Journal of
Nursing Scholarship

CONTENTS

PROFESSION AND SOCIETY

The Official Publication of the Honor Society of Nursing, Sigma Theta Tau International

WILEY Blackwell

Building Sustainable Careers in Nursing Science: Scientific Innovations and Transdisciplinary Collaborations

The National Nursing Research Roundtable (NNRR) is an annual meeting that provides an opportunity for leaders of nursing organizations that have a strong research mission to discuss and disseminate research findings to improve health outcomes, as well as to discuss priorities in science, practice, and policy. In 2017, the NNRR was cohosted by the American Association of Colleges of Nursing (AACN) and the National Institute of Nursing Research (NINR) and addressed the critical topic of preparing nurse scientists for sustainable careers through innovation and transdisciplinary collaborations.

In the series of articles that follow, invited NNRR speakers elaborate on their roundtable presentations and perspectives. In 2017, speakers included Dr. Antonia Villarruel, Professor and Dean of Nursing, at the University of Pennsylvania; Dr. Jacquelyn Taylor, Associate Professor, School of Nursing, at Yale University; Dr. Patti Brennan (who did not submit an article for this series), Director National Library of Medicine at the National Institutes of Health (NIH); and Dr. Kathleen Hickey, Associate Professor of Nursing, at Columbia University.

Dr. Antonia Villarruel's article provides an extensive discussion about building innovation and sustainability in research. Innovation, as noted by Dr. Villarruel, is inherent to sustainability as a means to address changing contexts and new discoveries. Offering a broad perspective on the seemingly incongruent relationship between innovation and sustainability in research, she discusses the use of novel concepts, approaches, and methodologies, as well as improvements on or new applications of concepts, approaches, and interventions, while encouraging nurse scientists to think about sustainability early in their research planning. Aspects including the program of research, the team, infrastructure, innovation, and resources must be considered for sustainability. Furthermore, the role of science and research is important for informing health policy and health care. Dr. Villarruel highlights these concepts through her own research that focuses on health issues of Latino children and adolescents. Her work demonstrates long-term effectiveness of interventions and feasibility for dissemination to multiple communities and in a variety of formats.

Dr. Taylor's article focuses on the importance of nursing science in the context of -omics-based research and precision health in minority populations. She notes that nurses have conducted research with hard-to-reach populations for decades and are well positioned as both principal investigators or coinvestigators to lead efforts in genetics and genomics. Although past precision health and -omics-based initiatives have had few nurse scientists in leadership positions, Dr. Taylor highlights a cadre of nurse scientists and their projects in genetics who have proven their viability in conducting research that contributes to current precision health initiatives, including the Precision Medicine Initiative's *All of Us* Research program. While challenges remain, Dr. Taylor offers recommendations for nurses to increase their knowledge in -omics and to continue to build a strong presence of nurse scientists as leaders in precision health research by engaging in early career collaboration, participating in ongoing training, and taking an inclusive approach to diversity in nursing and -omics research, resulting in leaders who will be well placed in reducing health disparities through research, practice, and education.

In addressing strategies for sustainability in a data-driven environment, Dr. Brennan, Director of the National Library of Medicine (NLM), discussed key elements that support the development of sustainable careers, such as team science and international research collaborations that can inform future problems both in the United States and abroad. Sharing science with society, engaging in science broadly, and the expansive sharing of data across disciplines, including results of non-federally-funded research, are all examples of how the idea of open science can also foster sustainability. Making data available to the research community, beyond traditional forms of scientific publication, was also emphasized by Dr. Brennan. She described the FAIR (findability, accessibility, interoperability, reusability) Data Principles that encompass considerations for an infrastructure to support data reuse.

Dr. Brennan discussed the relocation of NIH's data science initiatives to the NLM, which has historical experience in storing data collections and disseminating its holdings. Future goals in data science include building new tools for analytics and visualization, promoting training in general data science to enrich specific disciplines, and supporting collaboration. To this end, the NIH Commons, a shared virtual space under development,

will allow investigators to find, manage, share, use, and reuse data, software, metadata, and workflows. Dr. Brennan advised nurse scientists to incorporate data access and data management in planning future research projects.

In her article, Dr. Kathleen Hickey, of Columbia University, provides an overview of strategies to build and sustain a career as a nurse scientist. She discusses how integrating technologies and precision approaches into clinical practice, research, and education will advance the next generation of nursing scholars and shape sustainable transdisciplinary careers. To ensure that nurses are prepared for a successful transdisciplinary career, Dr. Hickey emphasizes that classroom and clinical learning must merge to develop nurses who work effectively in complex healthcare environments and who reflect the innovation being implemented in health care. She notes the growing number of -omics and precision health training programs and research topics for nurses and the widening interdisciplinary and transdisciplinary research environments at institutions. Citing her own research as an example of team science, Dr. Hickey describes her current project, iHEART, which uses novel, noninvasive, real-time home monitoring of arrhythmias in atrial fibrillation patients.

In addition to speaker presentations, the roundtable featured a wider discussion session that concentrated on (a) the practice, education, and policy implications of science innovations and transdisciplinary collaborations in sustaining the careers of nurse scientists, and (b) strategies that NNRR organizations could use to highlight the importance of innovations and collaborations in sustaining the careers of nurse scientists.

Approaches discussed included increasing public awareness of nursing science and its role in research and healthcare advances, which could contribute to sustainability of nursing science. Also, coordinated messages and well-crafted media stories, tailored to resonate with each audience, are necessary for informing policymakers. Highlighting the scientific foundation of nursing care, nurse scientist participation in significant research collaborations, and cutting-edge nursing science discoveries were also among the focus areas recommended by attendees.

In addition, promoting collaborative research by universities and partnerships with industry, and nonacademic nurse researchers was viewed as essential to enhance team science. In light of the desire to work collectively, there should be awareness of interconnection of the missions and activities of nursing organizations, as well as recognition of individual contributions.

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Building Innovation and Sustainability in Programs of Research

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Abstract

Purpose: Innovation and sustainability are two important concepts of impactful programs of research. While at first glance these concepts and approaches may seem at odds, they are synergistic.

Approach: We examine the social, political, and policy context as it relates to innovation and sustainability. We present an exemplar of a program of research and discuss factors to consider in developing innovative and sustainable programs of research.

Conclusions: Innovation is an important component of sustainable programs of research. Understanding the social and political context and addressing relevant policy issues are factors to be considered in both innovation and sustainability.

Clinical Relevance: Innovation and sustainability, important components of research, are also central to clinical practice. Open communication between researchers and clinicians can support the acceleration of innovations and the integration of evidence-based findings in practice.

Building a program of research is a hallmark of a successful academic career. Importantly, a program of research represents persistence in advancing knowledge, and in the case of nurse researchers, for the purpose of promoting and improving health. Innovation and sustainability are two important components of impactful programs of research. While at first glance these concepts and approaches may seem at odds, they are in fact synergistic. In this article, we discuss the concepts of innovation and sustainability and examine the social, political, and policy context as they relate to programs of research. We present a program of research as an exemplar and discuss factors to consider in developing innovative and sustainable programs of research.

Innovation and Sustainability

There are many definitions of innovation. Common elements include a novel application of ideas, the implementation of something new, improvement to an existing product or process, and continued relevance

(Skillicom, 2016). Benjamin Franklin is renowned for being America's first and one of the most famous inventors (creation of new products, process and ideas such as the lightening rod) and innovators. His innovations included developing a flexible urinary catheter and bifocals, both which represented improvements from versions used in Europe.

Innovation is a key component in research. It is a consideration in evaluation and funding of applications from the National Institutes of Health (NIH). For example, reviewers are asked to evaluate proposals for the utilization and application of novel concepts, approaches, and interventions, the refinement of these approaches within the study, and how the proposal seeks to shift current paradigms (NIH, 2016b).

Similar to innovation, there are many definitions of sustainability. Common elements include the ability to support an activity, process, or product after initial implementation and funding. Sustainability refers to the long-term impact of a particular outcome or goal of the initial activity and, as such, may require modifications

to adapt to changes in context, resources, and priorities (U.S. Department of Labor, 2010).

There has been growing attention to sustainability of research within the NIH and other funding agencies. The focus on dissemination and implementation research recognizes that the movement of research findings to an individual, community, practice setting, or policy are not automatic or unidirectional. Request for dissemination and implementation proposals focus on understanding the way in which individual behavior and context influences the adoption, implementation, and sustainability of evidence-based interventions (NIH, 2016a).

At first glance, innovation and sustainability appear to be concepts that are opposite in meaning. But in fact, sustainability requires innovation. A few examples from business—Blackberry, Ringling Brothers and Barnum & Bailey Circus, and the Ford Motor Company—illustrate this relationship. Blackberry was a leader in mobile productivity and secure communications and for a period of time dominated the mobile device market. However, the company stopped production of its mobile devices, having fallen behind in market share of mobile devices after the introduction of innovations including the iPhone and android technologies (Spence, 2016). Similarly, the Circus stopped performances after 100 years. While rising production costs and declining ticket sales were cited as factors in the Circus closing (Feld Entertainment, 2017), continuous protests from animal rights groups concerned with cruelty of animals and the subsequent discontinuation of popular animal circus acts were other contributing factors. In the case of Blackberry, the failure to keep pace with innovations in the personal digital technology space led to its untenable loss of market share. In the case of the Circus, the changing context of performance art, concerns about animal welfare, and the inability to create a new model that was responsive to changing contexts led to the closing of an institution.

In contrast, the Ford Motor Company, long known as an innovator in automobile technologies and manufacturing, is rebranding itself. In addition to automobiles, Ford is showcasing innovations including self-driving and electric vehicles and ride-sharing and connected vehicles. This forward thinking is reflected in the company slogan: "Developing more ways to move through life … faster, easier, better. Today and tomorrow we're going further, so you can!" (Ford Motor Company, 2017). Only time will tell if this new direction and investment in innovations will lead to success for the company. However, Ford is taking a glimpse into the future, and not only responding to it, but also shaping the future. Ford demonstrates the type of innovative thinking and planning necessary for sustainability.

Innovation and Sustainability in Research

Innovation and sustainability are integral to research—both in the design of the research and in the implementation of products or processes that result from the research. It is important to be clear at the beginning of a study or a program of research—what is the problem to be solved? What is the end result or outcome of the study or program of research? A program of research in the context of addressing a certain health problem may not be sustainable for a variety of reasons. Ideally, multiple investigations might lead to solutions that address and solve the health issue. Vaccine development and the design of restraints in automotive vehicles are examples of solutions to combatting common childhood illnesses and injury and death from motor vehicle crashes. Innovations did not stop with these discoveries, because additional issues that were not part of the initial research or health problem arose. In the example of vaccine development, how to ensure safe vaccines and sustain protection, and determining the right incentives to providers, patients, and families to ensure adherence to vaccine schedules led to further research and innovations. Similarly, in relation to restraints in automotive vehicles, further research led to safety modifications and the development of both passive (e.g., airbags) and active restraints (e.g., seatbelt and shoulder strap use) and the development of incentives (e.g., reduced insurance rates) and disincentives (e.g., warning alarms, traffic fines). In these examples, additional approaches, including technology and policy, needed to be developed and tested in order to reduce communicable diseases in children and fatalities from motor vehicle crashes. The programs of research that developed the interventions may or may not have been central to the development of subsequent innovations. The point is that keeping focused on the problem to be solved, versus sustaining a program of research, is the right focus for advancing health.

In addition to keeping the focus on the problem to be solved, researchers need to be finely attuned to present and future contexts. As the noted columnist, David Brooks (2011) said:

> The roots of great innovation are never just in the technology itself. They are always in the wider historical context. They require new ways of seeing. As Einstein put it "The significant problems we face cannot be solved at the same level of thinking we were at when we created them."

Research does not exist in a vacuum and is heavily influenced by social, economic, and political contexts. Because contexts dynamically change over time, innovations are

needed to modify existing approaches or create new ones to new, emerging, and persistent health issues. In developing a sustained program of research, it is important to: (a) assess significant health issues, from the perspective of incidence, cost, morbidity, and mortality; (b) determine how science will change health outcomes and inform subsequent policy and practice to advance the health of the public; (c) recognize the potential of the research and interventions to be scaled up and sustained long-term; and (d) align the research with priorities at the institutional, regional, national, and global level (Feetham, 2011; Feetham & Doering, 2015; Feetham & Meister, 1999).

There has been a growing awareness among researchers that if our work is to result in sustainable solutions to health problems, an increased use of high-leverage change strategies is needed. For example, according to the Health Impact Pyramid (Frieden, 2010), the development and testing of counseling and education and clinical interventions, represented at the apex of the pyramid, requires high individual effort and results in low population impact and sustainability. These types of interventions have been a primary focus of nursing research. In contrast, socio-economic factors, represented at the base of the pyramid, often require policy interventions and necessitate less individual effort, which are likely to have greater population impact and sustainability.

The need to address policy changes and socio-economic factors is similarly confirmed in a comprehensive study of the American Academy of Nursing Edge Runner Models (Martsolf, Mason, Sloan, Sullivan, & Villarruel, 2017; Martsolf et al., 2016;), which are innovative nurse-designed care models with evidence of improved clinical and financial outcomes. Many of these models are research based and have demonstrated regional and also national impact and address a multitude of health (pregnancy to elder care) and health system (coordination of care, delivering comprehensive primary care) issues. Despite the success of various Edge Runner Models, nearly all have struggled with obtaining a consistent source of funding to sustain the scope and spread of their evidence-based and cost-effective programs. There is a clear need to begin to impact policy and payment levers that can facilitate the continued success of these evidence-based approaches.

Exemplar

Considering innovation and sustainability research processes and products is illustrated in a program of research designed to reduce sexual risk behavior among Latino adolescents. Initial studies began at a time when minority youth in general, and Latino youth in particular, were at high risk for acquiring sexually transmitted HIV. While prevention interventions were an important part of reducing HIV risk, few interventions had been tested or developed for Latino youth. The initial goal of this program of research was to develop a theoretically grounded and culturally effective intervention with a focus on adolescents and parents. The longer-term goal, if the intervention was proven to be efficacious, was to have the program implemented in practice with Latino adolescents in the United States and throughout Latin America.

The intervention developed, *Cuídate*, was an adaptation of an existing program that had been proven efficacious with African-American adolescents. The innovation in this study was identifying and incorporating Latino cultural beliefs and values that were believed to influence sexual behavior. A randomized controlled trial established the efficacy of the intervention with Latino adolescents (Villarruel, Jemmott, & Jemmott, 2006), and subsequent funding was obtained to examine the efficacy of the intervention with Mexican adolescents (Gallegos, Villarruel, Loveland-Cherry, Ronis, & Zhou, 2008). The innovation in the study with Mexican adolescents was to also develop and test a parent–adolescent communication intervention to strengthen the effects of the adolescent intervention (Villarruel et al., 2008). The parent–adolescent communication intervention, which was delivered in a small group format, was efficacious with Mexican parents. Subsequent funding was obtained to develop and test the parent intervention, *Cuídalos*, with Latino parents, but rather than just examine the efficacy with Latino parents in the United States, a shortened computer-based version and a subsequent Internet version was tested with Latino parents (Villarruel, Loveland-Cherry, & Ronis, 2010) and Puerto Rican parents (Villarruel & Varas-Diaz, 2012). This approach was designed to test the content and efficacy of the parent intervention, and also to test the delivery and acceptability of the mode of intervention delivery (e.g., computer and Internet). The introduction of technology approaches was examined in order to facilitate uptake and implementation of the *Cuídalos* intervention.

This program of research provided evidence of the efficacy of adolescent and parent interventions for Latino populations in reducing sexual risk behaviors and improving parent–adolescent communication about sex. Studies demonstrated the acceptability and feasibility of the interventions in multiple Latino communities and in different formats (small group and web-based). The innovative approaches tested included adaptation of evidence programs in different populations, identification and use of cultural beliefs and multilevel (individual and parent)

approaches to support safer sex, and the use of different modes of delivering intervention content (face-to-face and technology-based interventions). The clear introduction and testing of innovations, which built upon previous processes or products, the relevance of the health issue and testing or new approaches to address this health issue, were factors in sustaining this program of research.

Parallel to these studies were efforts to disseminate and scale-up the efficacious *Cuídate* intervention. These efforts were facilitated by support from the Centers for Disease Control and prevention (CDC, 2016) through their Replicating Effective Programs and Diffusion of Effective Behavioral Interventions (DEBI) programs in which efficacious interventions were provided with support to enable persons to implement evidence-based programs in their communities. This support included funds to support the development and testing of user, facilitator training, and trainer of training manuals, technical assistance, and marketing materials. Further, the DEBI program provided an infrastructure to support training and technical assistance to CDC-funded grantees and others around the country. These efforts resulted in a nation-wide (over 30 states) distribution and use of the *Cuídate* program.

Dissemination and use of evidence-based interventions are limited by training costs, which under the DEBI model often includes travel costs to remote locations, paid days for training, and the actual costs of attending a training session. To address these issues, we conducted a study to examine the efficacy of using a multi-user virtual environment, Second-Life®, to develop facilitator capacity to implement *Cuídate* (Villarruel, Aebersold, Valladares, Yeagley, & Tshannen, 2014). The innovation in this study was developing and testing alternatives to face-to-face training for evidence-based interventions. Findings from this study showed that while facilitators rated Second-Life® training high in relation to being provided a good demonstration of activities and a safe learning environment, they preferred face-to-face training (Aebersold et al., 2015). Despite this preference, facilitators were able to deliver the *Cuídate* curriculum with fidelity (Tschannen, Yaksich, Aebersold, & Villarruel, 2016), thus making virtual training an acceptable and feasible alternative to face-to-face training. Establishing the efficacy of alternative forms of training is an important innovation for sustaining the spread and use of similar evidence-based programs.

As mentioned previously, context is an important factor in both innovation and sustainability. There were many social, cultural, and policy factors that both supported and acted as barriers in developing this program of research and related dissemination and scale-up efforts. In relation to science policy, research priorities early in the HIV/AIDS epidemic supported the development of

Table 1. Considerations for Innovation and Sustainability in Research

What is the goal of the program of research (i.e., not just one study)?

What is the health problem to be solved?

What are the viable solutions that will address the health problem?

How will you engage relevant stakeholders in the design, implementation, and scale-up of the innovation?

What are the various methods of communication you will use with stakeholders?

How will these solutions, if proven successful, be sustained?

What will be needed to introduce the innovation to practice? To policy? What will be needed to sustain the innovation? What is the cost of the innovation (both financial and other)?

Who are the people or organizations that will champion and/or support the innovation?

Adapted from Feetham (2011); Feetham and Doering (2015); and Feetham and Meister (1999).

prevention interventions for racial or ethnic minorities as well as extending similar research in other areas across the globe. Subsequently, as the HIV/AIDS epidemic changed, science policy changed to address secondary prevention among high-risk populations. During this time, the Office of Adolescent Health was established with an emphasis on prevention of teen pregnancy, including research and dissemination efforts of evidence-based interventions. Similarly, the NIH Roadmap, with its emphasis on dissemination and implementation science, accelerated the translation of research findings to practice. Several programmatic efforts by federal (e.g., CDC, Office of Adolescent Health) and nonprofit agencies (e.g., National Campaign to Prevent Teen and Unintended Pregnancies) supported the use of evidence-based prevention interventions in practice and similarly facilitated their use in practice. Conversely, the development and implementation of studies to support safer sex was and is once again hindered by policies at the national and local levels that solely supported abstinence-only approaches for youth. Finally, the widespread development and use of computer and web-based technologies spurred innovations in both the development and dissemination of evidence-based prevention interventions.

Developing Innovative and Sustainable Programs of Research

The exemplar presented and lessons learned in the process (**Table 1**) provide direction for developing impactful programs of research. First, it is important to develop a research vision. What is the problem to be solved? What is the study or studies that will lead to viable solutions? It is important to develop a plan, once the vision is established, to begin thinking about how the innovation developed from research will be sustained. This will be an

important factor in designing the research. It is important to engage with multiple and diverse stakeholders (e.g., patients, providers, policymakers, insurers, business, community-based organizations) who are dealing with the particular health issue not only for support, but also to identify resistance and counterforces that need to be addressed either in research or in sustainability efforts. Further, the involvement of multiple stakeholders and different points in time throughout phases of research support the development and spread of innovations.

It is important to be aware of the social and political context that will affect investments in research and sustainability of products and processes. You might have a great idea for solving an important health issue. However, if existing policies will not support the investment in the research study or subsequent innovation, then the approach needs to be reconsidered. Determining the practice and policy relevance is a deliberate process that should include identifying the science policy that supports the research. Importantly, periodic re-envisioning and reframing of the research and approach are necessary so that support for the research and subsequent innovations can be sustained.

Communication of findings to scientific, practice, lay, and advocacy communities through a variety of outlets, including scientific and lay journals and social media, is an important strategy. It is important to not only report results, but to clearly outline the impact of the research and its significance in addressing the health issue. An important stakeholder group is government officials—and taxpayers! The public does support research and approaches to addressing important health problems. We need to include them in the work we do to maximize impact.

