote the health and well-being of patients and caregivers in a practice-based, patient-centred clinical setting. It is through the conduct of scientific investigation in these three main areas, described below, that nursing research seeks solutions to unmet, complex health needs of patients and caregivers.

Symptom science seeks to transform the practice using biological, clinical and/or behavioural approaches to investigate symptoms aiming to individualise care and assess patient-reported outcomes such as quality of life and well-being (Grady, 2017). Self-management science is based on a complex set of cognitive and behavioural self-regulation responses that individuals engage in to manage chronic illnesses or factors that increase the risk for illness (Araújo-Soares et al., 2019). Research to support self-management includes developing and evaluating a broad range of interventions often focused on providing education and guidance for managing specific illnesses, partnering with healthcare providers and coping with challenges of living with chronic illness (Allegrante et al., 2019).

Caregiving science is research that explores effective approaches to reduce burden on and promote the health and well-being of professional and lay caregivers (Grady, 2017). Research that examines methods to include caregivers in the care process and to design and test interventions that include them has the potential to significantly contribute to improved patient outcomes and patient-centred care (Littleton-Kearney & Grady, 2018).

4.4 | Leveraging team science, big data, innovation, and technology

In addition to cutting-edge research methods, nurse scientists leverage team science, big data, innovation and technology as tools, resources and methods to seek solutions to unmet health needs of patients and caregivers (Brennan & Bakken, 2015; Conn, 2019; Grady & Gough, 2018). Within the MCNR model, these four resources and methodologies contribute to the advancement of nursing science in the areas of symptom, self-management, and caregiving. *Team science* leverages the strengths and expertise of professionals trained in different disciplines or nursing specialties through a collaborative effort to address a scientific challenge (Bennett & Gadlin, 2012). Team-based research initiatives can be uni- or multidisciplinary groups, and teams can be large or small (Conn, 2019). In team science, multiple stakeholders contribute unique perspectives on the topic at hand and are deeply engaged in the project (Bennett et al., 2018). The World Health Organisation has acknowledged the importance of team-based research through implementation of nursing collaborating centres, which focus on collaborative research of global or regional importance (National Institutes of Health, 2015).

Big data science allows researchers to analyse large and complex volumes of information that are newly available at unprecedented rates from sources such as electronic health records, large databases, sensor-enabled equipment, imaging techniques, smart devices and high-throughput genetic sequencing methods (Fernandes et al., 2012). Through the application of big data research methods, including artificial intelligence, researchers can discover new ways of understanding and addressing the needs of the patient (Fernandes et al., 2012). For example, big data methodologies can be implemented to maximise the utility of patient-reported outcome data in order to capture the patients' perspectives on how their disease, and

the treatment of their disease, is impacting their lives. These data can be used to inform clinical decision-making, predict long-term outcomes and identify future innovations in health technologies and other interventions (Calvert et al., 2015). This patient-centric approach ultimately allows healthcare providers to have a better understanding of how individuals are living with and managing their illness, and to make more informed decisions regarding personalised interventions that will have a measurable impact on the patient experience (Brennan & Bakken, 2015).

Innovation is defined as a creative, fast-moving endeavour that involves scientific methods and improvisation to design unique solutions that change the world (Mayo Clinic Center for Innovation, 2020). Innovative research uses novel theoretical concepts, methodologies and interventions to challenge current clinical practice paradigms. Innovations in health care can be seen in product innovation for the introduction of new types of goods and services, and in process innovation, which is centred on enhancing internal processes for the production of high-quality care (Arshad et al., 2018; Govindasamy & Wattal, 2018; Thune & Mina, 2016).

Technology in medical research involves innovations that impact health or healthcare delivery (Healthcare News & Insights, 2020; Martins & Del Sasso, 2008). Biotechnology, machine learning, pharmaceuticals, information technology, remote monitoring and medical devices are examples of technology. Other technologies include software and applications for self-management and symptom tracking. Technologies can maximise efficiency and access to health care, such as digital solutions to connect patients to the appropriate provider (National Institute of Mental Health, 2020).