In summary, programs of research need to be focused on solving important health issues. Researchers need to be aware of contextual factors affecting their science in order to develop innovative and sustainable approaches to addressing these issues. Innovation is spurred on by changing contexts and new discoveries and must be incorporated in research if we are not only to support further discoveries but also to develop sustainable solutions that can be implemented and sustained outside of the context of research.

Clinical Resources

- Idea to Value. https://www.ideatovalue.com/about/
- Moving forward: Tips for program sustainability. https://www.doleta.gov/business/PDF/SustainTips.pdf

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Improving -Omics-Based Research and Precision Health in Minority Populations: Recommendations for Nurse Scientists

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Abstract

Purpose: The purpose of this article is to provide an overview of the role of nurse scientists in -omics-based research and to promote discussion around the conduct of -omics-based nursing research in minority communities. Nurses are advocates, educators, practitioners, scientists, and researchers, and are crucial to the design and successful implementation of -omics studies, particularly including minority communities. The contribution of nursing in this area of research is crucial to reducing health disparities.

Methods: In this article, challenges in the conduct of -omics-based research in minority communities are discussed, and recommendations for improving diversity among nurse scientists, study participants, and utilization of training and continuing education programs in -omics are provided.

Findings and Conclusions: Many opportunities exist for nurses to increase their knowledge in -omics and to continue to build the ranks of nurse scientists as leaders in -omics-based research. In order to work successfully with communities of color, nurse scientists must advocate for participation in the Precision Medicine Initiative, improve representation of nurse faculty of color, and increase utilization of training programs in -omics and lead such initiatives.

Clinical Relevance: All nursing care has the potential to be affected by the era of -omics and precision health. By taking an inclusive approach to diversity in nursing and -omics research, nurses will be well placed to be leaders in reducing health disparities through research, practice, and education.

The Precision Medicine Initiative (PMI) was announced by President Obama in 2015 with the goal of enrolling 1 million participants in a longitudinal cohort study, named the All of Us Research Program, to examine the effects of genetics, environment, and behavior on health (National Institutes of Health, 2017). A key goal of this program is to personalize medicine to individuals based on their unique genetic makeup, lifestyle, and environments, with an emphasis on recruiting a diverse cohort to examine health disparities within a representative population in the United States. This precision medicine approach goes beyond traditional genetics to include -omics, defined as fields of study ending in -ome/-omics: genomics, epigenomics, proteomics, metabolomics, etc. Where genetics is the study of single genes, variation, and heredity, genomics is the study of interrelationships of all genes. Further, epigenomics is the study of how the environment affects gene expression, and other fields such as proteomics and metabolomics examine how proteins and metabolites affect gene expression.

The purposeful inclusion and targeted enrollment of minority populations in the All of Us program is an attempt to address the many racial or ethnic disparities in health and disease outcomes. Despite bearing a disproportionate burden of disease, racial and ethnic minorities in the United States are often underrepresented in research studies (Oh et al., 2015). Potential reasons for

minority nonparticipation in research are often cited, such as mistrust of researchers, lack of resources or transportation, and lack of interest; however, there is evidence that minorities are no less willing to participate in research studies than other groups (Wendler et al., 2006). As such, attention must turn to recruitment and retention of targeted groups for participation in research using effective strategies (Yancey, Ortega, & Kumanyika, 2006).

Nurses are an invaluable resource in improving diversity among participants in studies such as the PMI. Nursing is patient focused and has a strong tradition of partnering with vulnerable communities to achieve positive health outcomes (Chin, Walters, Cook, & Huang, 2007). Similarly, nurses have been conducting research with "hard to reach" populations for decades. Through the development of strong partnerships, landmark nursing research studies in the areas of HIV, hypertension, diabetes, arthritis, and maternal and child health demonstrate that nurses are effective in conducting research in minority communities (Hill et al., 2003; Jemmott, Jemmott, & Fong, 1998; Kitzman et al., 1997; Lorig, Gonzalez, & Ritter, 1999; Taylor, 2009; Taylor, Wright, Crusto, & Sun, 2016). Although some of these studies are more than 10 years old, they remain relevant as seminal works because they provide the groundwork for recruitment and inclusion of minority populations in various types of investigations (i.e., HIV, cardiovascular disease, maternal–child health, etc.) that have been historically underrepresented in research.

Despite these significant research contributions, nursing has lagged behind in the design and conduct of studies in genetics or genomics (genetics-genomics). Nurses have traditionally held roles in the conduct of research, including participant recruitment and study or program management. Fewer nurses have held principal investigator (PI) or co-principal investigator (co-PI) roles in genetic-genomic research. As will be discussed in the text that follows, nurses are well placed to lead research efforts in genetics-genomics and contribute to the conceptualization of research, design and methods, laboratory analysis, data analytics, recruitment and retention efforts, and dissemination of findings. The purpose of this report is (a) to provide an overview of the role of nurse scientists in -omics-based research, including previous studies and ongoing research, and (b) to facilitate a discussion within the profession of nursing around the conduct of -omics-based research in minority communities, including recommendations for improving diversity among both nurse scientists and study participants, as well as to improve utilization of training and continuing education programs in -omics.

Previous and Ongoing -Omics Research

Despite knowledge that nurses and nurse scientists have and continue to be successful in recruitment and conduct of studies in underserved populations, few nurses have had leadership roles in many precision health or -omics-based initiatives. For example, many genome-wide association studies (GWAS), epigenome-wide association studies (EWAS), and whole genome sequencing studies (WGS) have received funding priority from the federal government (**Table 1**), yet the key personnel consists primarily of physicians, basic scientists, and epidemiologists. In fact, when nurses are included in such studies, many are underutilized in roles that are limited to data collection, participant counseling and retention, or as consultants. Some nurse scientists have successfully collaborated with some GWAS, EWAS, and WGS consortia, but they are few. More nursing leadership in these studies would be advantageous for participants and scientists alike if nurse scientists were included as PIs or co-investigators (Co-Is) of such important work.

One example of the lack of diversity in genetic and genomic studies is that of consortia, which are an effective way to pool the large number of participants necessary for genetic studies. Genetic and genomic consortia have few ethnic minority nurse scientists in the role of PI. Further, these consortia collaborate on studies in major metropolitan and urban areas in the United States (i.e., Boston, Dallas, Detroit), yet despite the high proportion of minority communities in these cities, Black and Latino participant representation in these studies is low. For example, the Clinical Sequencing and Exploratory Research consortia are an ongoing group of studies that examine the use of genome sequencing in populations across the United States (Green et al., 2016). Diversity is lacking in genome sequencing, and many factors may contribute to this phenomenon, such as lack of outreach to minority groups, lack of minority investigators, and disconnect between institutions funded and surrounding communities of need (Green et al., 2016). Because of this lack of diversity, the renewal grant program announcement released by the National Institutes of Health (NIH) now requires that a certain percentage of enrolled participants come from underrepresented minority groups. We recognize the leadership of the NIH for taking such a stand for diversity among participant groups. In the future, forward progress should extend to team composition to develop truly multidisciplinary teams with underrepresented minority scientists (particularly nurse scientists) from various backgrounds contributing to the conceptualization and leadership of such studies to aid in overall successful outcomes.

Table 1. -Omics Studies Inclusion of Minority Participants and Nurse Scientists

Examples of types of studies	Inclusion of ethnic minorities in research	Nurse scientist collaborators	Nurse scientists as key personnel (not consultants or research assistants)
GWAS	✔	✔	Limited
EWAS	Limited	✔	Limited
Microbiome	✔	✔	✔
Sequencing	Limited	Limited	Limited

Note. EWAS = epigenome-wide association studies; GWAS = genome-wide association studies.

National Institutes of Nursing Research–Supported -Omics Research

There is a cadre of nurse scientists currently conducting research in genetics-genomics, and some of their research is funded by the National Institutes of Nursing Research (NINR; Williams, Tripp-Reimer, Daack-Hirsch, & DeBerg, 2016). Nurse scientists are well positioned to conduct research that can contribute to the PMI, including work on improving risk assessment, efficacy of drug treatment and self-management, and advocating for equal access to -omic technologies for vulnerable populations, which are key strategic areas for nurses in the future (Williams, Katapodi, et al., 2016). Studies in the areas of genetics-genomics and health disparities have also been prioritized as an area of high importance for nurse researchers (Genomic Nursing State of the Science Advisory Panel et al., 2013).

NINR-funded research in genetics and genomics demonstrates the effectiveness of nurse scientists in leadership roles. Nursing researchers have reported their procedures for successfully recruiting substantial numbers of minority participants into genetic-genomic studies and collecting specimens for biobanks, citing the importance of building rapport, transparent communication, and collaboration with experts in genomics as key features contributing to their success (Oruche, Carpenter, Renbarger, & Ross, 2016; Taylor, 2009). Other nurse scientists have led their own studies examining common and chronic conditions, such as gene–environment and DNAm-environment interactions associated with blood pressure in African American mothers and their young children (Taylor, Wright, 2016). Corwin and colleagues are studying how stress, diet, and health behaviors influence the microbiome during pregnancy and may lead to preterm birth in African Americans through work at Emory University (Dunlop et al., 2015). Still other researchers are examining how genetics-genomics may play a role in pain through P30 center grants (Kim et al., 2017; Starkweather et al., 2016). Another example, the Precision Medicine Core at Columbia University, is led by nurse scientists and focuses on genetics-genomics related to symptom self-management in Latinos with their Precision in Symptom Self-Management Center.

These examples of nurse scientists leading and participating in -omics-based research demonstrate nursing's potential contribution to the PMI All of Us Research Program and extend the role of the nurse to the design and conduct of research that directly impacts patients and families (see **Table 2** for examples of NINR-supported -omics research with minority populations). In fact, there have been several -omics-based special issues of nursing journals that showcase the excellent work of nurse scientists conducting studies in -omics and health disparities. In 2013, Nursing Research and Practice published a special issue on "Health Disparities in Genomics and Genetics." Articles in this issue focused on -omics studies that had an emphasis on underserved populations and were conducted by ethnic minority investigators. Spruill et al. (2014) of the University of South Carolina described pioneering studies led by nurses. These included studies on attitudes toward genetic testing among African-American families in Detroit (Taylor, Peternell, & Smith, 2013), and epigenomics of renal function among African Americans in the Genetic Epidemiology Network of Arteriopathy (GENOA) study (Bomotti et al., 2013), among others.

The *Journal of Nursing Scholarship* also offered a special issue in 2013 on "Relevance of Genomics to Healthcare and Nursing Practice" (Calzone et al., 2013) that showcased many reviews on various topics, such as cardiovascular genomics (Wung, Hickey, Taylor, & Gallek, 2013), genomics of metabolic syndrome (Taylor, Kraja, et al., 2013), and newborn screening (DeLuca, Zanni, Bonhomme, & Kemper, 2013). In 2017, a special issue with a focus of "Omics in Nursing Science" was published by *Nursing Research*. The 2017 special issue showcased -omics studies of varying methodologies led by nurse scientists, including ethnic minority nurses. Methods highlighted in the 2017 Nursing Research special issue ranged from candidate gene analyses (Zahari et al., 2017), the microbiome (Cong et al., 2017),

Table 2. NINR-Supported -Omics Studies

Examples of types of studies	Inclusion of ethnic minorities in research	Nurse scientist collaborators	Nurse scientists as key personnel (not consultants or research assistants)	PI and institution
P20 or P30 centers	✔	✔	✔	Starkweather, A., University of Connecticut; Bakken, S., Columbia University; Page, G., Johns Hopkins University; Waldrop-Valverde, D., Emory University; Docherty, S., Duke University; Moore, S., Case Western Reserve University; Miyong, K., University of Texas Austin; Dorsey, S., University of Maryland; Redeker, N., Yale School of Nursing; Guthrie, B., Northeastern University; Kelechi, T., University of South Carolina; and many others
R01	✔	✔	✔	Corwin, E., Fitzpatrick, A., & Xaio, C., Emory University; Cresci, S., & Heitkemper, M., University of Washington; Groer, M., University of South Florida; Holman, A., UC-Irvine; Taylor, J., Yale School of Nursing; and many others
R21/R03	✔	✔	✔	[a]Aouizerat, B., NYU; [a]Conley, Y., University of Pittsburgh; Zhang, C., Rush University; and others
T32	✔	✔	✔	Allen, J., Johns Hopkins University; Bakken, S., & Larson, E., Columbia University; Dunbar, S., Emory University; Hodge, F., UCLA; Portillo, C., UCSF; and many others
PECASE	✔	✔	✔	Spruill-Johnson, I., University of South Carolina; Gill, J., NINR intramural; Taylor, J.,Yale School of Nursing

Note. P20, P30, and T32 information is from the NINR website: https://www.ninr.nih.gov/researchandfunding/funded-ninr-grants-collaborative-activities. NINR = National Institutes of Nursing Research; PECASE = Presidential Early Career Award for Scientists and Engineers; PI = principal investigator.
[a]Although these PIs are not nurses, they have contributed significantly to the inclusion and advancement of nurse scientists in -omics research.

pharmacogenomics (Aroke, Crawford, & Dungan, 2017), proteomics (Voss et al., 2017), and recommendations for use of whole genome sequencing to advance nursing science (Taylor, Wright, Hickey, & Housman, 2017).

Lastly, a new call for papers has been issued by *Biological Research for Nursing* on the topic of "Genetics and Genomics in Nursing Science" (Biological Research for Nursing, 2017) with an anticipated publication date of 2018. It is clear that nurses and nurse scientists are involved with -omics-based research and care at various levels, and these contributions, particularly among vulnerable populations, are being highlighted in nursing and other scientific journals. Although much progress has been made with nurse-led -omics studies, more work is needed to solidify the importance of and highlight the work that nurse scientists do in leading such efforts. One important example that highlights the stellar work in -omics by three nurse scientists is the Presidential Early Career Award for Scientists and Engineers (PECASE) (White House Office of the Press Secretary, 2017; Wikipedia, 2017). The PECASE is the highest honor bestowed upon scientists by the federal government and recognizes scientists and engineers for exemplary scientific accomplishments that are in alignment with

national goals. All three nurse scientists who have been awarded the PECASE have programs of research in -omics, and two are ethnic minority nurses who study -omics in ethnic minority populations. All three PECASE nurse scientists received their awards under President Barack Obama—two in 2013 and one in 2017.

Challenges and Considerations

Despite the progress discussed here in the conduct of -omic-based nursing research and minority populations, many challenges remain. First, the lack of minority representation that continues in both the practice and science of nursing hinders the development of research questions focused on and developed with communities of color. According to the American Association of Colleges of Nursing (2015), only 13% of nursing faculty nationwide identify as African American, Latino, or from other underrepresented groups, while these groups made up 37% of the U.S. population in 2012 and are expected to grow to over 50% by 2043 (U.S. Census Bureau, 2014). This underrepresentation of nurse researchers is especially problematic considering the well-documented

and longstanding racial and ethnic health disparities in the United States (Smedley, Stith, & Nelson, 2003).

Second, the inclusion of nursing in the era of -omics research also requires clarification of nomenclature. Much research is labeled "interdisciplinary," yet is limited to physicians representing distinct medical specialties instead of truly drawing from the expertise of diverse disciplines of study, including nursing, genetic counseling, social work, social sciences, and others (Rosenfield, 1992; Stokols, Hall, Taylor, & Moser, 2008). Further, including nurse scientists and minority nurse scientists as "consultants" on research teams is not interdisciplinary. Nurses are leaders, and their unique and important contributions to teams need to be respected as part of the core leadership structure, instead of being limited to ancillary research support. Before the terms clinical-translational science, bench-to-bedside, or community-based participatory research were coined phrases in the literature, these axioms simply described nursing. For example, the definition of nursing can be found as early as Florence Nightingale models with an ecology emphasis that incorporates "interactions and interrelationships between the individual person and their environments" (Donaldson & Crowley, 1978). A further expansion for nursing science includes a definition of the study of personal health, family, the environment, or familial human health ecology to encompass communities and shared social interactions (Donaldson, 2002).

Third, the inclusion of nursing and other disciplines is imperative to successfully formulate comprehensive and patient-centered research, considering the many ethical, legal, and social issues related to PMI in the recruitment and protection of minority communities (Sankar & Parker, 2016). Collaboration is increasingly important since -omics is a rapidly growing and expanding field, and it is impossible to have expertise in every component. For example, pharmacogenomics research in nursing is a field that will require nursing input and collaboration for successful integration into translational clinical care (Knisely, Carpenter, & Von Ah, 2014).

Conclusions and Recommendations

The nursing perspective is integral to precision health, as it is not only informed by experiences working with patients in the clinic, but also includes the fundamental nursing approach of the holistic view of the patient and community. This understanding incorporates the interaction of genetic-genomic and psychosocial mechanisms that contribute to disease development and prevent the achievement of optimal health. It is at this interface that nurses and nurse scientists can be instrumental in advancing science, and in promoting responsible bioethical

approaches to genetics research carried out with minority populations. All too frequently, researchers in -omics fields self-restrict to their silos of expertise. This compartmentalization of knowledge limits understanding of -omics-based research and contributions to the study of health disparities including the following: bioethics, sociocultural, psychological, and environmental risk factors. All of these areas listed above and more are considered in nursing science.

For nurses conducting research with minority or otherwise vulnerable populations, it is not sufficient to do a study on a population, even if it elucidates novel research findings. Research must be conducted with the population in a manner that is ethical, espouses an approach of cultural humility, and respects the community's needs and desires for services from healthcare providers, based on their priorities. Simply stating statistics on populations that have the highest incidence and prevalence of a disease is not appropriate. Nurses must strive to understand the environmental, sociocultural, genetic-genomic (-omic), and other factors why these disparities exist in order to develop interventions to reduce such risks.

To this end, it is recommended that nurse scientists initiate collaborations with large genetic-genomic consortia in the early career stages, where possible. Some nurse scientists have been extremely successful with bringing a nursing perspective to already existing studies such as the GENOA study (Taylor, Sun, Chu, Mosley, & Kardia, 2008), the Jackson Heart Study (Taylor et al., in press), HyperGEN (Taylor, Schwander, et al., 2016), InterGEN (Barcelona de Mendoza et al., 2017; Taylor, Wright et al., 2016), and others that include ethnic minority populations in -omics research. Working closely with established PIs and Co-Is that have ongoing relationships working with and inside minority communities enhances access and promotes collaborative research approaches. These connections not only enhance transdisciplinary opportunities, but may also assist junior scientists with development of the leadership skills necessary for management of their own research programs when working with minority populations.

Another way that junior scholars can enhance their knowledge in -omics and begin to establish their research careers is through additional training opportunities at all levels of nursing education. In fact, Jenkins, Grady, and Collins (2005) noted the importance of genomic literacy for nurses at all levels of education because nurses are the point of contact for care and can be instrumental in bridging the gap among interdisciplinary teams, becoming the catalyst for hastening the integrating of -omics options for patients in the clinical setting. Much work has been done on recommendations for expanding

Table 3. -Omics-Based Educational Programs

Name	Sponsor	Website	Nurses Included
Summer Genetics Institute	NINR	https://www.ninr.nih.gov/training/ trainingopportunitiesintramural/ summergeneticsinstitute	Yes
Precision Health—From Omics to Data Science Bootcamp	NINR	https://www.ninr.nih.gov/training/ trainingopportunitiesintramural/ bootcamp	Yes
PRIDE: Programs to Increase Diversity in Health-Related Research— Cardiovascular Genetic Epidemiology	NHLBI	https://www.nhlbi.nih.gov/research/ training/PRIDE-research-programs	Yes
Statistical Methods for Functional Genomics	Cold Spring Harbor Laboratory	https://meetings.cshl.edu/courses. aspx?course=C-DATA&year=16	Yes
Short Course in Genomics: Nurse, Physician Assistant and Faculty Track	NHGRI	https://www.genome.gov/27564236/ nhgri-short-course-in-genomics-nurse -physician-assistant-and-faculty-track/	Yes

Note. NHGRI = National Human Genome Research Institute; NHLBI = National Heart, Lung, and Blood Institute; NINR = National Institutes of Nursing Research.

nursing education to include -omics into doctoral level curricula; for example, an entire special issue of *Nursing Outlook* in 2015 was dedicated to this topic, and researchers provided discussion and recommendations on how to incorporate this content into PhD programs (Conley et al., 2015). As these opportunities have been relatively limited to few nurses in the past, it will also be important to support the -omics competency of nurses at all levels, and to encourage nurses and nurse scientists to take the lead in promoting a precision medicine approach in underserved communities where they work (Chadwell, 2013).

Postdoctoral and other training opportunities for nurses in -omics can support nursing's contribution to precision medicine and ensure that nurses take their place among an interdisciplinary team leading the way for this new era of health care. Additional examples of training opportunities that can build nursing competency in -omics are presented in **Table 3**. Emerging nurse scientists must be encouraged to avail themselves of these opportunities, such as the NINR's Summer Genetics Institute and boot camps for analysis of Big Data, among others. These training opportunities are available to postdocs, junior faculty, and more seasoned nursing faculty, and help to build knowledge and confidence in -omics, as well as leadership development, which is an essential ingredient necessary for success. The overall purpose of these training programs is to foster a new generation of nurse scientists who possess the recommended requisite experiences, training, and knowledge so that they can lead multi-omic-related studies as key personnel and move beyond the role of consultants or research assistants.

It is also recommended that nurse scientists be bold and expand their horizons to participate in -omics-based programs targeted specifically for nurses and other disciplines as well. Many other sponsored programs exist that are not targeted to nurses, but are wholly relevant to nursing research (e.g., epidemiology, medicine, social sciences, etc.). If a program of interest is identified and nursing is not listed as a discipline in the eligibility criteria, nurses must not shy away, but should reach out to the director of the programs to determine if nurses may also be considered. Many programs may be developed with certain disciplines in mind, but do not seek to exclude others. These opportunities for learning among transdisciplinary colleagues are important in expanding the perception and understanding of the nursing profession, and in sharing the increasingly relevant role of doctorally prepared nurses in -omics-based health disparities research. Nurses are also involved in developing policy recommendations related to -omics, further expanding nursing science's reach and visibility among other disciplines, including the public (Starkweather et al., 2017). Programs such as the American Academy of Nursing's Jonas Policy Scholars broaden nursing's visibility and impact on population health through early exposure to health policy for burgeoning nurse scientists.

In summary, nurse scientists have contributed significantly to -omics-based health disparities research, yet more needs to be done in terms of (a) advocacy for the role of nurses and nurse scientists at the national level in the PMI All of Us program, (b) expanding utilization of training programs for early career nurse scientists in -omics, particularly when working with

minority populations, and (c) increasing representation of minority nurse scientists in -omics among faculty of schools of nursing so that faculty demographics are more representative of the diverse communities that nurses and nurse scientists serve. -Omics is an exciting area of scientific discovery that has the potential to improve the health care of every American, changing the face of how health care is delivered. These changes will affect the nursing care delivered by nurses at all levels of practice, from the bedside to the community, and it is essential that nurses expand their scope of knowledge to be truly holistic in this -omics era. Including -omics in the nursing profession lexicon, daily practice, and educational approaches is essential to reducing health disparities and providing high-quality care for all populations.

Acknowledgment

Clinical Resources

- American Nurses Association. Essentials of genetic and genomic nursing: Competencies, curricula guidelines, and outcome indications. https://www. genome.gov/pages/careers/healthprofessional education/geneticscompetency.pdf
- National Human Genome Research Institute. Clinical sequencing evidence-generating research (CSER2). https://www.genome.gov/27546194/ clinical-sequencing-exploratory-research-cser/
- National Institutes of Health. All of Us Research Program. https://allofus.nih.gov/
- Yale University. Intergenerational Blood Pressure Study. http://intergen.yale.edu/

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CLINICAL SCHOLARSHIP

Developing and Sustaining a Career as a Transdisciplinary Nurse Scientist

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Abstract

Purpose: The purpose of this article is to provide an overview of strategies to build and sustain a career as a nurse scientist. This article examines how to integrate technologies and precision approaches into clinical practice, research, and education of the next generation of nursing scholars.

Design: This article presents information for shaping a sustainable transdisciplinary career. Programs of research that utilize self-management to improve quality of life are discussed throughout the article. The ongoing National Institute of Nursing Research–funded (R01 grant) iPhone Helping Evaluate Atrial Fibrillation Rhythm through Technology (iHEART) study is the first prospective, randomized controlled trial to evaluate whether electrocardiographic monitoring with the AliveCor™ device in the real-world setting will improve the time to detection and treatment of recurrent atrial fibrillation over a 6-month period as compared to usual cardiac care.

Methods: Opportunities to sustain a career as a nurse scientist and build programs of transdisciplinary research are identified. These opportunities are focused within the area of research and precision medicine.

Findings: Nurse scientists have the potential and ability to shape their careers and become essential members of transdisciplinary partnerships. Exposure to clinical research, expert mentorship, and diverse training opportunities in different areas are essential to ensure that contributions to nursing science are visible through publications and presentations as well as through securing grant funding to develop and maintain programs of research.

Conclusions: Transcending boundaries and different disciplines, nurses are essential members of many diverse teams.

Clinical Relevance: Nurse scientists are strengthening research approaches, clinical care, and communication and improving health outcomes while also building and shaping the next generation of nurse scientists.

One of the key elements to advancing nursing scholarship is the recognition of the critical role of the nurse scientist as an essential member of many diverse transdisciplinary teams. Although nurses have long engaged in interdisciplinary approaches (working with multiple disciplines yet maintaining boundaries), only more recently have they become part of transdisciplinary research teams. This is defined by "full investigatory partnership, credit-sharing, and recognition of nursing's unique contribution to the phenomena under consideration, and the development of new definitions and methods" (Grey & Connolly, 2008, p. 102). However, confusion exists among researchers and clinicians regarding the definition of transdisciplinarity, specifically as it relates to health care, and the term continues to be inappropriately used and often confused with multidisciplinarity and interdisciplinarity (Van Bewer, 2017). The lack of clarity and the use of concepts interchangeably among
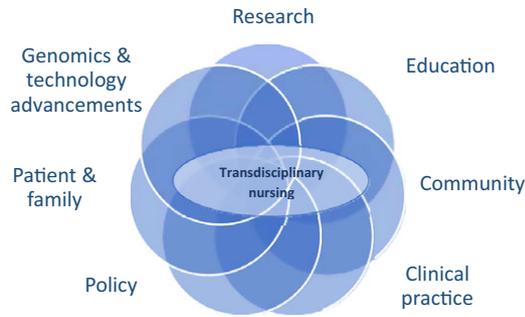
Figure 1. Model of the elements that intersect to develop a career as a transdisciplinary nurse scientist.

professionals can hinder the potential of the impact of transdisciplinarity from being reached, especially among the next generation of nursing scholars. Rosenfield's definition of multidisciplinarity describes teams as working in parallel from a discipline-specific framework to address common problems (Rosenfield, 1992), whereas interdisciplinarity describes teams as working together jointly and sharing concepts, theories, and approaches across disciplines. A recently completed content analysis (Van Bewer, 2017) critically examined the literature across multiple databases and disciplines and provided a healthcare definition of transdisciplinarity as transcending discipline boundaries, including a sharing of knowledge and decision making, a focus on real-world problems, and the inclusion of multiple stakeholders, including patients, families, and their communities (Van Bewer, 2017).

The conceptual model created by the author (K.T.H.) illustrates the overlapping sources on which the author was able to build a career as a transdisciplinary nurse scientist (**Figure 1**). While in this representation the circles are of equal size, depending on the individual's career trajectory, one particular area may have more emphasis compared to others. Central to the circles is the transdisciplinary nurse scientist, and the circles represent the overall complex skills necessary to develop a successful career as a nurse scientist. This model is not all inclusive, and the necessary elements may differ based on the individual's focus area.

The purpose of this article is to highlight essential elements needed to foster and sustain a career as a transdisciplinary nurse scientist while providing specific real-world examples and strategies of how this can be achieved. As defined by the National Institute of Nursing Research (NINR), nurse scientists study individuals and their response to illness by utilizing data and observations derived from clinical settings (Grady, 2010).

Bachelor of Science in Nursing Education

One critical element to a successful career in nursing is an early, integrated exposure to research, education, and clinical practice (Boland, Kamikawa, Inouye, Latimer, & Marshall, 2010). Baccalaureate nursing students have reported a discrepancy between what they learn in the classroom and what they learn during their clinical rotations (Flood & Robinia, 2014). Reasons for this discrepancy may include inexperienced faculty members unable to bridge the gap for students, instructors who have long been removed from clinical scenarios, or a general shortage of stellar nurse educators (Flood & Robinia, 2014). To assure that nurses are adequately prepared for a transdisciplinary career, classroom and clinical learning must be melded to yield nurses who are able to work effectively in complex healthcare environments and systems. As a result, the changes and advances being implemented in the real world of health care will be reflected in practice (Lewis, Stephens, & Ciak, 2016).

Since the 1970s, research began its integration into nursing baccalaureate programs, with nurse leaders implementing different practices to educate their students on research protocols and practices (Tsai, Cheng, Chang, & Liou, 2014). According to some nurse educators, it is difficult to do this because students may not understand the nature of certain research projects or have difficulty with the clinical application of the research (Tsai et al., 2014). Nurse educators believe that research courses may not be interesting for students, or that students are oftentimes more focused on "concrete tasks" of their education, such as passing their exams and going through clinical rotations (Kennel, Burns, & Horn, 2009). In order for future nurses to succeed and develop the skills necessary to build and sustain a successful transdisciplinary career, they must have early exposure to research and strong clinical experiences that meld new scientific advancements, for example, in the area of -omics (i.e., genomics, metabolomics, epigenomics, proteomics). The importance of exposure to current and emerging scientific approaches is also essential to educating future nurse scientists and ensuring they are competitive and have sustainable and novel programs of research (Conley et al., 2015).

Nurse Scientists and the Electronic Health Record

Nurses must specifically "be prepared ... to manage accountable care organizations that make effective use of emerging technologies that are implemented through an interprofessional team approach" (Gerard, Kazer, Babington, & Quell, 2014, p. 330). For example, the

electronic health record (EHR) is one such area where nurses are contributing to topics such as how best to communicate and share a family health history, genomic health information, privacy and confidentiality issues, access to care in the community, bio-banking, and the overall impact of undergoing genetic testing in many diverse populations (Williams et al., 2016). Nursing education exposure to big data and the potential utility of the EHR in nursing programs is one approach to enhance exposure and the opportunity for nurse scientists to contribute their expertise. However, this also raises important questions and challenges such as how best to train the nursing workforce and next generation of nurse scientists on topics such as research using the EHR, genomics, and advances in technology that are being integrated into all aspects of health care. One must consider what approaches work best to teach nurses and advance practice nurses to recognize "red flags" in the EHR, family history, or physical exam or electrocardiogram (ECG) that may indicate an underlying genetic condition. Additionally, one must consider how best to expose early career nurse scientists to diverse teams and approaches to truly guide them as they develop and ultimately sustain cutting edge career trajectories while meeting their educational and competency requirements and completing their nursing education.

Evolving Mobile Health Technologies in Health Care

To account for the newly developing technologies and needs of the healthcare system, it is important for curricula to adapt and keep pace with the latest information and advances in health. For example, topics in mobile health are being integrated into clinical and research curricula across the nation (Sakakibara et al., 2017) with the expansion and usage of so many new technologies in clinical practice and research endeavors. In fact, more patients are utilizing technology to engage, monitor, manage, and communicate their health findings via smartphone applications, wearable devices, and patient portals (Gerard et al., 2014). Nurse scientists are ideally suited to lead the way in integrating innovative mobile health approaches targeting improvements in health outcomes of not only individuals but their caregivers. With the aging population and continued increase in life expectancy across the globe, caring for patients living with multiple comorbidities is a reality (Modig, Andersson, Vaupel, Rau, & Ahlbom, 2017). The NINR and its partners have recognized this concern and held a summit (May 2017) to provide perspectives across the spectrum of caregiving, including the importance of caregiving

across the lifespan and future directions for research. A key aspect of this summit was to bring together an audience of researchers, advocates, healthcare providers, educators, the media, and others interested in the science of caregiving and to exemplify a transdisciplinary approach to caregiving and a future area for nurse scientists.

Building and Sustaining a Career as a Nurse Scientist in the Real World: Atrial Fibrillation as an Exemplar

Atrial fibrillation (AF) is an irregular heartbeat that can lead to blood clots, stroke, heart failure, and many other heart-related issues and affects over 2.7 million Americans (American Heart Association [AHA], 2017). In fact, individuals living with AF are five times more likely to suffer a stroke as compared to those who have a normal heart rhythm, further highlighting the significance of the problem (AHA, 2017). As a result, the burden to society due to the staggering hospitalization costs, strokes, and mortality associated with AF within the U.S. healthcare system alone is estimated at $26 billion (Cutugno, 2015). AF is an epidemic and a growing public health concern. In fact, AF is the most common cardiac arrhythmia encountered in clinical practice, which increases in prevalence with advancing age and the presence of co-existing cardiac risk factors such as hypertension, diabetes, obesity, heart failure, and increased alcohol intake (Yancy et al., 2017). Consequently, the incidence of AF is expected to double over the next 50 years (Cutugno, 2015) and highlights one of many areas where a plethora of clinical and research questions remain to be answered by the next generation of nurse scientists. Researchers have already demonstrated that patients who are discharged with a team led by nurses and/or nurse practitioners are less likely to be readmitted to the hospital, have shorter hospital stays, and have fewer adverse outcomes as compared with standard of care approaches not led by a nurse (Cutugno, 2015).

Symptom Self-Management and Chronic Conditions

Nurse scientists are also currently conducting research focused on symptom self-management, quality of life (QoL), and approaches aimed at earlier detection of AF using advancements in ECG mobile health technology in an effort to improve health (Hickey et al., 2016). It is also important to recognize the many debilitating symptoms associated with AF, such as fatigue, shortness of breath, palpitations, exercise intolerance, and sleep

disturbances (McCabe, Rhudy, Chamberlain, & DeVon, 2016) to name a few. The ongoing research conducted by nurse scientists continues to play an influential role in helping individuals recognize, manage, and alleviate their symptoms. One important issue related to AF is the difficulty of diagnosing and detecting AF, particularly when the patient is asymptomatic or may simply ignore symptoms such as fatigue and assume such symptoms are "normal" age-related changes (Brachmann et al., 2016). Additionally, symptoms of AF can mimic symptoms associated with other cardiac and noncardiac underlying conditions (Hickey et al., 2016). This highlights the many areas associated with chronic conditions and symptom self-management where nurses can make a significant impact on improving the health of the nation while also sustaining and evolving their career trajectory. However, in order to ensure this becomes a reality, it is vital that nurses have early clinical and research exposure, mentoring, and opportunities for "hands on" engagement in many diverse areas that can be easily accessible and integrated into the clinical, research, and education curricula across all schools of nursing, from the undergraduate to the doctoral level.

Real-World Technologies Integrated Into Research Approaches by a Nurse Scientist

Early ECG monitoring is a valuable tool to help patients detect cardiac abnormalities before experiencing the potentially lethal consequences of an arrhythmia (irregular heart beat). Studies have shown that patients who monitor their ECGs are more likely to prevent mortality, as their self-monitoring may lead to the early identification of arrhythmias that might have otherwise gone undetected. Self-monitoring and early detection may lead to interventions such as pacemakers and implantable cardioverter defibrillator (ICD) devices aimed at treatment (Hickey et al., 2010). Healthcare providers are encouraged to target patients at risk for cardiac disease (based on age, comorbidities, etc.) and provide them with the tools to actively self-monitor to maintain their optimum health (Hickey et al, 2010). In fact, real-world, easy-to-use, noninvasive technologies are being marketed so that patients are purchasing them and utilizing them effectively to track their heart rate, diet, exercise, and symptoms. One such device is the AliveCor™ Heart Monitor, a U.S. Food and Drug Administration–approved portable device that transmits an ECG to an application on a smartphone, which can detect and distinguish abnormal rhythms such as AF from a normal heart rhythm. The efficacy of this device has been proven in several studies, and it has been

shown to have high sensitivity, specificity, and accuracy (Chan et al., 2016; Hickey et al., 2016). As health technologies become more widespread and continue to be utilized by individuals to self-monitor for cardiac abnormalities or arrhythmias, clinicians and nurses in particular must adapt to assure they are integrating state-of-the-art real-world approaches to their research and clinical practices, including patients, families, and communities. In addition, exposure and participation of junior faculty on such clinical and research teams will guide their development into the next generation of nurse scholars.

Building a Sustainable Program of Research

Initial pilot research funded by an R03 grant from the NINR demonstrated the utility of cardiac arrhythmia screening in a primarily underserved, urban, elderly population living with coexisting chronic conditions on the ability to detect previously unrecognized AF (Hickey et al., 2013). In addition, other cardiac arrhythmias (bradycardia and nonsustained ventricular tachycardia) were also recorded; these led to more timely clinical interventions such as implantation of a pacemaker or ICD in patients who otherwise would not have received them, possibly preventing additional adverse clinical outcomes during follow-up. It is important to examine whether monitoring high-risk populations with or without symptoms that may be associated with AF or another underlying arrhythmia is effective. Additionally, how such advances in ECG monitoring and other wearable technologies may be used by patients and families to self-monitor, diagnose, and distinguish the etiology of symptoms to improve patient outcomes and QoL must be determined. For example, symptoms such as shortness of breath or fatigue may be related to AF versus several other underlying chronic conditions such as heart failure (Kirchhof et al., 2012). Self-monitoring may help patients better recognize triggers of their AF by capturing AF in the setting of symptoms. For example, moderate alcohol intake is a known trigger for AF, and increased dietary sodium intake is a well-known associate of heart failure (Yancy et al., 2017). Treatment led by nurse scientists may improve the QoL of those living with chronic conditions by increasing their engagement and knowledge about the importance of lifestyle modifications.

Technology-, Clinical Practice–, and Quality of Life–Focused Research

The AliveCor™ device (**Figure 2**), in particular, promotes patient engagement and encourages patients
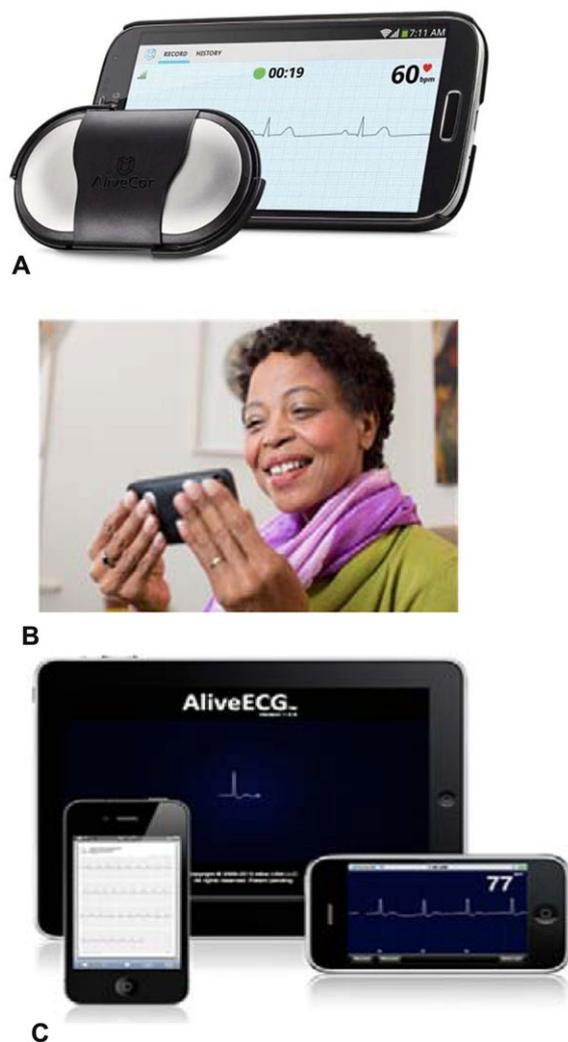
Figure 2. (A) AliveCor device and Kardia application used to capture an electrocardiographic (ECG) recording. (B) Patient using the AliveCor device and Kardia application to capture and view her ECG in real time. (C) ECG information captured can be viewed by a patient/provider on their iPhone, iPad, or desktop computer (not shown).

to take an active role in monitoring their own cardiac health. While several studies have established the sensitivity and specificity of the mobile health ECG monitoring device (Desteghe et al., 2017), no study to date has investigated the effect on clinical outcomes (Hickey et al., in press). The ongoing NINR-funded (R01 grant) iPhone Helping Evaluate Atrial Fibrillation Rhythm through Technology (iHEART) study (R01NR014853) will be the first prospective, randomized controlled trial to evaluate whether ECG monitoring with the AliveCor™ device in the real-world setting will improve the time to detection and treatment of recurrent AF over a 6-month period as compared to usual cardiac care. In addition, the iHEART

study will also evaluate the impact of behavior-altering motivational text messaging sent to the participant's smartphone targeting underlying cardiac risk factors known to be associated with AF. These outcomes will be quantified and compared to those of patients receiving usual cardiac care as determined by their healthcare providers. Finally, the study will evaluate the differences in self-reported QoL in those randomized to the iHEART intervention versus usual cardiac care. This study illustrates ongoing transdisciplinary work in the real world by engaging patients and families in self-management research focused on improving clinical outcomes. Nurses must keep pace with the frequent advancements in healthcare and integrate novel and clinically relevant approaches to their research trajectories. This will allow nursing researchers to raise their visibility as independent investigators, increase their ability to compete for limited funding and resources, and emerge into new areas of inquiry.