4.5 | Discovery-translation-application continuum

Research conducted at Mayo Clinic occurs along a continuum to address unmet patient needs. The process by which new information makes its way into practice along this continuum is through discovery, translation and application, depicted in the outermost ring of the model in Figure 1. *Discovery* uses scientific methods to seek solutions to improve the health and well-being of patients with complex conditions; *translation* is the development and testing of possible solutions; and *application* is the dissemination, integration, and evaluation of solutions into practice (Ammerman et al., 2014).

Nursing research contributes to innovation at all points along the discovery-translation-application continuum, continually advancing science, transforming patient care and improving outcomes (Grady, 2017). Guided by the MCNR model, nurse scientists discover answers to puzzling clinical questions that can be translated and applied directly to clinical practice to improve patient care as rapidly and as safely as possible. There are at least seven implementation science models or frameworks available to guide translation of findings to practice. Systematic reviews show variability in their scope and application so selection of an implementation framework according to the context of change is key (Dintrans et al., 2019; Moullin et al., 2015). In our setting, translation is achieved through

clinical partnerships where the department's evidence-based practice model is used to guide implementation. As depicted in the model in circular form (Figure 1), this process is iterative rather than linear. Discoveries are made through observation, discussion or other forms of data. These discoveries, seen through the nursing lens, may have broader applications to be considered. Further, empirical evidence is needed prior to implementing new discoveries into practice. During implementation, new discoveries and applications may come to light.

5 | EXEMPLARS OF THE MAYO CLINIC NURSING RESEARCH MODEL

The overall purpose of the MCNR model is to provide a coordinated focus and consistent approach that guides and prioritises practice-based nursing research. Nurse scientists use the model in their own focused areas of research as well as to guide nurses in the conduct of research that arises from their practice. Outlined below are exemplars of how the MCNR model guides the conduct of practice-based research among nurse scientists at Mayo Clinic. Examples of how the model has informed research are presented. Not all aspects of the model are evident in each exemplar.

The first nursing research exemplar, within the domain of symptom science (second ring of the MCNR model), aims to address unmet needs of critically ill patients (centre of model) related to comfort-promoting interventions. Under the mentorship of a PhD-prepared nurse scientist, this descriptive, cross-sectional study is being conducted by two practising ICU nurses who first identified in their own clinical setting the problems of: (1) numerous sources of discomfort among ICU patients; (2) the absence of objective assessment of these discomforts as distinct from objective assessment of pain; and (3) the inability to intervene appropriately with effective comfort-promoting interventions. Next, they identified the distinction between discomfort and pain. They are currently assessing, describing and quantifying the contributing sources of discomfort experienced by nonmechanically ventilated ICU patients using the Discomforts Perceived by ICU Patients instrument, a modified version of the French instrument Inconforts des Patients de REAnimation (IPREA) questionnaire (Baumstarck et al., 2019). The end-product of this study will be the discovery of new knowledge (outer ring of model) to inform ICU nursing practice regarding discomfort-producing stimuli. Future areas of investigation would include developing and testing interventions (translation of possible solutions through clinical trials), of which those that are found to be effective would then be directly applied in the setting of ICU clinical nursing practice contributing to symptom science for critically ill patients.

An exemplar within the domain of caregiving science (second ring of MCNR model) is a multidisciplinary trial co-led by a nurse scientist and physician (team science—third ring of model). The investigators noted that patients with advanced cancer or those nearing the end-of-life experience significant, unique distress related to their disease, treatment and impending mortality. In addition, they noted

a lack of evidence on best methods to manage psychosocial distress in patients and caregivers with complex needs (centre of model). Thus, they designed a study to determine the feasibility of a modified version of the Resilient Living Program (The Resilient Option, 2020) that is tailored to the needs of patients with advanced cancer and their adult caregivers. Outcomes of the study include feasibility of participant recruitment, acceptability of the intervention and self-reports of resilience, quality of life, stress, anxiety, sleep, fatigue and caregiver role overload. Findings from this study will lead to the discovery (outer ring of model) of best practices for integrating a resilience training programme within the care of patients with complex needs (centre of model), and their caregivers. Future studies will examine the outcomes of revised training programmes that are more effectively tailored to the unique needs of these populations.

Recognising the emotional distress their patients endure, a group of nurses working on the bone marrow transplant (BMT) unit expressed interest in specific nursing interventions to support their patients' emotional well-being. Although they knew from their clinical experience that hospitalisation for BMT is quite stressful, they wanted to have a better understanding of when the most distressing times were for the patients, and what aspects of undergoing BMT were the most stressful. A review of the literature did not identify the specific information they were seeking. In collaboration with a nurse scientist and social workers on the unit, they implemented a descriptive study aimed at answering their questions. The study is in progress, and when finished, the results will inform both nursing and social work practice. This is an example of how clinical nurses identified a need centred around the health and well-being of complex patients (centre of the MCNR model), focused on symptom science (second ring of the model), and used team science (third ring of the model) to discover new information (outer ring of the model) from which nursing interventions can be developed and tested.

The final nursing research exemplar is within the domains of symptom science and self-management science (second ring of the MCNR model) to address the unmet needs of complex critically ill patients (centre of model). As of this writing, a randomised controlled clinical trial is testing the efficacy of self-administered versus intensive care unit (ICU) nurse-administered sedative therapy for anxiety in critically ill patients receiving mechanical ventilatory support (1R01 HL130881). Primary outcomes of the study include anxiety, duration of mechanical ventilation, delirium, level of arousal, alertness and sedative exposure. Post-ICU outcomes are also being examined and include functional status, depression and health-related quality of life. Findings from this clinical trial will be applied to the practice setting (outer ring of the model) to implement patient-centred interventions that improve not only ICU outcomes but also quality of life during the trajectory of recovery from critical illness and injury.

6 | DISCUSSION

The MCNR model guides nursing research across settings and prioritises inquiry on symptom science, self-management science and

caregiving science. The model is unique in that it specifically focuses on generation of nursing knowledge through the focus and conduct of research in a practice-based clinical setting. Few such models have been found in the literature; those that are available focus on advancing bedside nurses' involvement in research (Brewer et al., 2009; Stutzman et al., 2016). Robust programmes of nursing research remain relatively uncommon in clinical settings (Robichaud-Ekstrand, 2016). Availability of time and resources needed to facilitate clinical research are often constrained. Even in large academic medical centres with institutional commitment, the contributions of nursing research often go unrecognised, even from within the nursing profession. The MCNR model can be used to communicate the scope and focus of nursing research, from which studies can be developed to address significant problems impacted by nursing practice.

In creating the MCNR model, we sought to demonstrate the unique contributions of nursing research at our institution and develop a framework to guide the overall direction of nursing research. This model may have limited application in nonclinical settings; however, other institutions may glean information to develop similar models tailored to their settings. Adaptation of the model to fit a specific organisational context and available resources may be necessary. Although the model is implemented in a setting rich in human and other resources to guide nursing science, it could easily be used in settings with more limited resources to help frame the scope and function of nursing science. However, this model was primarily developed for use in clinical settings in which some resources for the conduct of research exist. Unfortunately, there are still many settings where the resources needed to facilitate nursing research are sparse or non-existent.

The MCNR model can also be integrated with existing models of nursing research. The National Institutes of Health Symptom Science Model is one example of a complementary model that can be used in tandem with the MCNR. The Symptom Science Model provides a guide for researchers to study complex symptoms experienced by individuals and incorporates the components of phenotypic characterisation, biomarker discovery and clinical application, with an overall goal of symptom reduction and improvement (Cashion et al., 2016). These methodologic components can be used to advance the care of patients with complex needs in the context of the institutional priorities and infrastructure described in the model. The MCNR model can be applied in several ways to advance scientific knowledge in the areas of symptoms, self-management and caregiving. The model incorporates advancements in biological sciences, technology and big data methods to meet the needs of patients in a holistic way using nursing's unique body of knowledge (Henly et al., 2015). While nurse scientists may not have extensive expertise in all areas, collaborating with other scientists and clinicians who have complementary expertise ensures that investigations incorporate the best science and technology from other fields to inform nursing knowledge and practice.

As nurse scientists are increasingly employed in clinical settings, it will become more important to evaluate and publish outcomes of models, including this one. Nursing research within our institution is evolving to best meet the needs of patients. The MCNR model is a step in the process to define our direction and differentiate our areas of expertise from those of other disciplines.