Precision Nursing to Improve Health Outcomes

The notion of patient engagement and new technologies that help monitor patients' health aligns with the Precision Medicine Initiative (The White House, n.d.) and the role that genes play in susceptibility to disease and inheritance across the life span. For instance, the detection of certain genetic biomarkers provides insight into which individuals might be more susceptible to developing certain rare and common conditions. The next generation of nurse scientists needs to be prepared to improve health, guided by the vision reflected in the Precision Medicine Initiative, to accelerate discoveries that can provide new tools, knowledge, and therapies. It is essential that nurses have exposure to genetics and genomics. The NINR has been leading the way by providing an intensive 1-week genetic boot camp (NINR, 2017). The purpose of the 1-week intensive boot camp is for nurses to examine the latest advances in genomics, pharmacogenomics, and nutrigenomics, to name a few, as well as the ethical and social implications of precision medicine (NINR, 2017). The NINR supports a broad range of research to develop personalized strategies to prevent and manage the adverse symptoms of disease across diverse populations and settings, as well as across the lifespan. Nurse scientists are engaged in various areas of research, including at the Center for Genomics of Pain at the University of Maryland in Baltimore (NINR, n.d.). Additionally, institutions such as Johns Hopkins University, Emory University, Duke University, and Case Western Reserve University are focused on similar research topics across

an interdisciplinary and transdisciplinary research environment. Topics range from neurocognitive studies and sleep-related symptom science to self-management studies. The University of Texas, Austin, is the site of the Center for Transdisciplinary Collaborative Research in Self-Management Science (TCRSS). The goal of the Center for TCRSS is to develop, test, and disseminate innovative self-management solutions to improve the health outcomes of people with chronic conditions (NINR, n.d.). Mentors and mentees must actively engage in implementing clinical applications of genomics, symptom science, and other -omics science into their research, education, and clinical practice roles.

One such example of nursing's contribution to precision health is the advent of the Precision in Symptom Self-Management (PriSSM) Center at Columbia University School of Nursing (CUSON) in New York City. This center is one of several centers across the nation funded by the NINR that is essential to training and mentoring the next generation of nursing scholars in genetics. The goal of this PriSSM center is to advance the science of symptom self-management, particularly in Latinos, through a social lens that takes into account variability in individual, interpersonal, genetics, ancestry, and environmental factors across the lifespan (CUSON, n.d.). In addition, the center will advance research conducted by new nurse scientists focused on symptom self-management across conditions and the lifespan while also examining the role of ancestry informative markers and genetics associated with rare and common conditions (CUSON, n.d.).

Examples of Collaborations, Partnerships, and Networking

It is important to recognize the influential nursing organizations that contribute to the advancement of nursing science, leadership, and education. These organizations include the International Society of Nurses in Genetics, Sigma Theta Tau International Honor Society of Nursing, Eastern Nursing Research Society, American Academy of Nursing, and American Association of Critical-Care Nurses, among many others. Each offers additional training opportunities for nurse scientists as well as networking and partnership with senior nurse scientists.

The AHA suggests that clinicians complete certain core competencies in cardiovascular genetics, acknowledges the importance of trained genetic professionals, and notes that the ability to translate genetic test results are key in assuring that clinicians harbor a strong knowledge of these topics (Mital et al., 2016). Moreover, the AHA

suggests that advances in the precision medicine era will arise when clinicians are able to apply this knowledge to real-life patient scenarios (Mital et al., 2016). Nurses must then cultivate their comprehension of -omics to lead a "boots on the ground" approach to develop a new generation of nurse scientists in precision health (Calzone et al., 2010). Nurse scientists are the most trusted health professionals involved on the front lines in various areas of health supporting, educating, and advocating for the public. Nurse scientists will undoubtedly partake in shaping transdisciplinary health teams.

Helpful Hints for Shaping a Sustainable Transdisciplinary Career

Pearls of wisdom to be passed on to the next generation of nurse scientists include integrating advancements in science and technology to ensure sustainable careers. Mentors and mentees should challenge each other to reach beyond their own programs of research, offering and taking part in pre- and postdoctoral training opportunities across disciplines, and actively participating as key members of other teams. Early stage nurse scientists should actively ask questions, seek training in unknown disciplines, say "no" to extra responsibilities or change the direction of their career path as health care evolves and changes. Through the development and expansion of their careers, early nurse scientists should not forget to maintain a healthy work and life balance and celebrate their successes along the way. Nurse scientists should aim to surround themselves with motivational mentors and be unafraid of persisting and persevering in unknown areas.

Conclusions

On the forefront of an exciting yet challenging career path, nurse scientists have the potential and ability to shape their careers and become essential members of transdisciplinary partnerships. Nurse scientists should utilize as many resources as possible to assure they achieve this goal. Doing so involves taking advantage of diverse training opportunities, being exposed to clinical research, receiving expert mentorship in different areas, and ensuring contributions to science are visible through publications and presentations as well as through securing grant funding to develop and maintain programs of research. By transcending boundaries and different disciplines, nurses will be able work together to strengthen communication and discussion, thereby improving patient care and future health outcomes while building and shaping the next generation of nurse scientists. Only then

will the true promise of transdisciplinary approaches be realized.

Clinical Resources

- ClinicalTrials.gov. iPhone helping evaluate atrial fibrillation rhythm through technology (Iheart). https://clinicaltrials.gov/ct2/show/NCT02731326
- International Society of Nurses in Genetics. http://www.isong.org/
- The White House. The Precision Medicine Initiative. https://obamawhitehouse.archives.gov/node/333101

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The Impact of Entrepreneurial Leadership on Nurses' Innovation Behavior

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Abstract

Purpose: The purpose of this study was to examine the influence of entrepreneurial leadership on nurses' innovation work behavior and its dimensions.

Design and Methods: This cross-sectional study employed the 10-item Innovation Work Behavior Questionnaire and the 8-item Entrepreneurial Leadership Questionnaire to explore the impact of entrepreneurial leadership on the innovation work behavior of 273 nurses from public and private hospitals in Iran.

Findings: Entrepreneurial leadership had a significant positive impact on nurses' innovation work behavior and most strongly improved idea exploration, followed by idea generation, idea implementation, and idea championing.

Conclusions: Entrepreneurial leadership was effective in enhancing nurses' innovation work behavior. More attention needs to be focused on developing entrepreneurial leadership competencies and on developing nurse leaders.

Clinical Relevance: Healthcare policies and strategies are needed to facilitate the implementation of entrepreneurial leadership by providing healthcare leaders with the appropriate environment.

Numerous researchers have suggested the critical influence of leadership on employees' innovation work behavior (IWB), organizational innovative abilities, and competitiveness in different contexts, including in established companies and public organizations (Chen, Tank, Jin, Xie, & Li, 2014; Janssen, 2005; Karol, 2015; Kim, Park, & Miao, 2017). For healthcare professionals, leadership plays pivotal roles in shaping the IWB of nurses, who greatly contribute to patient care, the improvement of healthcare services' effectiveness, and the constant innovation capacity of healthcare organizations through generating new techniques, processes services (Andrews, Richard, Robinson, Celano, & Hallaron, 2012; Cummings et al., 2010; Kessel, Hannemann-Webera, & Kratzerb, 2012; Malik, Lochan & Chandler, 2016; Xerri, 2013).

Exploring the leadership style and behavior that effectively influence innovation and creativity highly enhances the development of individual nurses' innovation as well as innovation leadership in healthcare organizations (Cummings et al., 2010; Malik et al., 2016). Yet, there is little knowledge on the type of leadership that focuses on enhancing the IWB of employees and shapes and directs innovation in the organization (Kang, Solomon, & Choi, 2015; Sharifirad, 2013). Furthermore, healthcare leaders practice leadership styles that are less likely to stimulate and develop IWB (Chapman, Johnson, & Kilner, 2014). Empirical research has also provided inconsistent findings on the association between leadership and IWB (Chen, Li, & Leung, 2016). This led scholars to question the effectiveness of general leadership styles (e.g., transformational or transactional) in fostering employees' IWB (Rosing, Frese, & Bausch, 2011; Sharifirad, 2013). Herrmann and Felfe (2014) argued that general leadership styles are not specifically designed for regulating employees' behavior toward innovation and do not

determine the leader's exact behavior and techniques to direct new idea generation and implementation. Guo (2009, p. 28) also postulated that previous leadership practices focusing on "directives and control mechanisms are no longer effective," and healthcare organizations urgently require leadership styles focusing on innovation and new opportunity recognition. Entrepreneurial leadership (EL) has long been suggested to be effective in inspiring innovation and change among nurses (Ballein, 1998). This leadership style also enables leaders to effectively overcome the ever-changing and more serious challenges of healthcare organizations (Guo, 2009). However, empirical research on the impact of leadership style on fostering the IWB of healthcare professionals and particularly nurses is in the early stages of development (Cummings et al., 2010; Malik et al., 2016; Xerri, 2013).

The majority of previous studies have not specifically focused on nurses and their innovation behavior (Currie, Humphreys, Ucbasaran, & McManus, 2008; Kessel et al., 2012; Radaelli, Lettieri, Mura, Spiller, 2014). These studies mostly investigated the impact of transformational leadership (Reuvers, van Engen, Vinkenburg, & Wilson-Evered, 2008), leader-member interactions (Xerri, 2013), and existence of organizational guidelines (Kessel et al., 2012) on the IWB of nurses. Research on the impact of leadership on nurses' behavior and performance also has been predominantly conducted in the United States and Europe (Andrews et al., 2012; Currie et al., 2008). Furthermore, the few studies on EL in health care concentrated on identifying the core competencies (Guo, 2009) and characteristics of healthcare entrepreneurial leaders (Ballein, 1998). As far as we know, there has been no empirical research on the impact of EL on nurses' IWB.

This study set out to examine the influence of EL on nurses' IWB in Iran. Drawing on De Jong and Den Hartog's (2010) conceptualization of employees' innovation behavior, this study also aimed to explore if EL has different effects on the dimensions of nurses' IWB, including idea exploration, idea generation, idea championing, and idea implementation. To our knowledge, this study provides some of the first empirical findings on the influence of EL on IWB in healthcare organizations, specifically in Iran. The research also contributes to the few studies on the association between leadership and nurses' IWB (Malik et al., 2016; Xerri, 2013).

IWB in Health Care

Creating and fostering innovation have long been a main concern of different organizational leaders, regardless of the size, nature, or structure of the organization (Kang et al., 2015). In particular, leaders of organizations with highly challenging and complex environments

(Chen et al., 2016) such as health care have been struggling with inspiring employees' IWB and creating the appropriate environment for innovation (Ballein, 1998; Radaelli et al., 2014; Xerri, 2013). Innovation has also been a critical component of employees' effective job performance and their contributions to organizational success (Ng & Feldman, 2013; Weng, Huang, Chen, & Chang, 2015).

Scholars have mostly defined IWB as the intentional initiations and efforts led by individual employees to generate new ideas, get support, and implement ideas to improve the performance of their tasks (Chen et al., 2016; De Jong & Den Hartog, 2010; Kessel et al., 2012; Radaelli et al., 2014). Idea exploration and generation as the first phases of the innovation process are determined by employees' cognitive abilities and knowledge to identify problems and create new ideas to solve the problems. Employees then need to champion and implement their new ideas, and their success in these phases strongly depends on their capabilities to persuade colleagues and top managers on the usefulness of their ideas and build their commitment to realize these ideas (De Jong & Den Hartog, 2010; Mumford, 2003). Accordingly, IWB is a person-, task-, and context-specific concept that differs from creativity by successfully accomplishing the activities related to the implementation of a novel idea so that it creates value (Kessel et al., 2012; Xerri, 2013). Importantly, innovation is challenging, complex, and risky for the employee, leader, and organization (Chen et al., 2016; Kessel et al., 2012; Middlebrooks, 2015; Ng & Feldman, 2013; Radaelli et al., 2014). Therefore, leaders play fundamental roles in facilitating new idea creation and implementation by individual employees as well as creating the supportive environment that fosters innovation processes in the organization (Chen et al., 2014; Kang et al., 2015).

In health care, innovation has been constantly highlighted as being effective for enhancing the quality of performance and success of healthcare professionals (Guo, 2009; Kessel et al., 2012; Mumford, 2003; Radaelli et al., 2014). Innovation improves the quality and effectiveness of treatments and services provided by individual healthcare employees by enhancing the possibility and essence of new idea generation and implementation and consequently improving the competitiveness and success of healthcare organizations. However, few empirical studies have investigated IWB in healthcare organizations (Kessel et al., 2012; Xerri, 2013). While the critical importance of employing the leadership styles that facilitate IWB, such as EL, has been suggested for healthcare leaders and supervisors (Middlebrooks, 2015), healthcare leaders are practicing leadership styles (Chapman et al., 2014) and top-down and controlling approaches

(Radaelli et al., 2014) that are less likely to be effective to inspire and create innovation in healthcare organizations. Particularly for nurses who play critical roles in patients' treatment and healthcare services' quality improvement (Malik et al., 2016; Xerri, 2013), current healthcare systems are not effective in providing the supportive environment that facilitates their IWB (Xerri, 2013). In addition, despite their high propensity for innovation (Kessel et al., 2012), leaders have mostly regulated nurses toward performance of their tasks rather than directing them to perform beyond their routine and given tasks (Cummings et al., 2010). Building on previous calls (Kessel et al., 2012; Mumford, 2003; Ng & Feldman, 2013; Xerri, 2013) for further investigation on nurses' IWB in cultures apart from the United States because of the differences in their healthcare systems, this study set out to examine the IWB of nurses from public and private hospitals in Iran. We examined nurses' perceptions towards their supervisors' EL practices because nurses differ both in their views toward and their reflections on the leadership style of their supervisors (Andrews et al., 2012).

EL and IWB

Prior research has suggested EL as an influential leadership style and behavior for stimulating and improving IWB, as well as for consequently fostering competitiveness, effectiveness, and the growth of organizations of all sizes and natures (Karol, 2015; Kim et al., 2017; Koryak et al., 2015; Leitch, McMullan, & Harrison, 2013; Renko, Tarabishy, Carsrud, & Brännback, 2015), including health care (Ballein, 1998; Guo, 2009). Entrepreneurship also has been explored as the mechanism that improves the impact of leadership styles such as transformational leadership on innovation (Chen et al., 2014). EL improves innovation through developing an inspiring entrepreneurial vision (Guo, 2009; Karol, 2015). To achieve the vision, entrepreneurial leaders improve employees' attitudes toward and self-efficacy in creating novel ideas and direct them to implement new ideas (Gupta, MacMillan, & Surie, 2004; Kang et al., 2015; Kim et al., 2017; Leitch et al., 2013; Renko et al., 2015). Such leaders also create an environment and culture in the organization that encourage and support employees to face the challenges of engaging in innovation efforts (Karol, 2015).

To define EL style, researchers looked at the entrepreneurial behavior of leaders in established organizations and the leadership behavior of business owners (Gupta et al., 2004; Koryak et al., 2015; Middlebrooks, 2015). Early conceptualization of the notion focused on the exceptional traits and contextual factors enabling

individuals to successfully lead entrepreneurial ventures and the differences in entrepreneurial leaders' behavior when they encounter the complexities of leading an entrepreneurial organization (Gupta et al., 2004). Recent definitions have concentrated on the competencies and roles of entrepreneurial leaders in creating innovative ideas and leading the process of innovation (Renko et al., 2015). Surie and Ashley (2008) described entrepreneurial leaders as creative innovators who are highly committed to value creation. Middlebrooks (2015, p. 27) also defined entrepreneurial leaders as those who employ their unique knowledge and capabilities to "maximize innovation" and explore new opportunities. Empirical research has recently examined the impact of EL on innovation at the organizational level (Huang, Ding, & Chen, 2014; Kim et al., 2017). Building on both the personal and functional challenges of entrepreneurial leaders in organizational settings and their competencies in overcoming the challenges, Gupta et al. (2004) developed a theoretical foundation for this style of leadership. According to the theory, the personal competencies of entrepreneurial leaders enable them to develop an innovative vision for their organization. Functional competencies of entrepreneurial leaders empower them to influence and inspire their group members to abandon their conventional activities and extend their efforts to perform innovative actions, involve them in developing innovative ideas, and build their confidence in and commitment to implementing the new ideas (Leitch et al., 2013).

Highlighting innovation leadership as one of the core competencies of entrepreneurial leaders, Guo (2009, p. 21) defined EL in healthcare organizations as "the pursuit of opportunities involving major risk, responsive to systematic changes, and the development of innovation" to benefit society. Previous studies have also accentuated the merits of EL for improving innovation and effectiveness among healthcare leaders and overcoming the unique difficulties and crises of healthcare organizations (Ballein, 1998; Guo, 2009). For nurse supervisors in particular, employing EL principles is of vital importance because of the challenging and complex nature of their roles and tasks (Ballein, 1998; Currie et al., 2008; Middlebrooks, 2015). Previous research has called for further investigations on the influence of EL in different organizations and contexts because of the differences in governance and enactment of EL in different organizations and countries (Guo, 2009; Currie et al., 2008). Yet, to our knowledge, there has been no empirical study on the impact of EL practices of healthcare leaders and particularly supervisors on improving the IWB of nurses. Therefore, this study tested the following hypotheses:

Hypothesis 1: EL has a significant positive impact on nurses' IWB.

Hypothesis 2: EL has different significant effects on dimensions of nurses' IWB (idea exploration, idea generation, idea championing, and idea implementation).

Method

Sample

A cross-sectional and survey design was employed to examine the impact of EL on IWB and its dimensions through perceptions of nurses from public and private hospitals in Iran. We focused on EL and IWB in hospitals based on the assumption that innovation and entrepreneurial activities exist at all levels of healthcare organizations (Ballein, 1998; Guo, 2009). Both public and private hospitals were included in this study due to the differences in their organizational structure, healthcare professionals (Currie et al., 2008; Radaelli et al., 2014; Xerri, 2013), and the enactment of EL (Currie et al., 2008).

The participants were 273 nurses randomly selected from different nursing sections in three public and two private hospitals in Tehran, the capital city of Iran (the response rate was 69.2%). The majority of participants were female ($n = 208$, 80%) and 51 were male (20%). The average age of the participants was 33 years, ranging from 20 to 58 years ($SD = 7.43$). The average duration of nursing experience was 9.7 years, ranging from 1 to 29 years ($SD = 6.97$). The majority of participants had a bachelor's degree in nursing ($n = 222$, 81%), followed by diploma ($n = 17$, 6.2%) and master's degree ($n = 13$, 4.8%).

Instruments

We used validated items to measure both IWB and EL (De Jong & Den Hartog, 2010; Renko et al., 2015). This research used a self-reported rating of nurses' IWB to guard against the biases related to supervisors' and other colleagues' assessment of the IWB of nurses (Chen et al., 2016; De Jong & Den Hartog, 2010; Radaelli et al., 2014). Additionally, employees have more precise information about their involvement in innovation work activities and the degree to which they generated and presented new ideas in their organization (Chen et al., 2016; Ng & Feldman, 2013; Radaelli et al., 2014). Previous research findings have also indicated the consistency between self-reported assessments of employees' IWB and supervisors' scores of employees' IWB (Chen et al., 2016).

We measured nurses' IWB using the questionnaire developed by De Jong and Den Hartog (2010). The questionnaire assesses employees' IWB in four dimensions, including idea exploration (two items, e.g., "I wonder how things can be improved"; $\alpha = .89$), idea generation (three items, e.g., "I generate original solutions for problems"; $\alpha = .84$), idea championing (two items, e.g., "I make important organizational members enthusiastic for innovative ideas"; $\alpha = .90$), and idea implementation (three items, e.g., "I contribute to the implementation of new ideas"; $\alpha = .80$). Participants were asked to indicate their agreement on the items using a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The questionnaire had a high reliability to measure nurses' IWB ($\alpha = .92$).

Renko et al.'s (2015) EL questionnaire was also employed to measure the EL practices of nurse supervisors. The questionnaire examines how employees perceive different aspects of their leaders' EL behavior (eight items; $\alpha = .94$), including innovativeness (three items, e.g., "Often comes up with radical improvement ideas for the services we are selling"), driving innovation (two items, e.g., "Wants me to challenge the current ways we do business"), risk taking (one item, "Takes risks"), and passion for work (one item, "Demonstrates passion for his or her work"). The nurses were also asked to assess their immediate supervisors' EL practices using a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The questionnaires were translated into Persian using standard back-translation procedures (Brislin, 1986). The participants were also asked to indicate their demographic information, such as age, gender, education qualification, and years of experience. Participation in this study was voluntary, all questionnaires were completed anonymously, and the participants were ensured of the confidentiality of their responses. Data were collected during the summer and fall of 2016. All data collection activities were approved by the institutional review board of each hospital.