The model is not without limitations. The MCNR Model was developed by nurse scientists within the Division of Nursing Research to serve as a guide and focus for our conduct of research, and to communicate our work with others. It is a reflection of the current foci of nursing research at a single institution and, as noted earlier, may need to be adapted to meet the needs of other institutions. It is intended to serve as a starting point for the infrastructure needed to generate research ideas and to serve as a guide to focus the conduct of research in distinct scientific areas in practice-based settings. It is not intended to constrain research foci that are outside of this model. The model may be of lower utility in settings where nurse scientists are not available. It will be revisited periodically by the research team and stakeholders to ensure that it reflects the current focus of nursing research throughout the institution.

7 | CONCLUSION

Nurse scientists embedded in healthcare settings are uniquely positioned to inform translation of research findings to practice. As health care evolves and the needs of patients and caregivers become more complex, the importance of studying symptoms, self-management and caregiving is becoming increasingly critical. Nurse scientists leverage team science, big data, innovation and technology to move knowledge generation along the continuum of discovery, translation and application. The MCNR model can be used to advance generation of new nursing knowledge to improve the health and well-being of patients and caregivers.

8 | RELEVANCE TO CLINICAL PRACTICE

The MCNR model can be used by nurse scientists embedded in healthcare settings to address clinically relevant questions and ultimately improve the overall physical, mental, spiritual, social and role functioning of patients and caregivers, as well as to enhance individuals' perceptions, judgements and expectations regarding their health. The model provides a structure for addressing nursing science priorities through the discovery, translation and application continuum, and advancing the generation of new nursing knowledge.

CONFLICT OF INTEREST
The authors report no conflicts of interest with this manuscript.

AUTHOR CONTRIBUTIONS
Conception and design of the work, drafting of the article, critical revisions of the article and final approval of the version to be published: All authors.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

ORCID

Sherry S. Chesak https://orcid.org/0000-0001-8126-4486
Lori M. Rhudy https://orcid.org/0000-0002-2537-6368
Cindy Tofthagen https://orcid.org/0000-0002-3757-5823
Linda L. Chlan https://orcid.org/0000-0001-6922-7551

REFERENCES

Allegrante, J. P., Wells, M. T., & Peterson, J. C. (2019). Interventions to support behavioral self-management of chronic diseases. *Annual Review of Public Health*, *40*, 127–146.

Ammerman, A., Smith, T. W., & Calancie, L. J. A. (2014). Practice-based evidence in public health: Improving reach, relevance, and results. *Annual Review of Public Health*, *35*, 47–63.

Araújo-Soares, V., Hankonen, N., Presseau, J., Rodrigues, A., & Sniehotta, F. F. (2019). Developing behavior change interventions for self-management in chronic illness: An integrative overview. *European Psychologist*, *24*(1), 7.

Arshad, H., Radić, M., & Radić, D. (2018). Patterns of frugal innovation in healthcare. *Technology Innovation Management Review*, *8*(4), 28–37.

Baumstarck, K., Boucekine, M., Estagnasie, P., Geantot, M.-A., Berric, A., Simon, G., Floccard, B., Signouret, T., Fromentin, M., Nyunga, M., Sossou, A., Venot, M., Robert, R., Follin, A., Audibert, J., Renault, A., Garrouste-Orgeas, M., Collange, O., Levrat, Q., … Kalfon, P. (2019). Assessment of patients' self-perceived intensive care unit discomforts: Validation of the 18-item version of the IPREA. *Health and Quality of Life Outcomes*, *17*(1), 29.

Bennett, L. M., & Gadlin, H. (2012). Collaboration and team science: from theory to practice. *Journal of Investigative Medicine*, *60*(5), 768–775.

Bennett, L. M., Gadlin, H., & Marchand, C. (2018). *Collaboration team science: Field guide*. US Department of Health & Human Services, National Institutes of Health.

Boyer, E. (1990). *Scholarship reconsidered: Priorities for the professoriate*. Retrieved from Princeton, NJ: https://www.hadinur.com/paper/BoyerScholarshipReconsidered.pdf

Brennan, P. F., & Bakken, S. (2015). Nursing needs big data and big data needs nursing. *Journal of Nursing Scholarship*, *47*(5), 477–484.

Brewer, B. B., Brewer, M. A., & Schultz, A. A. (2009). A collaborative approach to building the capacity for research and evidence-based practice in community hospitals. *Nursing Clinics of North America*, *44*(1), 11–25, ix. https://doi.org/10.1016/j.cnur.2008.10.003

Buckwalter, K. C., Cullen, L., Hanrahan, K., Kleiber, C., McCarthy, A. M., Rakel, B., Steelman, V., Tripp-Reimer, T., & Tucker, S. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing*, *14*(3), 175–182. https://doi.org/10.1111/wvn.12223

Calvert, M., Thwaites, R., Kyte, D., & Devlin, N. (2015). Putting patient-reported outcomes on the 'Big Data Road Map'. *Journal of the Royal Society of Medicine*, *108*(8), 299–303.

Cashion, A. K., Gill, J., Hawes, R., Henderson, W. A., & Saligan, L. (2016). National Institutes of Health Symptom Science Model sheds light on patient symptoms. *Nursing Outlook*, *64*(5), 499–506. https://doi.org/10.1016/j.outlook.2016.05.008.

Cashion, A. K., & Grady, P. A. (2015). The National Institutes of Health/National Institutes of Nursing Research intramural research program and the development of the National Institutes of Health Symptom Science Model. *Nursing Outlook*, *63*(4), 484–487. https://doi.org/10.1016/j.outlook.2015.03.001.

Chan, R., Gardner, G. E., Webster, J., & Geary, A. (2010). Building research capacity in the nursing workforce: The design and evaluation of the nurse researcher role. *Australian Journal of Advanced Nursing*, *27*(4), 62–69.

Chlan, L. L., Johnson, P. O., Peterson, P. E., Striegel, L., Au, G., Fritsche, A., Bursiek, A., Engelmann, A., & Tofthagen, C. (2019). Strategies to promote nurses' engagement in clinical research: Description of two nurse scholar programs. *Journal of Professional Nursing*, *36*(3), 111–115. https://doi.org/10.1016/j.profnurs.2019.11.001.

Cohen, M. Z., Thompson, C. B., Yates, B., Zimmerman, L., & Pullen, C. H. (2015). Implementing common data elements across studies to advance research. *Nursing Outlook*, *63*(2), 181–188. https://doi.org/10.1016/j.outlook.2014.11.006.

Conn, V. S. (2019). *Team science: Challenging opportunity*. SAGE Publications.

Dang, D., & Dearholt, S. L. (Eds.) (2018). *Johns Hopkins nursing evidence-based practice: Model and guidelines* (3rd ed.). Sigma Theta Tau International.

Dintrans, P. V., Bossert, T. J., Sherry, J., & Kruk, M. E. (2019). A synthesis of implementation science frameworks and application to global health gaps. *Global Health Research and Policy*, *4*(1), 25.

Fernandes, L. M., O'Connor, M., Weaver, V. J. J. O. A. (2012). Big data, bigger outcomes: Healthcare is embracing the big data movement, hoping to revolutionize HIM by distilling vast collection of data for specific analysis. *Journal of AHIMA*, *83*(10), 38–43.

Govindasamy, S., & Wattal, S. (2018). Linking dynamic capabilities and healthcare innovations: A case study approach. *Paper presented at the 2018 engaged management scholarship conference: Philadelphia, PA*.

Grady, P. A. (2017). Advancing science, improving lives: NINR's new strategic plan and the future of nursing science. *Journal of Nursing Scholarship*, *49*(3), 247.

Grady, P. A., & Gough, L. L. (2018). Using nursing science to inform health policy: The role of the National Institute of Nursing Research. *Annual Review of Nursing Research*, *36*(1), 131–149.

Grady, P. A., & Hinshaw, A. S. (2017). *Using nursing research to shape health policy*. Springer Publishing Company.

Healthcare News & Insights (2020). *Medical technology*. Healthcare Business & Technology. http://www.healthcarebusinesstech.com/medical-technology/

Henly, S. J., McCarthy, D. O., Wyman, J. F., Stone, P. W., Redeker, N. S., McCarthy, A. M., & Conley, Y. P. (2015). Integrating emerging areas of nursing science into PhD programs. *Nursing Outlook*, *63*(4), 408–416. https://doi.org/10.1016/j.outlook.2015.04.010.

Hickey, J., Duffy, L. V., Hinkle, J. L., Prendergast, V., Rhudy, L. M., Sullivan, C., & Villanueva, N. E. (2019). Scholarship in neuroscience nursing. *Journal of Neuroscience Nursing*, *51*(5), 243–248.