Confirmatory Factor Analysis and Correlations

We performed confirmatory factor analysis to measure the extent to which the constructs in our study were distinct. First, we tested the four-dimension model for IWB (De Jong & Den Hartog, 2010) using the maximum likelihood method (Amos 20, IBM Corp., Armonk, NY, USA; Hair, Black, Babin, & Anderson, 2010). The model fit the data well because χ^2/df was less than 3, all of the goodness of fit indices were higher than .90, and root mean square error of approximation (RMSEA) was less than the .05 threshold (Byrne, 2010); $\chi^2/df = 2.50$, comparative fit index (CFI) = .90, goodness of fit index (GFI) = . 90, Tucker-Lewis nonnormed fit index (TLI) = .90, and Bollen's incremental fit

Table 1. Means, Standard Deviations, AVE, MSV, ASV, and Intercorrelations of Variables in the Study

Variable	Mean	SD	AVE	MSV	ASV	1	2	3	4	5
1. Idea exploration	3.99	0.81	0.53	0.51	0.34					
2. Idea generation	3.75	0.84	0.58	0.53	0.34	.29*				
3. Idea championing	3.45	0.99	0.52	0.46	0.28	.28*	.16*			
4. Idea implementation	3.65	0.88	0.55	0.53	0.41	.53**	.51**	.50**		
5. Entrepreneurial leadership	3.71	1.08	0.67	0.18	0.16	.41**	.37**	.33**	.28**	

Note. N = 273. ASV = average shared squared variance; AVE = average variance extracted; MSV = maximum shared squared variance.
*$p < .05$; **$p < .01$.

index (IFI) = .92. All of the indicators also significantly loaded to their intended dimension (>.50). The alternative one-factor model in which all items on IWB loaded on a common factor had poor fit (χ^2/df = 6.67, GFI = .70, CFI = .69, IFI = .69, TLI = .64, RMSEA = .14). These findings suggested discriminant validity of the measures for IWB dimensions and multidimensionality of the construct. We then developed a measurement model including the items on the dependent and independent variables. The results showed a good model fit (χ^2/df = 2.36, GFI = .90, CFI = .91, IFI = .91, TLI = .90, RMSEA = .04). To ensure the discriminant validity of the constructs in the scale, we also measured the average variance extracted (AVE), maximum shared squared variance (MSV), and average shared squared variance (ASV) for each construct. **Table 1** presents means, standard deviations, and bivariate correlations for all variables. As **Table 1** shows, all of the constructs had an AVE higher than .50, indicating that the majority of the variance in each construct was explained by its items (Hair et al., 2010). The scored values of the constructs for MSV and ASV were also less than the AVE scores. These findings supported the discriminant validity of the measures used for the constructs in our scale.

As the participants reported on their own IWB and the same person reported on the EL practices of their supervisors, we ensured that the common method variance (CMV) did not affect the standardized path coefficients and the model fit indices. To this end, the standardized regression weights of the full measurement model were compared with and without a common latent factor (Podsakoff, MacKenzie, & Podsakoff, 2012). The results indicated that the differences between regression weights in all paths of the two models were less than 0.2. Therefore, our findings were not affected by CMV bias.

Results

Impact of EL on IWB and Its Dimensions

To test the research hypotheses on the impact of EL on IWB and its dimensions, we first included the two variables in one model. The results indicated that EL had a significant positive effect on nurses' IWB (β = .20, $p < .01$), indicating the influential impact of supervisors' EL practices on nurses' IWB. The model fit indices also showed that the model fits the data well (χ^2/df = 2.04, GFI = .90, CFI = .94, IFI = .94, TLI = .93, RMSEA = .049). We then examined the impact of EL on each dimension of nurses' IWB in one model. The results confirmed the significant impact of EL on nurses' idea exploration (β = .45, $p < .01$), idea generation (β = .42, $p < .01$), idea implementation (β = .37, $p < .01$), and idea championing (β = .33, $p < .01$). More specifically, EL as perceived by the nurses significantly explained 50% of the variance in the nurses' idea exploration, 32% of the variance in their idea generation, 28% of the variance in their idea implementation, and 20% of the variance in their idea championing, and the model had an adequate fit (χ^2/df = 1.97, GFI = .90, CFI = .92, IFI = .90, TLI = .92, RMSEA = .049).

Discussion

Stimulating and improving nurses' IWB through effective leadership has been one of the core focuses of healthcare policymakers, researchers, and practitioners (e.g., Cummings et al., 2010; Malik et al., 2016; Xerri, 2013). Previous research highlighted the urgent need to explore the impact of innovation and opportunity-oriented leadership styles on employees' IWB (Herrmann & Felfe, 2013; Rosing et al., 2011; Sharifirad, 2013), specifically in healthcare organizations, where innovation is not a required element to perform tasks (Kessel et al., 2012; Mumford, 2003; Ng & Feldman, 2013; Xerri, 2013). In response, we examined the influence of EL on nurses' IWB. Our findings confirmed the hypothesized significant impact of EL on nurses' IWB. This finding contributed some of the first empirical evidence on the influential effect of EL on IWB in public and private organizations (Huang et al., 2014; Kim et al., 2017). In particular, this finding extends previous studies that have long suggested the influential effects of EL on IWB in healthcare organizations (Ballein, 1998; Guo, 2009).

Therefore, despite various challenges and constraints that leaders and supervisors encounter in performing EL roles and tasks in public (Currie et al., 2008) and private (Ballein, 1998; Guo, 2009) healthcare organizations, supervisors' EL behavior (ability to propose new ideas to solve the complex and unique problems of health care, recognize opportunities, and challenge employees to create new ideas) improves nurses' capacity for innovation. Entrepreneurial leaders play a significant role in improving nurses' IWB through encouraging and supporting them to abandon the traditional ways of executing their tasks and change their perceptions towards their capabilities to create and implement new ideas (Gupta et al., 2004). Entrepreneurial leaders also advance nurses' IWB through acknowledging their efforts and contributions in the process of innovation, offering them the required information and resources for innovation and practicing and valuing innovation (Guo, 2009). In addition, healthcare entrepreneurial leaders develop effective strategies and approaches to facilitate innovation and new opportunity recognition activities (Currie et al., 2008; Guo, 2009).

This study extends our knowledge and understanding of the effective leadership type that fosters employees' IWB (Chen et al., 2016; Weng et al., 2015), specifically in healthcare organizations. Our research also contributes to the few studies that have explored the impact of leadership behavior on nurses' IWB (Malik et al., 2016; Xerri, 2013). Furthermore, this study contributes to the limited research on EL in a specific context other than small and new businesses (Bagheri, Lope Pihie, & Krauss, 2013; Kim et al., 2017), that is, healthcare organizations, which has been investigated by few researchers (Ballein, 1998; Currie et al., 2008; Guo, 2009).

While the significant impact of leadership on nurses' innovation and creativity has been highlighted in developing countries (Malik et al., 2016), this research provides, as far as we know, the first empirical evidence on the effectiveness of EL on nurses' IWB, specifically in Iran. In accord with previous research (Guo, 2009; Herrmann & Felfe, 2013), our findings emphasize the critical influence of developing new leadership competencies in healthcare leaders to enable them to create an effective climate and strategies for innovation development and generating innovative solutions for the challenging and complicated problems of healthcare organizations (Chen et al., 2014; Kang et al., 2015; Kessel et al., 2012).

To this end, current and future healthcare leaders need to be trained to improve their EL capabilities (Guo, 2009) by being actively involved in education and training programs (Leitch et al., 2013). Previous researchers argued that a single leadership style cannot be effective in improving employees' IWB (Rosing et al., 2011). Therefore,

healthcare leaders and supervisors should also learn how to incorporate EL competencies with other leadership styles to better promote innovation among employees.

Furthermore, this study demonstrated the hypothesized significant and different impact of EL on the dimensions of nurses' IWB. Therefore, nurses' successful IWB depends on their supervisors' support throughout the innovation process, from exploring and generating a new idea to championing and implementing the idea (Kessel et al., 2012). This finding supports the contention that the influence of EL style varies with different dimensions of innovation behavior (Huang et al., 2014). More specifically, our findings provide new insights on the stronger effect of entrepreneurial leaders on nurses' capacity to explore, generate, and implement new ideas than on championing new ideas. Entrepreneurial leaders play these critical roles through influencing nurses' attitudes toward innovation (Kim et al., 2017), improving their capabilities of and self-efficacy in creating new ideas (Gupta et al., 2004; Leitch et al., 2013; Renko et al., 2015), and supporting them to enact their new ideas (Karol, 2015). However, their smaller influence on nurses' new idea championing can be partially attributed to the nature of idea championing, which depends on employees' competencies to persuade their colleagues and top managers on the adequacy of their ideas and improve their commitment to realize the ideas (De Jong & Den Hartog, 2010; Mumford, 2003).

Implications for Nursing Leadership

Our findings have several implications for nursing leaders. First, top healthcare leaders can facilitate the implementation of EL through providing nurse leaders and supervisors with the appropriate environment that encourages and supports EL practices (Kessel et al., 2012), specifically in public healthcare organizations (Currie et al., 2008). Our findings also assist nurse leaders in recognizing their key roles in leading the process of innovation in healthcare organizations and developing procedures that give nurses more opportunities for creative thinking, generating new ideas, and taking the risks to implement the ideas (Guo, 2009; Xerri, 2013). Leaders also need to develop encouraging and supporting mechanisms for nurses who devote their efforts to the challenging process of innovation (Janssen, 2005; Kessel et al., 2012; Ng & Feldman, 2013; Xerri, 2013). Second, our finding on the significant impact of supervisors on fostering the IWB of nurses helps supervisors recognize the impact of their relationships and interactions in shaping nurses' perceptions toward and capabilities in innovation (Andrews et al., 2012; Huang et al., 2014). Therefore, supervisors need to build strong relationships

with nurses to inspire and support their new idea generation and implementation (Chen et al., 2016).

Limitations

This research has several limitations, which need to be addressed in future studies. We focused on the impact of EL and did not examine the simultaneous influence of other leadership styles on nurses' IWB. Future research should compare EL with other leadership styles and explore the most effective leadership style in fostering the IWB of nurses. We also did not examine other leadership-related factors, such as personal characteristics of the supervisors and the impact of their support on employees' IWB (Chen et al., 2016). Future research should explore if personal traits and innovation support of nurse supervisors significantly affect their EL practices and nurses' IWB. We also examined the impact of EL on individual nurses' IWB. Future research should be done on the relationship between EL and team-level IWB.

Due to the effects of employees' characteristics and motivation on their perceptions of their leaders' support of IWB (Chen et al., 2016; Kessel et al., 2012; Xerri, 2013), future research should also explore the relationship and interaction between EL and employees' characteristics and IWB. EL implementation (Currie et al., 2008) and IWB (Kessel et al., 2012) vary in different organizations and countries. We encourage future research to examine if the emerging relationship between EL and IWB is consistent in other organizations and countries. The participants in this study were mostly females. Previous studies related gender and entrepreneurial leadership practices (Henry et al., 2015). Therefore, future research should be undertaken to explore if gender affects the relationship between EL and employees' IWB. Furthermore, our study is based on a cross-sectional design and cannot provide generalizable interpretations. Future experimental and longitudinal research should provide causal evidence for the relationships emerging from this study. Finally, to provide a deeper understanding of EL and IWB, future studies should include the assessment of these variables through supervisors' and colleagues' perspectives.

Conclusions

In conclusion, this study suggested the critical influence of entrepreneurial leaders on improving nurses' IWB and consequently addressing the challenges of current healthcare organizations (Ballein, 1998; Guo, 2009). In accord with prior studies (Chen et al., 2014; Guo, 2009; Herrmann & Felfe, 2014), this research highlighted the need to include innovation-oriented leadership styles in the research and theory development on IWB,

particularly in health care. This study also highlighted the need for healthcare leaders to employ entrepreneurial leadership principles in performing their tasks to improve their employees' IWB.

> ## Clinical Resources
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> - Iranian Nursing Association. http://ina.ir
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Resistiveness to Care as Experienced by Family Caregivers Providing Care for Someone With Dementia

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Abstract

Purpose: This research explored family caregivers' lived experiences of resistiveness to care when they provided care for people with dementia. The goal was to identify a general meaning of family caregivers' lived experiences to target potential areas for future nursing interventions to help family caregivers manage their caregiving role and provide a base for future research surrounding resistiveness to care.

Design: Descriptive phenomenology was used to provide descriptions of eight family caregivers who provided care for someone with dementia and experienced resistiveness to care. Family caregivers were recruited from Alzheimer's support groups from June to November 2014.

Method: Caregiver interviews were transcribed verbatim and analyzed using scientific phenomenology to identify essential constituents of the experience.

Findings: The identified general meaning structure contained five essential constituents. These included self-questioning of abilities; signal for increased future caregiver responsibilities; changed perception of personal self; unexpected emotional responses; and seeing a changed person, not the disease.

Conclusions: Study findings represent family caregivers' lived perceptions of resistiveness to care, which are different from current research findings regarding nurses' perceptions of resistiveness to care. The identified meaning structure indicates focus areas for future research and for nursing interventions to help family caregivers manage their distress when experiencing resistiveness to care.

Clinical Relevance: Identification of the meaning caregivers ascribe to their lived experience of resistiveness to care (five essential constituents) provides nurses with opportunities to help family caregivers (coproviders of care) holistically. Supporting caregivers in their caregiving role can decrease caregiver distress when resistiveness to care occurs.

In the United States, 83% of older adults are cared for by a family member or friend, and less than 10% receive care from a formal or paid caregiver (Alzheimer's Association, 2016). Family caregivers provide an invaluable service and often manage care once provided by nurses—coordinating the administration of medications, preventing injury, providing function support, and assessing when professional health services are needed (Grant & Ferrell, 2012), earning them the recognition of coproviders of care. Nearly two thirds of family

caregivers have admitted that they have experienced distress when facing behaviors displayed during caregiving activities (Sloane et al., 2004).

The task of providing care has both positive and negative effects on family caregivers. Some caregivers report their caregiving as a rewarding experience—development of close intimacy with their family member or friend, or creating cherished memories during the time spent together (Brandon, 2013). Many other caregivers describe their caregiving situations as distressful, especially when resistiveness to care occurs when providing assistance with bathing, dressing, toileting, eating, or grooming (Fauth, Zarit, Femia, Hofer, & Stephens, 2006; Sloane et. al., 2004), referred to as activities of daily living (ADLs).

Resistiveness to care occurs as a result of neurologic degeneration processes (Rabins, 2013) and is considered one of the behavioral and psychological symptoms of the disease, along with agitation and aggression. Resistiveness to care is defined as an identified collection of behaviors signaling an opposition to care provided during a caregiving encounter between a caregiver and care recipient (Mahoney et al., 1999). To date, much of the resistiveness to care research focused on paid caregivers' experiences (Cunningham & Williams, 2007; Jablonski et al., 2009; Kovach, Noonan, Schildt, & Wells, 2005).

There are, however, differences noted between paid caregivers' experiences of resistiveness to care and unpaid family caregivers' experiences. For paid caregivers, the resistiveness to care occurred in long-term care facilities and produced stress for the caregiver when tasks were interrupted or took longer to perform (Rogers et al., 1999), but for unpaid family caregivers, resistiveness to care occurred in the home setting, also producing stress, which led to role overload, burnout, and distress (Fauth, Femia, & Zarit, 2016; Williams, Herman, Gajewski, & Wilson, 2009). Mahoney, Trudeau, Penyack, and MacLeod (2006) noted family caregivers verbalized concerns with efficacy completing the task rather than focus on resistiveness to care. Earlier work by Kinney and Stephens (1989) as well as Pearlin, Mullan, Semple, and Skaff (1990) suggested that exploring the meaning that family caregivers attribute to their experiences with care-resistive behaviors may provide insight into reports of distress during family caregiving. Social scientists have also identified resistiveness to care when caregivers assist with instrumental activities of daily living (IADLs), such as shopping for groceries, preparing meals, preparing medications, or paying bills (Shirai & Koerner, 2016). Social scientists (Gaugler, Davey, Pearlin, & Zarit, 2000) have identified that repeated exposure to caregiving stresses could impact family caregivers' physiological health and overall well-being. Pearlin, Schieman, Fazio, and

Meersman (2005, p. 214) ascertained that although the consequences of stress may vary, "the persistence, bundling or layering of stressors across time, can add to what is called the allostatic load. The greater this load the more difficult it is for bodily systems and their biological products to function optimally." Thus, the overall health and well-being of family caregivers may be in jeopardy.

Therefore, the purpose of this research was to investigate family caregivers' lived experiences of a potentially distressful phenomenon—resistiveness to care in order to identify areas in which nurses can support family caregivers throughout this distressing time.

Methods

Descriptive phenomenology (scientific phenomenology method) incorporates rigorous human science, a disciplinary perspective for data collection and analysis, and is ideal for studying phenomena that cannot readily be studied using a natural science approach (Giorgi, 2009). The first author (P.C.S.) entered into the phenomenological reduction to perform the analysis of the caregivers' descriptions of their experience with resistiveness to care. Within phenomenological reduction, the researcher accepts what participants describe as described (does not infer more into the descriptions) and incorporates what is commonly known as "bracketing" (withholding previous known ideas regarding the phenomenon). The goal was to obtain a tangible structure of an eidetic invariant meaning (meanings that do not vary and remain stable), which ultimately clarified the meaning of the phenomenon. After reading and re-reading the interview text and gaining a sense of the whole, the first author (P.C.S.) determined units of meaning (instances of the phenomenon identified using a nursing disciplinary perspective) throughout the entire text. Next, meaning units were transformed using free and imaginative variation, establishing a level of invariance and expressing the raw data in a more secure level of generality. Lastly, transformed meaning units were used to write a general meaning structure of family caregivers' experiences with resistiveness to care.

Recruitment and Informed Consent Procedure

The Pennsylvania State University institutional review board approved this study. A purposive sample of family caregiver participants was identified during Alzheimer's support group meetings. Leaders at identified Alzheimer's support group meetings gave permission for the first author (P.C.S.) to attend and introduce the study to family caregivers. A formal definition of resistiveness to care was not provided to potential participants. Family caregivers

Table 1. Family Caregiver Demographics

	Family caregiver	Care recipient
Age (years)		
Mean	71.1	82.1
Range	60–82	72–95
Gender (*n*)		
Female	7	3
Male	1	5
Duration as caregiver/care recipient after dementia diagnosis (years)		
Median	4–5	4–5
Range	2–20	0.5–20
Care recipient residence	Lives with caregiver, *n* = 4	Lives in nursing care facility, *n* = 4
Types of resistiveness described by caregiver		Wanting to leave, *n* = 3
		Refusing personal hygiene, *n* = 1
		Wanting to drive, *n* = 1
		Not wanting help with finances, *n* = 1
		Resisting everyday caregiving, *n* = 2

who self-identified with the phenomenon and believed they had experienced the resistiveness to care were encouraged to enroll. Time was provided at the end of meetings for interested family caregivers to ask questions and determine if they met the inclusion criteria. Inclusion criteria included being an unpaid family caregiver of someone with dementia, physically helping the person with dementia, or providing verbal cueing (i.e., giving directions during dressing), and believing to have experienced the phenomenon— resistiveness to care. Participants had to be 18 years of age or older and have the ability to both speak and understand the English language. No participant was excluded based upon gender, ethnicity, racial group, or sexual orientation, and participants were not required to reside with the care recipient. After verbal agreement to participate, eight family caregivers signed a consent form (see **Table 1**).

Data Collection

Although the initial contact with family caregivers took place at Alzheimer's support group meetings, the interviews were conducted at a mutually agreed-upon place that permitted private conversations in a relaxed environment. Each individual interview lasted approximately 1 hr, and participants were compensated for their time with a $10 gift card to a local convenience store. Demographic information was obtained at the start of the interview followed by a grand tour interview request: "Tell me what it is like providing care for (named person with dementia)." Caregivers were next asked to describe a recent time when they experienced difficulty while assisting the care recipient. Probing questions were asked to redirect family caregivers' descriptions if they deviated from the phenomenon or to help family caregivers

describe the experiences in more detail. Each interview was digitally recorded, transcribed verbatim, verified by the first author (P.C.S.) for accuracy, and managed using Microsoft Word. Data collection and data analysis occurred concurrently.

Data Analysis

Data analysis followed the scientific phenomenological method as developed by Giorgi (2009). The first author (P.C.S.) maintained the attitude of phenomenological reduction (i.e., accepting what is described as it is described and not inferring more into the descriptions) as well as a nursing disciplinary attitude and sensitivity toward the phenomenon of resistiveness to care throughout the process. The data analyzed consisted of text transcribed verbatim from family caregivers' digitally recorded descriptive experiences of resistiveness to care obtained through face-to-face interviews with the first author (P.C.S.). Analysis occurred over 6 months, during which time the data were segregated into meaning units. Meaning units (i.e., instances of the phenomenon) were transformed into nursing-sensitive expressions (i.e., expressions of caregiving). Through the use of free and imaginative variation, meaning units became invariant meaning units that were later used to form the general meaning structure of the lived experience of resistiveness to care. Credibility of the data analysis was attained when rich detailed descriptions of resistiveness to care were uncovered during the data analysis process. Qualitative data collection typically ceases when data saturation occurs. Using the scientific phenomenological method, the goal was a general structure of the experience. A general structure is obtained from varied instances of the resistiveness to care described in the data. Therefore, the unit

of variance is the instances of the phenomenon and not the number of participants. Data collection is complete when enough varied instance has flourished to determine a general structure of the experienced phenomenon (Giorgi, 2009). For this study, eight informants provided 115 detailed instances of resistiveness to care, ensuring enough variance to formulate a meaning structure and summary statement of the experiential phenomenon (Giorgi, 2009). To improve the trustworthiness of the data analysis process, the first author (P.C.S.) used an audit trail to record all steps and decisions made during the phenomenology research process: formulation of the research question, recruitment of participants, data collection, and data analysis.

Sample

Ten participants were planned and recruited for the study; however, two participants changed their minds, stating they did not think they experienced the phenomenon. Demographics of the eight consenting participants were congruent with current caregiver demographics according to the Alzheimer's Association (2016). At the time of the interviews, four caregivers lived with the care recipient and two of the four care recipients living in a care facility had lived with their caregivers prior to placement. See **Table 2** for individual caregiver responsibilities.