Joanna Briggs Institute (2016). *The JBI model of evidence-based healthcare*. https://joannabriggs.org/jbi-approach.html

Kowalski, M. O. (2020). Nursing research at an ANCC Magnet® designated medical center. *Applied Nursing Research*, *55*, 151290.

Littleton-Kearney, M. T., & Grady, P. A. (2018). The science of caregiving bringing voices together: summary of National Institute of Nursing Research's 2017 summit. *Nursing Outlook*, *66*(2), 157–159.

Martins, C. R., & Dal Sasso, G. T. M. (2008). Technology: definitions and reflections for nursing and health care practice. *Texto & Contexto - Enfermagem*, *17*(1), 13–14.

Mayo Clinic (2021). *Mayo Clinic mission and values*. https://www.mayoclinic.org/about-mayo-clinic/mission-values

Mayo Clinic Center for Innovation (2020). *What we do*. http://centerforinnovation.mayo.edu/what-we-do/

Moullin, J. C., Sabater-Hernández, D., Fernandez-Llimos, F., & Benrimoj, S. I. (2015). A systematic review of implementation frameworks of innovations in healthcare and resulting generic implementation framework. *Health Research Policy and Systems*, *13*(1), 16. https://doi.org/10.1186/s12961-015-0005-z.

National Institute of Mental Health (2020, September 2019). *Technology and the future of mental health treatment*. https://www.nimh.nih.

gov/health/topics/technology-and-the-future-of-mental-health-treatment/index.shtml

National Institute of Nursing Research (2016). *The NIINR strategic plan: Advancing science, improving lives.* https://www.ninr.nih.gov/sites/files/docs/NINR_StratPlan2016_reduced.pdf

National Institutes of Health (2015). *Global health matters.* https://www.fic.nih.gov/News/GlobalHealthMatters/january-february-2015/Documents/fogarty-nih-global-health-matters-newsletter-january-february-2015.pdf

Nightingale, F. (1992). *Notes on nursing: What it is, and what it is not.* Lippincott Williams & Wilkins.

Powell, K. (2015). Nursing research: Nurses know best. *Nature, 522*(7557), 507–509.

Robichaud-Ekstrand, S. (2016). New Brunswick nurses' views on nursing research, and factors influencing their research activities in clinical practice. *Nursing & Health Sciences, 18*(2), 246–255. https://doi.org/10.1111/nhs.12261.

Sadeghnezhad, M., Heshmati Nabavi, F., Najafi, F., Kareshki, H., & Esmaily, H. (2018). Mutual benefits in academic-service partnership: An integrative review. *Nurse Education Today, 68*, 78–85. https://doi.org/10.1016/j.nedt.2018.05.019.

Saylor, C. (2004). The circle of health: A health definition model. *Journal of Holistic Nursing, 22*(2), 97–115.

Spurlock, D. Jr (2019). Toward an inclusive vision of both nursing practice and nursing science. *Journal of Nursing Education, 58*(6), 319–320. https://doi.org/10.3928/01484834-20190521-01.

Stutzman, S., Olson, D., Supnet, C., Harper, C., Brown-Cleere, S., McCulley, B., & Goldberg, M. (2016). Promoting bedside nurse-led research through a dedicated neuroscience nursing research

fellowship. *Journal of Nursing Administration, 46*(12), 648–653. https://doi.org/10.1097/nna.0000000000000421.

Sullivan, M. (2003). The new subjective medicine: taking the patient's point of view on health care and health. *Social Science & Medicine, 56*(7), 1595–1604.

The Resilient Option (2020). *Our research.* https://www.resilientoption.com/p/our-research

Thune, T., & Mina, A. (2016). Hospitals as innovators in the health-care system: A literature review and research agenda. *Research Policy, 45*(8), 1545–1557.

Trego, L. L. (2017). Developing a military nurse scientist program of research: A military women's health exemplar. *Nursing Outlook, 65*(5), S130–S139.

Watson, J. (2008). *Nursing: The philosophy and science of caring* (Rev ed.). University Press of Colorado.

Zhao, J., Gao, S., Wang, J., Liu, X., & Hao, Y. (2016). Differentiation between two healthcare concepts: Person-centered and patient-centered care. *International Journal of Nursing Sciences, 3*(4), 398–402.