Findings

Resistiveness to care was found within the context of providing care for someone with dementia and usually occurred in a situation in which the family caregiver was engaged or interacting with the person with dementia. Sometimes resistiveness to care occurred when a caregiver had an agenda or goal and the care recipient was not compliant. In other situations, a sudden unexpected care recipient action or behavior resulted in family caregivers perceiving resistiveness to care. Once engaged in resistiveness to care, five essential components for the structure of resistiveness to care were assigned meaning in the consciousness of the family caregiver and were uncovered by the first author (P.C.S.). These essential components include self-questioning of abilities; a signal for future caregiving responsibilities; a changed perception of personal self; an unexpected emotional response; and seeing a changed person, not the disease. In response to resistiveness to care, family caregivers developed strategies to manage or avert the resistiveness to care behaviors. These strategies included a struggle to tell the care recipient "little white lies" or to be honest; using reasoning with the care recipient; and deciding to relinquish

the goal or agenda for the caregiving encounter. The potential existed that unsuccessful strategies used by family caregivers would propel the dyad (family caregiver and person with dementia) back into resistiveness to care, thus repeating the cycle of caregivers having to manage a new situation with strategic choices. The ultimate desire was to reach a stable state in which the resistiveness was averted. Permanent stability was unlikely as resistiveness to care occurs along with the progression of the disease process; therefore, a transient stable state was the goal.

Key Constituents for the Structure: The Experience of Resistiveness to Care

The following sections include detailed descriptions of each constituent and the concrete empirical variations of the resistive experience each family caregiver (pseudonyms are used throughout) encountered when providing care for someone with dementia. In the descriptive phenomenology Giorgi method, verbatim quotes are not used as key constituents; however, direct quotes from transcripts are used to verify that key constituents were formed from participant experiences (**Tables 3** and **4**).

Self-questioning of abilities. When exposed to resistiveness from the care recipient, all participants were triggered to evaluate their abilities as caregivers. The majority of caregivers appraised their abilities negatively. Caregivers questioned how they handled the situation, their ability to manage the resistiveness, whether they had done enough, and whether they were doing the right thing. One family caregiver remained positive despite her initial negative appraisal. Although stating that she was unpleasantly surprised with the resistiveness, Eve seemed to know exactly what needed to be done and was confident that she would be the one to handle the situations. Whether caregivers questioned their ability to handle the situation and appraised their ability negatively or positively, all reported increased responsibilities as they experienced resistiveness to care.

Signal for increased future caregiver responsibilities. When resistiveness to care occurred, family caregivers sensed their caregiver responsibilities and duties would increase as the disease progressed. Grace stated that each time she saw her husband do something new and different, it signaled that her life would not get easier. For Sam, the perceived increase in caregiver responsibilities necessitated placing his wife in a care facility. Jenny, the family caregiver for the longest duration, was the most positive with the increased caregiving responsibilities. She acknowledged that things could have been

Table 2. Caregiving Responsibilities of Family Caregivers

Caregiver	Caregiver gender	Amount of caregiving provided/needed	Care recipient gender	Care recipient residence
Alice	Female	• Able to do ADLs with prompting from caregiver • Caregiver must manage financial affairs and stimulation to prevent wandering • Can be left alone for short periods of time but not all day	Male	Lives with caregiver

Grace	Female	• Needs assistance and prompting with ADLs
		  ○ Needs reminded to shower
		  ○ Assistance needed after toileting
		  ○ Prompting needed during dressing
		• Can be left alone for parts of the day but not long periods of time
			Male	Lives with caregiver

Margie	Female	• Visits care recipient 2–3 times per week for 30 min each visit • Does the laundry and pays the bills for the care recipient • Takes the care recipient to all doctor visits or "anyplace she [care recipient] wants to go" • Considers herself the "major caretaker" for the care recipient. "I am the main one they [care facility] would contact."	Female	Lives in assisted care facility past 3–4 years Previously lived alone

Jenny	Female	• Needs minimal assist with ADLs
		  ○ Regulate the water temperature for a shower
		  ○ Provide clothing choices for dressing
		  ○ Will make a sandwich if ingredients are in the refrigerator
		• Can be left alone for parts of a day
		• Able to mow the lawn but not start the mower
		• Able to perform task with prompting
			Male	Lives with caregiver

Peggy	Female	• Needs prompting to perform ADLs on her own • Needs redirecting to do tasks • Can be left alone for short periods of time • Needs supervision for wandering	Male	Lives with caregiver
Deloris	Female	• Needs two-person assist with toileting, needs assistance with eating • Unable to walk—uses a wheelchair • Caregiver manages finances and does the laundry for the care recipient • Visits care recipient on days off work for several hours each visit	Female	Lives in a facility past 3 years Previously lived with caregiver
Eve	Female	• Manages the finances for the care recipient • Requires assistance with ADLs and supervision to prevent wandering • Visits when visiting daughter who lives nearby (not as often as liked)	Male	Lives in a care facility past 2 years Previously lived alone

Sam	Male	• Prompting and assist needed with ADLs
		  ○ Turning on the water for bathing
		  ○ Putting toothpaste on the toothbrush
		  ○ Preparing meals
		• Supervision for wandering and management of behaviors
		• Visits care recipient daily for several hour each visit
			Female	Lives in a care facility
				Prior lived with Caregiver

Note: ADL = activity of daily living.

Table 3. Verification of Key Constituents

Constituents	Alice	Grace	Margie	Jenny
Caregiver self-questioning of abilities	"I don't know this role as a caregiver . . . the funny part is he isn't even my husband."	"I feel like I'm not doing enough for him."	"When I took my mom's car [the support group leader] was the one to reassure me."	"My kids want me to retire . . . what would I do at home? No, I like the contact with the world."
Signal for increased future responsibilities	"It really takes a lot of what I was doing, you know. That I could come and go and do."	"It makes a lot of work. I know it's not going to get any better because each day . . . I notice he's doing something different."	"It is very difficult to take her to the doctor . . . it's draining for somebody like me . . . I have MS so it makes it worse."	"I'm very lucky in most ways. I'm very lucky. Very fortunate in a lot of ways, it could be a lot worse."
Changed perception of personal self	"So it's like holy good god look what my life is cut out for." "I'm getting more of a caregiver!"	"I have close friends . . . they know he has dementia . . . . It's poor [Grace's husband]."	" . . . My mother took care of me when I was a baby and now it's my turn to take care of her."	Husband gets all the attention—it is all about him but wants some recognition too.
Unexpected emotional responses	"I don't give a shit if he asked for it or not, I can't . . . I can't handle it."	Feeling bad for husband and pity for self-anger with need to be firm as a parent with a child.	"I guess I was thinking 'well I'm the bad guy here.'"	"Oh NO!" (Dread) "I get very angry, I just feel like if I just shake him and make him realize, but I know I can't."
Sees changed person, not the disease	Only sees PWD asking to go home. "I can't see the disease, I cannot see the disease."	He's like a 7-year-old boy. "He's 6'1" and it's hard for me to treat him like a little boy."	"As close as my mother and [Ed] were . . . she doesn't talk about him, which I don't understand."	"I see him the way he is now, and the way he used to be."

Note: MS = multiple sclerosis; PWD = person with dementia.

worse and was thankful that her husband could do as much as he could with minimal assistance. While enduring resistiveness to care, caregivers were aware of an evolving relationship with the care recipient that was different from what they had had before the dementia diagnosis. Caregivers also observed changes in themselves and their roles and relationships.

Changed perception of personal self. All participants described an awareness of becoming more of a caregiver and less of a significant other; noticing friends expressing sympathy for the care recipient but not the caregiver; and role reversals with offspring family caregivers caring for their parent as if they were a child. Margie described how her mother had cared for her when she was little and now she feels obligated to care for her childlike mother. Sam described feelings of turmoil when his wife rejected him and he was not able to care for her as her husband. The changing perceptions of self were distressing for caregivers. Most participants were also upset by the unexpected emotions that were triggered by their care recipient's resistiveness to care.

Unexpected emotional responses. The unexpected resistiveness to care triggered many different

emotions for the caregiver. Caregiver emotions varied in the spectrum of anger toward the care recipient, situation, or disease; fear of the unknown and unexpected in the situation; and frustration and irritation with the care recipient for the resistance. All caregivers experienced unpleasant surprises and confusion toward the resistance, felt sadness for the person with dementia, and felt guilt for their reactive thoughts and responses to resistiveness to care. This guilt emerged despite caregivers' justification of their responses—the need to protect the person with dementia or self. Margie stated she felt guilty for having to be the bad guy and take away her mother's car, while Grace said she felt guilty that she had to become forceful, as a parent must with a child to get her husband to shower. Eve was the only caregiver who despite feeling surprised and overwhelmed during the resistiveness to care episode stated she felt confident and was determined to provide the needed care. Amid the many emotions of the encounter, all caregivers admitted that in the moment of resistance, they were unable to see the behaviors as part of the disease process. They only saw the changed person before them.

Seeing changed person, not the disease. During resistive encounters, all caregivers admitted that they

Table 4. Verification of Key Constituents

Constituents	Peggy	Deloris	Eve	Sam
Caregiver self-questioning of abilities	"I think that's the main reason it's been difficult because I didn't know what to expect."	Guilt—wondering if mother would not have declined if they hadn't argued.	"I knew I'd be able to do it by sneaking things."	"Are we doing the right thing?" "You gradually begin to realize that it is a hopeless case."
Signal for increased future responsibilities	". . . over protect him for not knowing if he's going to say the wrong thing. That's what I was getting into problems with . . . I want to fix it but I can't."	"I know in my heart I can take the best care of her . . . probably if my sister lived closer . . . we would have her at home."	"It's a huge, huge job and emotionally you just don't . . . you know, you're caught up in all this work and emotionally just don't sit back and think about it."	"I couldn't do the job those people do in the nursing homes. I wouldn't be able to handle it. I think it's a tough job."
Changed perception of personal self	"I have to keep remembering he loves me. I don't have to forget I love him . . . ."	"I love my mom and I'm ashamed of myself for the way you know I talked to her back then."	Feeling overwhelmed with the amount of work and time as caregiver.	"I wasn't allowed to visit her [wife] because I was the enemy with the love child and mistress."
Unexpected emotional responses	"'You son of a bitch'—it's all I could think of. I wasn't supposed to be bawling."	"Sometimes I would get fed up and I would scream right back."	Surprise but determined to provide care. "I knew that I would just do it."	". . . guilt . . . not sure if you are doing the right thing." "So we were sort of stuck."
Sees changed person, not the disease	"There are some days he is his old self and I love those days."	"In my mind I'm thinking 'why can't you understand this? And she's . . . screaming at me.'"	Eve sees a "very bright man with a long career and his mind is a jumble."	" . . . most of the time when I talk to her she makes perfect sense and I agree with her."

saw the care recipient, but not the disease. This created conflict in the minds of the caregivers as they experienced resistiveness to care behaviors. Grace saw her husband as the 6′1″ man, but the behaviors and his responses were that of a 7-year-old little boy. This caused Grace confusion and uncertainty about how to respond. Deloris was completely at a loss for why her mother was acting resistive, which was so out of character, causing Deloris to wonder if her mother was having a mental breakdown. Peggy admitted that she tried to remember her husband could not control the resistive behaviors but had difficulty in the moment and only saw him as her husband before the disease. Only after the care-resistive episode ended were the family caregivers able to reflect on the interaction and attribute the resistiveness to the care to the dementia.

Caregivers' Management of Resistiveness to Care

Family caregivers attempted to manage the resistiveness when it occurred by using similar tactics that appeared to be strategic and intuitive. These included the use of reasoning and logic. When the resistiveness to care behaviors occurred, the family caregivers would reason or try to use logic with the care recipient to overcome the resistance. However, when these choices were ineffective, family caregivers would resort to "telling little white lies," which they are taught at the Alzheimer's support group meetings as a means to prevent resistiveness. Many family caregivers said in their interviews that they had moral struggles with using lies with their care recipient and weighed this strategic choice against being honest with the care recipient. Several participants reported feeling guilty for deceiving their care recipients with lies. As a result, family caregivers were often noted to abandon their goal or agenda as a more acceptable way to manage the resistiveness to care.

When one or more of these strategic choices failed to eliminate or lessen the resistance, family caregivers abandoned their goal or agenda. Only three caregivers admitted they did not give up their goal or agenda for the caregiving encounter when they encountered resistance that was not averted using reasoning, telling lies, or being honest. These caregivers (who were the exception) were confident in their ability to successfully reach their goals during resistive episodes. Despite whether they gave up their original goal or agenda during resistiveness to care, the ultimate aim for family caregivers was to achieve a stable state where resistiveness to care did not occur. However, all participants indicated they realized the stable state was only temporary, since the likelihood of more

resistiveness to care increased as the disease process continued to destroy neurologic functioning.

Discussion

This study revealed five essential constituents that occurred in a resistiveness to care episode to form the structural experience of the phenomenon as experienced by family caregivers (**Figure 1**). Although the essential constituents were present in every caregiver's experience of resistiveness to care, the constituents were different in appearance as each caregiver experienced the resistiveness to care in a different way.

When resistiveness to care occurred, all caregivers expressed they felt challenged and questioned their ability to be a caregiver. The majority of caregivers expressed a lack of confidence in their abilities to manage the caregiving role, as evidenced by their expressions of "I'm not doing enough" and when they questioned whether they did the right thing. The incidence of negative caregiver feelings and appraisals are supported in the research literature. Croog, Burleson, Sudilovsky, and Baume (2006) reported that family caregivers of persons with dementia often state they feel anxiety about their caregiving and feel as if they need to do more for the care recipient. Although Gaugler et al. (2000) found that over long durations of caregiving family caregivers begin to have more positive appraisals of their caregiving experiences, all caregivers (including Eve, who was confident in her abilities) questioned their ability as caregiver when they experienced resistiveness to care, regardless of time spent in the caregiving role.

As family caregivers encountered resistiveness to care, they developed a sudden sense that their caregiving duties and responsibilities would increase and anticipated that change. This finding is congruent with the findings of Williams, Morrison, and Robinson (2014), who reported that caregivers of persons with dementia anticipate and actually come to expect more caregiving demands in the future. In fact, Mittleman, Roth, Haley, and Zarit (2004) identified that family caregiver reaction to behaviors such as resistiveness to care was a significant predictor of whether or not a family caregiver would place the care recipient in a care facility.

While family caregivers were enduring episodes of resistiveness to care, they became aware that their relationship with the care recipient was changing and were cognizant of the fact that they themselves were changing. They noticed their roles were different and the relationships that they had had prior to becoming a caregiver began to disappear. All participants who cared for spouses or partners expressed an awareness of becoming more of a caregiver and less of a significant other. Children caregivers noted they were now in a parentlike role for their mother or father with dementia.

This notion of a changed self was supported in the literature. Croog et al. (2006) identified that limitations of family caregivers' social lives and personal time contribute to the perception of a changing personal self. Simpson and Acton (2013) reported that family caregivers who take on the parenting role during caregiving are doing it as part of what they call "emotion work"—struggling to do what is right and changing one's feelings to be more appropriate with what is accepted either by society or by the family caregiver personally. Whether the changes were due to limited social or personal time or to emotion work, the changing perceptions of themselves appeared to be distressing and difficult for family caregivers to understand and accept.

All of the caregivers interviewed for this study experienced unpleasant surprise and confusion regarding their own behavioral response toward the resistiveness to care. This was associated with sadness for the care recipient and expressed guilt for their reactive thoughts and emotional responses to the behaviors. This surprise response by family caregivers was supported by findings of Simpson and Acton (2013), which identified that family caregivers who are struggling to "do the right thing" wrestle with their behavioral responses to resistiveness and what they think their responses should be.

It was apparent that all participants could see the care recipient as a changed person during the moments of resistiveness, but they did not associate the resistiveness to care with dementia. Polk (2005) disclosed that many caregivers were not able to see the disease process but rather saw a changed person. Pot, Deeg, Van Dyck, and Jonker (1998) reported that family caregivers are too close to the situation and unable to step back and see the behaviors as part of the disease process. As a result, caregivers were conflicted in how they should respond and struggled with the responses they chose, which supported Polk's (2005) assertion that family caregivers who attributed behaviors such as resistiveness to care to the person with dementia and not a result of the disease process tended to have less patience with the care recipient. The family caregivers interviewed expressed anger or frustration with these "new" care recipient behaviors or actions and did not relate them to the disease process. It was only upon retrospection that family caregivers acknowledged that they were able to discern the behaviors as manifestations of the dementia.

These findings validated the speculations of Kinney and Stephens (1989) and what Pearlin et al. (1990) posited in the stress process model: primary stressors such as problematic behaviors (resistiveness to care) may not be the actual stressor for family caregivers
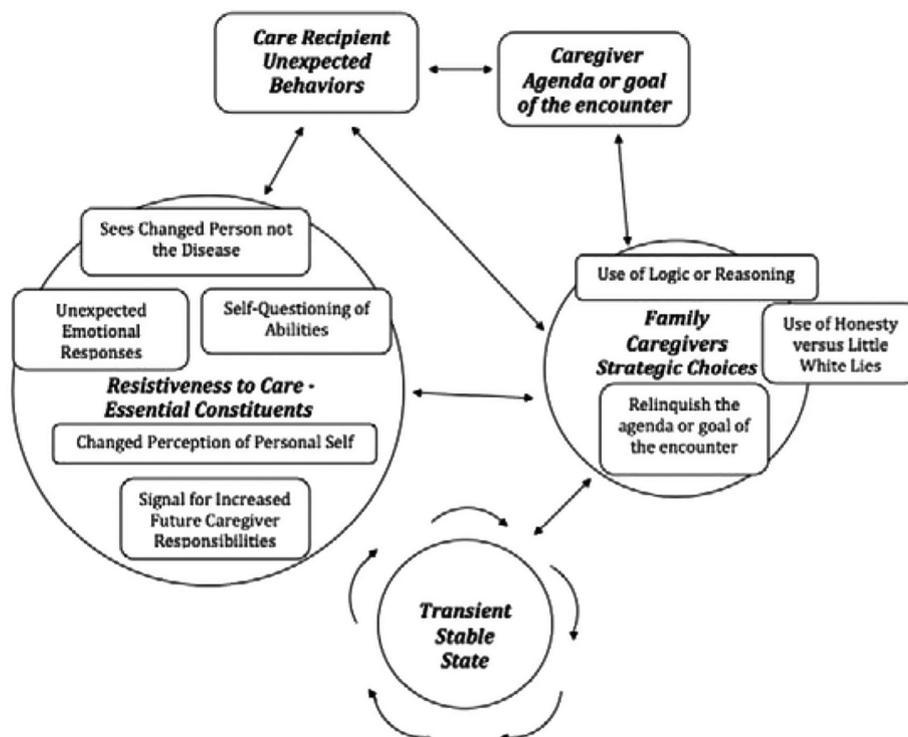
Figure 1. Schematic representation of the general meaning structure of resistiveness to care.

but rather the behaviors' trigger of a sudden reminder to the family caregiver of the changing person (care recipient). Both spousal and children family caregivers in this study described the changing person with dementia as distressful and difficult to comprehend. This aspect of the phenomenon may have played a part in how family caregivers managed the resistiveness to care that they experienced.

Nursing Importance of Resistiveness to Care

Findings from this study enhance nursing's grasp of the phenomenon of resistiveness to care. Nurses need to understand that family caregivers do not focus on the struggles of providing the tasks (ADLs or IADLs) or the actual objective behaviors of resistiveness to care. Instead, their descriptions revealed what the experience of resistance meant for them. This may be an indicator as to why some of the current nursing interventions aimed at reducing family caregiver distress via reducing resistiveness to care behaviors do not work as well as expected for family caregivers.

Nurses educated on the identified meaning structure and five essential constituents can be advocates for family caregivers by helping them to identify resources and

coping strategies for their responses in order to help them remain optimistic and enable them to sustain their caregiving role. This study identified common ways that family caregivers manage resistiveness to care (being honest, telling little white lies, and giving up the goal or agenda). Nurses aware of these management strategies can work with family caregivers to identify new ways of responding to the changed person (care recipient) during resistiveness to care that are less distressful and more therapeutic for family caregivers and persons with dementia.

Findings from this study provide an opportunity for nurses to use praxis and target the specific constituents identified in the study to help support caregivers who experience resistiveness to care. Advanced practice nurses should assess the person with dementia and family caregivers to determine if they are at or near their "tipping point" and help support them in their choice of care decisions. Advanced practice nurses' provision of anticipatory guidance for both caregivers and care recipients can be instrumental to smooth transitioning of caregiving from home to long-term care setting as well as for sustaining caregiving at home.

Limitations

The limitations of this study include a meaning structure that provides general descriptions of the

phenomenon and not a universal description. The findings are contextually bound to family caregivers of people with dementia and only render visible the quality of the relationship among the family caregivers, the person with dementia, and the situation that constitutes the experience of resistiveness to care. These findings provide a base for future research but do not delve further than the raw data given. Lastly, no theoretical assumptions are proposed, but the findings do raise new questions that can be stepping stones for future research.

Conclusions

The findings from this study add to the nursing science surrounding the phenomenon of resistiveness to care by providing a nontheoretical and objective understanding of resistiveness to care in the form of a structural experience of family caregivers. They also provide a subjective understanding of the family caregivers' lived experiences, which enhance nursing praxis and empathy when providing support for family caregivers—their fellow co-providers of care (Penrod, Hupcey, Loeb, & Baney, 2012). Lastly, the identified meaning structure of resistiveness to care provides a base for future research investigating interventions to help family caregivers in their role and assist with the transition from home to placement.

Future research opportunities should include investigations of the five constituents and their potential as moderating factors in the perception of distress for family caregivers. It is not clear whether support in these areas would be more beneficial than the social support currently recommended in the literature on caregiving. Further research is needed to determine whether the chronic illness trajectory could be used to identify when family caregivers in making the transition from home care to placement. Interventional research should include the subjective experiences of family caregivers rather than the objective behaviors of the disease process in order to help family caregivers manage the distressing situations of resistiveness to care.

Acknowledgments

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Clinical Resources

- Alzheimer's Foundation of America. https://alzfdn.org
- The Hartford Foundation. Caregiving resources. http://www.johnahartford.org/get-involved/caregiving-resources/
- The Hartford Institute for Geriatric Nursing. https://consultgeri.org
- The Rosalyn Carter Institute for Caregiving. http://www.rosalynncarter.org/caregiver_resources/

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CLINICAL SCHOLARSHIP

The Design, Development, and Evaluation of a Qualitative Data Collection Application for Pregnant Women

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Abstract

Purpose: This article explores the development and evaluation of a smartphone mobile software application (app) to collect qualitative data. The app was specifically designed to capture real-time qualitative data from women planning a vaginal birth after caesarean delivery. This article outlines the design and development of the app to include funding, ethics, and the recruitment of an app developer, as well as the evaluation of using the app by seven participants.

Organizing Construct: Data collection methods used in qualitative research include interviews and focus groups (either online, face-to-face, or by phone), participant diaries, or observations of interactions. This article identifies an alternative data collection methodology using a smartphone app to collect real-time data.

Conclusions: The app provides real-time data and instant access to data alongside the ability to access participants from a variety of locations. This allows the researcher to gain insight into the experiences of participants through audio or video recordings in longitudinal studies without the need for constant interactions or interviews with participants.

Clinical Relevance: Using smartphone applications can allow researchers to access participants who are traditionally hard to reach and access their data in real time. Evaluating these apps before use in research is invaluable.

Determining the approach to data collection is a key element of research design. Several factors, other than the research question, influence the choice of data collection methods, including but not limited to geographical location of participants and the researchers' available funding and access to resources, such as administrative datasets (Wilcox, Gallagher, Boden-Albala, & Bakken, 2012).

Traditional Qualitative Data Collection Strategies

Methods typically used for data collection in qualitative research include interviews and focus groups (either online, face-to-face, or by phone), participant diaries, or observations of interactions, including use of video to record day-to-day practice or events (Udtha, Nomie, Yu, & Sanner, 2015; Wilkerson, Iantaffi, Grey, Bockting, & Rosser, 2014). Advancements in digital and mobile technology are producing alternative methods for data collection with the benefits of smartphones, tablets, applications, and cloud-based storage (Chan, Torous, Hinton, & Yellowlees, 2014; Dhiliwal & Salins, 2015; Faulds et al., 2016; Wilcox et al., 2012); however, they also bring design, implementation, and ethical challenges that need careful consideration.

Online Qualitative Data Collection Strategies

Digital and mobile technology are increasingly utilised in health-related research, including mental health, palliative care, travel health, health promotion, telemedicine, and pregnancy care (Chan et al., 2014; Dhiliwal & Salins, 2015; Evans, Wallace, & Snider, 2012; Frazer, Hussey, Bosch, & Squire, 2015; Garnweidner-Holme, Borgen, Garitano, Noll, & Lukasse, 2015; Jordan, Ray, Johnson, & Evans, 2011; Krauskopf, 2017; Wang & Alexander, 2014). The popularity of smartphones and Internet accessibility can assist researchers to communicate with potential participants through a variety of modes, such as instant messaging, photo sharing, and video conferencing (Chan et al., 2014; Dhiliwal & Salins, 2015).

Digital technology offers the opportunity to capture the experiences and feelings of healthcare consumers immediately or soon after their appointments with professionals. The aim of this article is to detail the development of a purpose-designed smartphone application (app) from the initial idea through to the testing of the app. This article explores issues of ethics and intellectual property raised during the development of the app, as well as the evaluation by participants testing the app.

The main study was undertaken to explore the experiences of women planning to have a vaginal birth after caesarean delivery (VBAC) by collecting data immediately after their visits with health professionals from 32 weeks' gestation until birth. Part of the study involved data collection through the use of the myVBACapp.

Observational studies have explored the relationship between the pregnant woman and health professional and identified the varying communication styles found in different models of antenatal or maternity care (McCourt, 2006; Pollard, 2011). However, little is understood regarding the impact of what women are told in the antenatal appointments on their feelings and decisions.

Antenatal appointments increase in frequency in the third trimester, from monthly to fortnightly from 28 weeks' gestation, and to weekly from 36 weeks' gestation. This allows for increased communication and potential influence of the health professional on the woman's decision making.

Pregnancy-related apps occupy a large proportion of health-related apps available (Thomas & Lupton, 2015). Many pregnant women access apps for pregnancy-related information (Declercq, Sakata, Corry, Applebaum, & Herrlich, 2013; Evans et al., 2012; Frazer et al., 2015; Garnweidner-Holme et al., 2015; Jordan et al., 2011; Rodger et al., 2013; Thomas & Lupton, 2015). In 2014 to 2015, 97% of all Australian households with children under 15 years of age accessed the Internet at home, with 86% of households accessing the Internet via mobile or smartphones (Australian Bureau of Statistics, 2016). Tablet and smartphone technology utilizes small distributed apps, accessed from an operating-specific store (e.g., iTunes and Google Play), with many apps using cloud storage (Wilcox et al., 2012).

Development of the Mobile Phone App

Innovative problem solving led to the proposal to develop the myVBACapp for use with smartphone mobile technology. This novel approach to data collection focused on participants creating a video blog (log) following an antenatal appointment, which was sent to the first author (H.K.).

Selection of This Method

The aim of the main study was to explore the antenatal experiences of women planning a VBAC in Australia. The research team wanted to capture women's response to the information they were provided and the style of the interaction within the antenatal appointment.

Careful consideration was given to the methods of data collection to facilitate the inclusion of women from across Australia. Using the online environment for data collection can reduce costs involved with face-to-face interviews, such as travel and location costs (Wilkerson et al., 2014).

It was hoped this would capture how women felt immediately after their antenatal appointments, since three open-ended questions would have been posed regarding their feelings about the appointment, what information had been retained, and how this impacted on their decision making around planning a VBAC. This would remove the risk for bias and inaccuracy found with retrospective reporting (Fields, Bardill, Marzano, & Herd, 2015) and allow participants to tell their stories, identify their emotions, and report on their behaviors (Marzano et al., 2015) in the form of an audio or video diary. It was anticipated that by making an audio or video recording the participants would give honest and spontaneous accounts without the filtering and analyzing effect of writing responses in an online survey or diary tool.

The app was also designed to increase opportunities for participation from pregnant women all over Australia, provided they had access to smartphone mobile technology.

App Development

Although the first author (H.K.) conceptualized the initial idea of the app, it was beyond her skill set to design and set up the app. Here she looked to outsource the design to an app developer. The issues found in the early stages included financing, finding an app developer, and problems related to ethics approval.

Mobile technology presents issues for data collection, including privacy and confidentiality, access to suitable devices, and connectivity (Park & Lee, 2015; Wang & Alexander, 2014). As smartphones are increasingly being used for secure tasks, such as online banking, threats to privacy and security through the use of malware and Bluetooth can be present (Wang & Alexander, 2014). Processes such as encryption, digital signatures, and authentication are functions used to enhance security on smartphones (Wang & Alexander, 2014). Using devices that require current technology can also create a digital smartphone divide apparent across generational, income, and educational groups (Park & Lee, 2015).

It was decided to make an app for use on both iOS and Android platforms. Due to the increased time it takes to submit the completed iOS app to the App Store, the iOS app was made first. The first phase of app development was the formation of the wireframe. This is a simplistic drawing showing the progression of the app, screen by screen, and was shared with the authors for comment and feedback.

Once the wireframe was agreed upon, the app developer made the iOS and then the Android app. Communication was via Upwork's instant messaging service and occurred every few days or whenever there was a question that needed clarification, from either the app developer or first author (H.K.), such as proofing screens. At different stages of development, the app was sent to the authors and feedback was given.

Ethical Issues

Ethics approval was obtained through the (Western Sydney University) Human Research Ethics Committee, reference H11890. Ethical considerations included data privacy and storage (Garnweidner-Holme et al., 2015; Wilkerson et al., 2014). A detailed plan outlining the process for obtaining and securing the demographic and recorded log data was written in conjunction with the app developer and submitted to the Ethics Committee. Demographic data, obtained when registering the app, were encrypted as a bundle and sent to the server after the participant provided consent. No data were stored within the device. The data were stored within a database in their encrypted form and were only unencrypted when

accessed by the first author (H.K.). The video and audio data were also encrypted and held on the device until confirmed as successfully uploaded by the server. The uploading of the log data happened immediately after they were completed, or when the device was next connected to the Internet through Wi-Fi. The data were held on a block storage service separate from the demographic data. Both sets of data were mapped solely with an identifier number.

Finance Issues

An initial app developer was found through word of mouth and a quote was given and agreed upon. Unfortunately, following 4 months of slow progress, this app developer was unable to complete the work due to family commitments. The first author (H.K.) quickly sourced alternatives and sought support and advice from the supervisory team. Quotes were received from a wide variety of developers, including from those at established companies, through to freelancers.

The development needed to occur on a small budget as the lead author (H.K.) was a doctoral candidate and had access to limited funds. An app developer outside of Australia was commissioned through the use of the website upwork.com. The website acts as a freelancing website linking clients with freelancers worldwide and deals with secure payments, confidentiality, and intellectual property rights. Clients are able to review portfolios of potential freelancers and communicate through a messaging service on the site. A "job" was created for the app development, and prospective freelancers were reviewed. Requirements for the freelancer included a good understanding of the English language to aid in communication, a history of completing work in the required time frame, experience of app development with iOS and Android platforms, and immediate availability. A freelancer was chosen after communicating ideas and expectations and the project was commenced.

Intellectual Property

Issues of copyright and intellectual property were explored in depth when contracting with an app developer. The areas considered were the ownership of the logs, the app idea, and the app. Within the participation consent, permission is given to the researcher to use the video or audio logs for research and research dissemination, as long as confidentiality is maintained. The participation information was carefully worded to allow for ease of understanding (Taylor, 2015). The consent and permission for the use of data are supported within a legal framework (Carroll, 2015).

Intellectual property rights between the first author (H.K.) and the freelance app developer were clearly addressed in the contract through Upwork. Ownership of the app idea and final product belongs to the first author (H.K.) as directed under the user agreement.

Evaluation of the App

Once the apps were completed, they were sent to participants for testing and evaluation. There were three participants in the iOS group and four participants in the Android group. Participants were recruited through social media advertising; there were no exclusion criteria other than having access to either an Android or iOS smartphone. Participants were asked to install the app onto their phone, register the app, put in the activation code, make a video, and then audio log and upload them. Once this was done they were requested to fill out the online ease-of-use survey. An ease-of-use survey was designed using Qualtrics© (2017) software and provided as a weblink to the participants. Areas covered in the survey included installation, signing up, recording a log, uploading a log, appearance, and improvement (**Figure 1**).

Installation

To allow for installation prior to submitting to the Apple App Store and Google Play, the apps required manual installation. This was fairly straightforward for the Android app, with the app developer creating an Android application package (apk) file, which could be sent directly to the participant. This file could then be downloaded and installed straight onto the phone. Installation of the iOS app file was more complicated, with participants needing to find the unique device identifier (UDID) of their phone where a link was then created for downloading and installing the app (**Figure 2**).

Only one of the seven participants found installation "somewhat difficult." Feedback from the participants identified the issues with installation and also the reasons for this. "I think the issues I had with installation were only because it's the test phase, the actual procedure wasn't hard" (participant). As the app was not installed via the device store, one participant found they "just needed to turn off some safety settings on my phone" (participant).

Signing Up

The first stage of the app involved signing up to create an account including name, e-mail address, phone number, and expected due date. The sign-up page also had a link to the terms and conditions of the app and assumed agreement to these when signing up. Filling in the details and tapping on "submit" completed the sign-up process and initiated an e-mail to be sent to the participant with an activation code to continue to use the app. Once the activation code had been received, the participant was directed to the consent page and following agreement landed on the main log screen.

After the evaluation phase it was realized that a proofing system was required for the first author (H.K.) to access the database and manually validate individuals who had registered the app. Once the apps were available via the app stores, they were available for anyone to download and register, not just the intended participants. Access limitations needed to be applied to prevent unnecessary logs from individuals not in the study. This flaw was realized by the first author (H.K.) and was rectified by the app developer for an additional charge.

Six participants found sign up to be "extremely easy" and was described as "very straightforward" (participant).

Recording a Log

On the log screen the participant was able to make a log from a simple "+" button and to choose to create an audio or video log. The choice of audio was added after consultation with the supervisory team to allow for participants who may feel uncomfortable making a log in video format.

All participants found recording a log "extremely easy" or "somewhat easy" and it was described as a "really easy to use interface" (participant). One participant expressed that "I'm usually not so fabulous with technology and I found it very easy" (participant).

Uploading a Log

Once a log was recorded it was uploaded to a server and onto the researcher side of the app. The time taken to upload was dependent on whether the log was audio or video, the length of the log, and the speed of the Internet connection.

Five participants found uploading "extremely easy" and the remaining participants reported uploading as "somewhat easy." Participants noted that the process was "easy to do" (participant) and "uploaded quite quickly" (participant). One criticism was the delay in the recording appearing on the log screen: "It is a little confusing that the logs don't necessarily appear straight away in your log list so you aren't sure if it was successful or
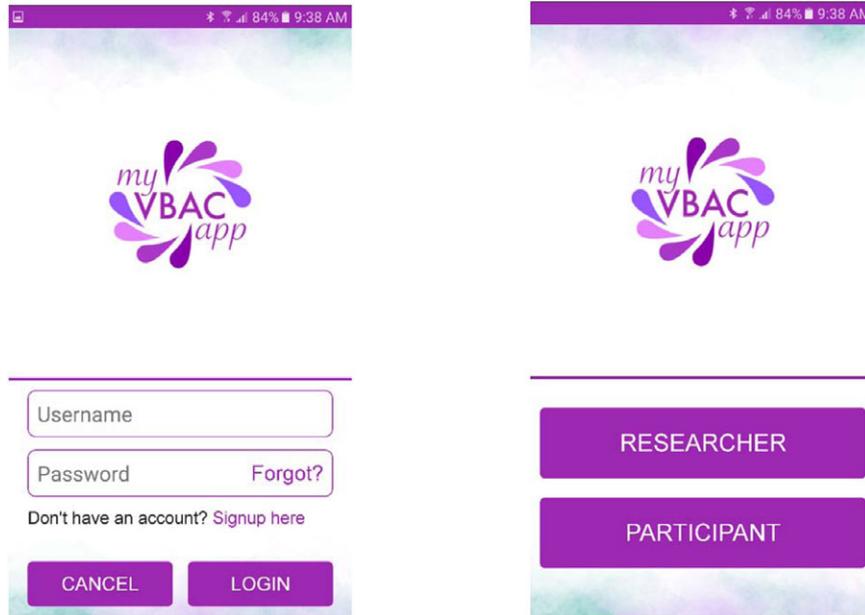
Figure 1. Screenshots of app.
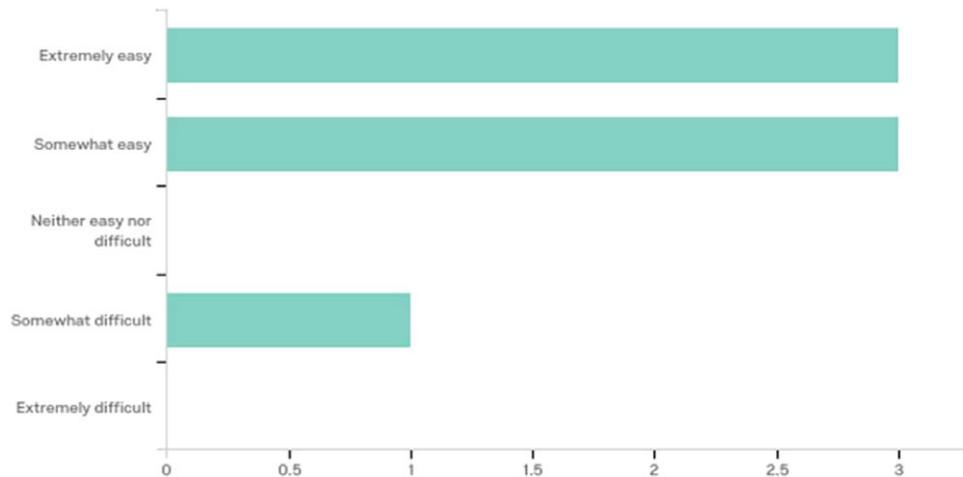
Figure 2. Question: How easy was it to install myVBACapp?

not if you miss the brief "success" message that appears" (participant).

Appearance of the App

The app was designed for female participants with the aim to look simple and professional. The app developer was given a color palate of purple and aqua.

All participants rated appearance as "like a great deal" or "like somewhat." Comments included a "nice simple interface which is good" (participant) and "love the colours and design, looks as though it will be easy to navigate and user friendly" (participant).

Suggestions for Improvement

At the end of the survey, participants were asked the question, "Have you any suggestions on how we can improve myVBACapp?" Three participants did not make any additional comments and were happy with the app.

Two participants gave suggestions. One stated, "There is a 'forgot password' button there, I kept accidentally hitting it! Perhaps moving it to underneath the login details" (participant). These issues were discussed with the app developer. It was decided to not change the "forgot password" location due to lack of room on the screen.
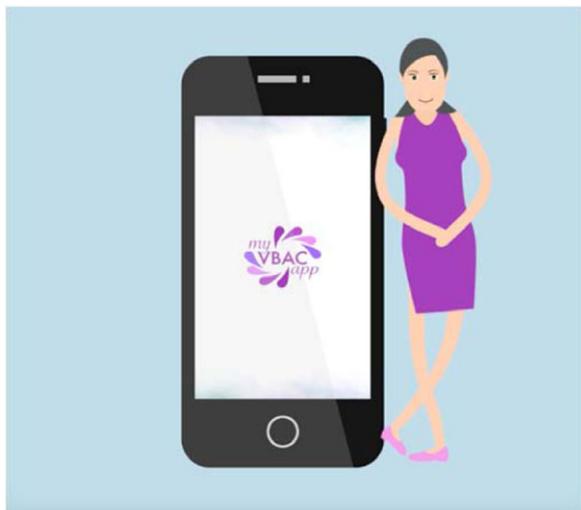
Figure 3. Still shot from instructional video.

The second participant made a suggestion regarding the uploading of logs: "Perhaps something a little more notable to say your log has uploaded successfully. I only saw the current notification 1 out of the 4 times I uploaded something because I was specifically looking for it" (participant). This was discussed with the app developer and modifications were made. Overall, the results of the evaluation group survey were extremely promising. Installation was the only area that received a score at the "difficult" end of the ease-of-use scale, and this was due to the issues of installing an iOS app not through the App Store. In the final study, participants accessed the app through the App Store or Google Play store, making the installation process easier.

Instructional Video

To help participants of the study understand the use of the app, and give guidance on what information to give in a log, an instructional video was commissioned to a different freelance video designer through Upwork. A voiceover by the first author (H.K.) and screenshots of the app were sent to the freelancer, and the research team checked proofs with changes recommended and implemented. The link to the instructional video is https://www.youtube.com/watch?v = Rcc1ES36R98

To share the myVBACapp development with other students, researchers, and academics, the first author (H.K.) submitted a short film to the Western Sydney University Higher Degree Research Showcase explaining the reason for the app and the development process. It was awarded with the People's Choice Best Film prize (**Figure 3**).

The App in Progress

In December 2016, the myVBACapp study commenced recruitment and is currently in the data collection phase. Initial issues experienced with the final app included duplication of logs in the iOS version of the app. This was rectified, and an update was issued to participants. Participants appeared to favor the "voice only" recording of logs rather than video. This has not impacted on the amount of data gathered.

When the researcher could see a log had been uploaded to the server, it was then downloaded and securely stored on a password-protected computer. Pseudonyms were allocated to each participant and the logs were transcribed for qualitative data analysis. Transcription was timely but not costly as the logs were a maximum of 5 min long, and even if multiple logs were submitted for one event, transcription was undertaken by the first author (H.K.) rather than outsourced.

Early experiences with the app have been positive, and there is anticipation and excitement in following participants on their VBAC journeys. Participants are keen to share their experiences. Listening to participants' experiences without the ability to step in and offer advice or information has at times been conflicting and challenging for the first author (H.K.), requiring sharing and debriefing within the research team.

Implications for Qualitative Nursing

The aim of this article was to report on the development and testing of a purpose-built app for data collection purposes for the "Antenatal Experiences of Women Planning a VBAC in Australia" study.

During the development and testing stage, the biggest factor contributing to successful completion of the app was communication. The first author (H.K.), a doctoral candidate, was in the role of project manager and enabled communication between all individuals. PhD candidates are increasingly expected to be work ready upon graduation, and there are many skills that universities and the workplace expect of them (Marino, Stefan, & Blackford, 2014; Mowbray & Halse, 2010). These include research and technical skills, production of research publications, project management and leadership skills, and effectiveness as a team player and autonomous self-manager (Horta & Santos, 2015; Mowbray & Halse, 2010). The development and implementation of the myVBACapp provided the opportunity for the first author (H.K.) to enhance communication and project management skills to ensure timely completion of the project.

One of the benefits of the myVBACapp is the ability to access real-time data, without the issues of retrospective

reporting (Fields et al., 2015). This is demonstrated in a U.K.-based study using virtual ethnography online with young people diagnosed with cancer (Gibson et al., 2016). Using longitudinal video diaries via a known website, the participants expressed their feelings and thoughts, communicating in a natural way and using colloquial language, without any influence from the principal investigator, what they identified as "being close to their authentic voice" (Gibson et al., 2016). In the preliminary data phase of the myVBACapp, participants have been expressing a variety of feelings and thoughts and, interestingly, directing the logs to the first author (H.K.) as the resultant listener. In the study by Taylor (2015), women also directed their daily video diaries, during their breastfeeding experience, to the researcher and reported participating in the study as a positive experience.

Marzano et al. (2015) found that using real-time data collection through smartphones allowed individuals with mental health issues the opportunity to tell their stories in their own time. Participants with a history of self-harm who used a mood diary via an app, alongside wearable devices tracking sleep and heart rates, found it to be a positive experience that increased their insight into their moods and behavior (Marzano et al., 2015). Their study also became a source of early intervention and treatment when real-time data highlighted disturbed thoughts and actions. This has been discussed within the research team for the myVBACapp, and if a situation is disclosed where the woman is at immediate risk, the woman can be contacted via e-mail or phone to refer her to support services.

Another benefit of the myVBACapp is the ability to facilitate the opportunity for women who live across Australia in regional, rural, and metropolitan areas to participate. The use of online tools or app-based research has the benefit of accessing many hard-to-reach participants across a wider area and has application for numerous disciplines such as mental health, cancer care, and maternity, especially when engaging with young people (Cooper, 2015; Fields et al., 2015; Gibson et al., 2016). Gibson et al. (2016) found the online environment beneficial when accessing young adults who were receiving palliative care, an area of research usually very difficult to undertake due to ethical and moral considerations.

The potential of using the myVBACapp in future qualitative studies is an exciting prospect. To be able to access participants in a variety of settings and capture their real-life experiences in real-time may have endless applications and certainly need not be limited to one project. The app is now being developed to move from the specific myVBACapp features to have more generic features under the name VoQual for use by other qualitative researchers. This will allow qualitative researchers to access participants in a range of locations and scenarios through the use of a smartphone or tablet.

Limitations with the use of the myVBACapp include the time commitment required by participants to record a log. Although the logs are less than 5 min each, participants are time poor and find partaking in the study an extra commitment. These issues will be explored in more depth with an online survey, similar to the evaluation survey, at the end of the main study.

Conclusions

This article has explored the development and evaluation testing of an app for qualitative data collection. The myVBACapp was developed due to the need to access the feelings and experiences of pregnant women planning a VBAC, following antenatal appointments in a timely manner. The app was designed to allow women across Australia to participate using a smartphone or tablet immediately following the antenatal appointment. The app was tested on a group of seven participants, and both quantitative and qualitative data about the ease of the app were obtained through a web-based survey. The app has the benefits of accessing data in real-time, reducing the need to rely on retrospective data, and allowing participants from a variety of locations to be involved in research.

Acknowledgment

Clinical Resources

- The Conversation. How to pick the good from the bad smartphone health apps. http://theconversation.com/how-to-pick-the-good-from-the-bad-smartphone-health-apps-58508
- The Conversation. Who's listening? The ethical and legal issues of developing a health app. http://theconversation.com/whos-listening-the-ethical-and-legal-issues-of-developing-a-health-app-69289
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CLINICAL SCHOLARSHIP

Scope of Nursing Practice in a Tertiary Pediatric Setting: Associations With Nurse and Job Characteristics and Job Satisfaction

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Abstract

Purpose: While professional nursing, like other health professions, has a recognized educational base and a legal scope of practice that is remarkably consistent across societies, there are important variations even within the same institution or organization in the extent to which professional nurses engage in the full range of activities for which they are qualified. There has been limited study of enacted (actual) scope of nursing practice (ESOP) or of its impacts on nurse job outcomes, such as job satisfaction. The aim of this study is to measure ESOP, as well as its predictors and impact on job satisfaction, in a specialty university-affiliated tertiary referral center in one of the few remaining jurisdictions outside the United States that continue to educate registered nurses at multiple educational levels.

Methods: This was a correlational cross-sectional design using structural equation modeling. Self-administered questionnaires were completed by 301 registered nurses holding permanent positions in specific clinical areas for 6 months or longer in a pediatric hospital in the province of Quebec, Canada.

Findings: ESOP or actual scope of practice was low—on average, nurses applied the range of skills within their theoretical scopes of practice only occasionally or "less than frequently" in their daily work (3.21 out of a possible 6 points). ESOP was strongly related to decision latitude ($\beta = 0.319$; $p = .012$), role ambiguity ($\beta = 0.297$; $p = .011$), and role overload ($\beta = 0.201$; $p = .012$). The personal characteristics that exerted the greatest direct influence on ESOP were education level ($\beta = 0.128$; $p = .015$) and growth need strength ($\beta = 0.151$; $p = .008$). Results also showed that ESOP exerts a direct positive influence on nurses' job satisfaction ($\beta = 0.118$; $p = .006$). Structural equation modeling analyses revealed a good fit of the data to the hypothesized conceptual model (χ^2/df ratio index $= 1.68$, root mean square error of approximation $= 0.049$, confirmatory fit index $= 0.985$).

Conclusions: Specific aspects of nurses' jobs are closely related to ESOP. ESOP is limited by certain job and personal characteristics and appears to affect nurses' job satisfaction.

Clinical Relevance: Results suggest that ESOP might be improved by adjusting nursing job characteristics and practice environments and that expanding ESOP increases nurse job satisfaction and may improve other health system outcomes as well.

In the contexts of generalist or advanced practice roles, it is well known that nursing personnel often apply only a fraction of the knowledge and skills for which they are educated and may not engage in types of work that they are legally entitled to perform (Besner et al., 2005; Kilpatrick et al., 2013; Oelke et al., 2008). In Quebec, recent research (D'Amour et al., 2012; Déry, Clarke, D'Amour, & Blais, 2016) suggests that in terms of both range of skills used and frequency of applying knowledge and skills, nurses report their enacted scope of practice to be at approximately half of what might be considered full utilization. Promoting both generalist and advanced practice nurses working at "full scope of practice" or "at top of license," especially by dealing with organizational and interprofessional barriers, is currently being advocated as a means of improving financial as well as patient outcomes in healthcare organizations (DeKeyser Ganz, Toren, & Yafit Fadlon, 2016; Poghosyan, Boyd, & Clarke, 2016; Russell-Babin & Wurmser, 2016).

There are multiple explanations for low enacted scope of practice (ESOP), some of which relate to institutional expectations of nursing practice and others seemingly linked to educational preparation and to socialization both prior to licensure and on the job. However, it appears as if a number of characteristics of specific work settings and positions tend to result in low ESOP, such as heavy workloads, low staffing levels, or mixes of staff not tailored to patient acuity, and ineffective team work (Besner et al., 2005; D'Amour et al., 2012; Déry et al., 2016; Oelke et al., 2008). Indeed, studies have shown that time constraints are particularly important here, with heavy patient loads and limited support personnel to carry out lower-level tasks resulting in omissions of types of work at higher levels of sophistication and applying advanced knowledge. Indeed, numerous studies have revealed that a fair proportion of nurses' time is spent on non-nursing tasks (Furaker, 2009; Hendrich, Chow, Skierczynski, & Lu, 2008), which limits the time that can be devoted to care activities that are actually part of nurses' professional role (D'Amour et al., 2012; Furaker, 2009).

In specialized settings, such as university-affiliated teaching hospitals, where patient acuity levels are high, technology is extensively used, and plans of care are complex and often involve multiple disciplines and specialties. Safe, high-quality care often demand that nurses apply all of their functions and responsibilities in their clinical practice. Limited opportunities to apply certain skills (e.g., patient teaching and discharge planning) due to time limitations has been found to affect a variety of patient outcomes, such as the quality and safety of care provided to children and their families (Lerret, 2009; Weiss et al., 2008). Other impacts of constrained ESOP

include disillusionment of nurses who feel that they have been overeducated for their work, and perceptions among stakeholders that the investments in nurse education (by students, their families, and society at large) may not be tied to improved direct clinical care or smoother health system functioning.

The purpose of this article is to present results of a test of a published proposed theoretical framework outlining both precursors and consequences of low ESOP (Déry, D'Amour, Blais, & Clarke, 2015) using regression modeling and testing a structural equation model. The context for this study was a specialty pediatric health sciences center where nurses presumably have many opportunities to marshal a full range of nursing knowledge and skills in direct care as well as in quality improvement and practice development. The Canadian province of Quebec, where this center is located, is one of the few remaining jurisdictions outside the United States where professional (registered) nurses are still educated at both a community/junior college level and with 4-year degrees. As documented in an earlier paper, in many cases, despite the broader preparation in population health, research, and leadership in baccalaureate programs, nurses with different levels of education often work in jobs with identical titles, just as in the United States and a number of other countries.

Conceptual Framework

ESOP is defined here as the range of functions and responsibilities carried out by nurses in their daily work, expressed as a fraction of a larger set of activities covered in professional education programs at the university level and described in broad definitions of the nature of practice. The concept of ESOP is close to that of "role enactment" (D'Amour et al., 2012), "the application of knowledge within parameters defined by legislation, experience, competence and contextual factors in the environment" (Besner et al., 2005, p. 6).

The Enacted Scope of Nursing Practice model published by Déry et al. (2015) is based on the job characteristics model (Hackman & Oldham, 1976), role theory (Biddle, 1979), the job strain model (Karasek, 1979), as well as the work of D'Amour et al. (2012) on scope of nursing practice. ESOP is at the center of the model and is posited to be influenced by a number of work (job) characteristics: autonomy (decision latitude), psychological demand, and role stressors—particularly role ambiguity, role conflict, and role overload. These same work characteristics are known to have a direct effect on nurses' job satisfaction (Ernst, Franco, Messmer, & Gonzalez, 2004; Zangaro & Soeken, 2007). ESOP is hypothesized to have

an effect on nurses' job satisfaction (Hinshaw & Atwood, 1985). In our model, personal characteristics act directly upon ESOP, as well as on the relationships that can exist, on one hand, between work characteristics and ESOP, and on the other, between enacted scope of nursing practice and nurses' job satisfaction. In addition to education, higher growth need strength should be more strongly compelled to carry out more complex care activities that call for new learning and continued development of skills. In this model, ESOP itself was hypothesized to be a mediating variable (Baron & Kenny, 1986) between work characteristics and nurses' job satisfaction.

Methods

Design and Sample

This study employed a correlational design involving self-administered surveys completed by nurses working in a pediatric university hospital in the province of Quebec, Canada. Eligibility criteria for the study included holding a permanent position at the hospital, having more than 6 months of experience, having a permanent unit assignment (not being part of a float team), and agreeing to take part in the study. Data collection followed Dillman's (2000) method and was conducted in April 2010. Questionnaires were distributed to all the nurses ($n = 335$) meeting selection criteria, of whom 301 completed and returned the surveys, for a response rate of 90%. We attribute the high response rate to three factors: a monetary incentive of $25 Canadian (approximately $US20) for completing the survey, two personalized reminder messages, and involvement of stakeholders (nurse managers, program managers, nursing directors) in encouraging participation.

Ethical Considerations

The study was approved by the ethics committee of Centre hospitalier universitaire Sainte-Justine.

Measures

All the instruments used here were validated and widely used in prior research with nurses, with the exception of the Actual Scope of Nursing Practice questionnaire (D'Amour et al., 2012), which had received preliminary psychometric support in a single earlier study. Five instruments were used to measure work characteristics: the Job Content Questionnaire (Karasek, 1985), the Role Ambiguity Questionnaire (Rizzo, House, & Lirtzman, 1970), the Role Conflict Questionnaire (Rizzo et al., 1970), and the instruments developed by Beehr,

Walsh, and Taber (1976) and Seashore, Lawler, Mirvis, and Cammann (1983) to measure role overload. To measure personal characteristics, only the Personal Growth Need Strength Scale (Hackman & Oldham, 1974) was used, with the other personal characteristics being sociodemographic variables. ESOP was measured using the Actual Scope of Nursing Practice questionnaire (D'Amour et al., 2012), and nurses' job satisfaction was measured with the Nursing Job Satisfaction Scale (Hinshaw & Atwood, 1985).

Enacted Scope of Nursing Practice

The Actual Scope of Nursing Practice questionnaire was developed by D'Amour et al. (2012). It consists of items describing 26 activities for which nurses are asked to indicate the frequency in their work on a Likert-type scale ranging from 1 (*never*) to 6 (*always*). The 26 items are divided into six dimensions of nursing practice: assessment and care planning; teaching of patients and families; communication and care coordination; integration and supervision of staff; quality of care and patient safety; and knowledge updating and utilization. This questionnaire was recently validated (D'Amour et al., 2012), and its internal consistency was 0.89.

Autonomy and Psychological Demand

The Job Content Questionnaire measures autonomy (decision latitude) and psychological demand (Karasek, 1985). It consists of two scales. The decision latitude scale (nine items) evaluates the capacity to use one's qualifications and develop new job skills, and opportunities for employees to choose how to do their work and influence related decisions (Karasek & Theorell, 1990). Possible scores for this scale ranged from 24 to 96. The psychological demand scale (nine items) measures the quantity of work, its mental demands, and time constraints experienced by employees. Possible scores for this scale ranged from 9 to 36. The questionnaire has been translated and validated in French (Brisson et al., 1998; Karasek et al., 1998; Larocque, Brisson, & Blanchette, 1998). The internal consistency values (Cronbach's alpha) reported by Brisson et al. (1998) for the decision latitude scale were 0.83 for men and 0.81 for women, and for the psychological demand scale, 0.74 for men and 0.73 for women.

Role Ambiguity and Role Conflict

The Role Ambiguity Questionnaire (Rizzo et al., 1970) measures role ambiguity using six items. Possible scores for this scale ranged from 1 to 7. On this scale, the higher the score, the clearer the role. The Role Conflict

Questionnaire (Rizzo et al., 1970) measures role conflicts using eight items. Possible scores for this scale ranged from 1 to 7, with higher scores indicating higher levels of conflict. The psychometric qualities of these two scales have been widely demonstrated (House, Schuler, & Levanoni, 1983; Schuler, Aldag, & Brief, 1977). The French-Canadian versions of these two scales have been validated and present internal consistencies (Cronbach's alpha) of 0.79 and 0.77, respectively (Lachance, Tétreault, & Pépin, 1997).

Role Overload

To evaluate role overload, or having too much work to do in the time available, we used the three items developed by Beehr et al. (1976) and three items developed by Seashore et al. (1983). Possible scores for those scales ranged from 1 to 7; Cronbach's alphas were 0.56 for the items of Beehr et al. (1976) and 0.65 for those developed by Seashore et al. (1983). For the purposes of this study, these six items were translated into French using the translation–back-translation method and were combined to form a new scale (Burns & Grove, 2005; Vallerand, 1989).

Personal Growth Need Strength

The Personal Growth Need Strength Scale (Hackman & Oldham, 1974) consists of 18 items divided into two distinct subscales. The first, in the "would like" format, contains six items used to assess the extent to which the respondent would like various elements to be part of her or his job (Cronbach's alpha 0.88). Possible scores for this scale ranged from 1 to 7. The second subscale, in the "job choice" format, consists of a dozen items (Cronbach's alpha 0.71) in the form of preferences of scenarios. Possible scores for this scale ranged from 1 to 5. A French-Canadian version of this scale was developed and validated by Rancourt (1983), for which Cronbach's alphas were 0.91 for the first subscale and 0.72 for the second, respectively.

Job Satisfaction

The Nurse Job Satisfaction Scale (Hinshaw & Atwood, 1985) measures nurses' job satisfaction. It has been translated and validated in a sample of French-speaking nurses in Quebec (Roch, 2008). It consists of 22 items (α = 0.91) divided into three dimensions: quality of care (three items, α = 0.74); job satisfaction (11 items, α = 0.91); and enough time to do optimal work (eight items, α = 0.84). Possible scores for this scale ranged from 1 to 5.

Statistical Analyses

First, we measured the internal consistency of each measurement scale of the questionnaire using Cronbach's alpha. We then presented a description of the sample using frequencies (for categorical variables), as well as the means, standard deviations, minimum, and maximum (for continuous variables). We used stepwise linear regression models to explain the variability in ESOP due to work characteristics and personal characteristics, testing additive and moderating effects of personal characteristics following methods described by Baron and Kenny (1986). Moderating effects were examined with inclusion of a supplementary block of variables containing interaction terms. Along the same lines, we used multivariate sequential analysis to explain variability in job satisfaction due to ESOP and personal characteristics by positing an additive and moderating effect of personal characteristics. Again, moderating effects were also tested using a supplementary block of variables containing interaction terms.

Finally, we verified the potential mediating effect of ESOP between work characteristics and job satisfaction using structural equation modeling (SEM). Confidence intervals and bootstrap p values of the indirect effects were calculated and model fit was examined using the χ^2/df ratio index, the root mean square error of approximation (RMSEA), and the confirmatory fit index (CFI). All the statistical analyses were performed using SPSS (version 19; IBM Corp., Armonk, NY, USA) and AMOS (version 19; IBM Corp.) with a significance level of .05.

Results

The nurses in the sample (N = 301) had an average age of 36 years (SD = 9.16) and had, on average, 12.70 years of nursing experience (SD = 10.94) and 9.50 years of experience on their current unit (SD = 10.60). In our sample, 61.5% of the nurses had completed a college diploma (n = 185), while 37.9% (n = 114) held a bachelor's degree. Only 0.6% of the nurses in our sample held graduate-level degrees. The scores for the various measurement scales and the internal consistencies are presented in **Table 1**.

The nurses in the sample reported an overall ESOP of 3.21 out of a possible 6 points, ranging from 1.58 to 5.54 (SD = 0.707), and an average score for job satisfaction of 3.44 on a possible 5 (SD = 0.521), ranging from 1.68 to 4.64. The nurses in our sample presented a decision latitude score of 71.97 (SD = 8.97; median = 72.00), which is considered low by instrument norms (Brisson et al., 1998).

Table 1. Scores for the Scaled Variables Examined

		α	n	Mean	SD
Work characteristics					
Autonomy (decision latitude)		.722	297	71.97	8.97
Psychological demand		.780	297	24.80	3.76
Role ambiguity		.765	301	5.35	0.720
Role conflicts		.846	300	3.47	0.980
Role overload		.726	301	3.72	1.28
Personal characteristics					
Growth need strength	Would like	.917	300	5.27	1.26
	Job choice	.627	300	2.69	0.46
Job satisfaction		.907	299	3.44	0.52
Enacted scope of nursing practice		.900	298	3.21	0.71

The results of the stepwise regression analyses revealed that work characteristics explained 27.1% ($p < .001$) and personal characteristics explained another 5.4% ($p < .001$) of the variance of ESOP, for a total explained variance of 32.5%. The moderating effect of personal characteristics in the relationship between work characteristics and ESOP ($p = .92$) was not significant. Stepwise regression models also found that ESOP explained 3.3% of the variance of job satisfaction ($p = .002$) and that personal characteristics explained another 8% ($p < .001$), for a total explained variance of 11.3%. The moderating effect of personal characteristics in the relationship between ESOP and job satisfaction was not significant ($p = .514$).

Following criteria discussed by Clayton and Pett (2008) and Hooper, Coughlan, and Mullen (2008), SEM analyses revealed a good fit of the hypothesized conceptual model based on various fit indices (χ^2/df ratio index = 1.68, RMSEA = 0.049, CFI = 0.985). The total and direct standardized effects exerted by work characteristics and personal characteristics on ESOP and job satisfaction are illustrated in **Figure 1**. These include a positive effect and significant effects of bachelor's-level education ($\beta = .128$; $p = .015$) and growth need strength ($\beta = .151$; $p = .008$). In our results, decision latitude exerted the strongest influence on ESOP ($\beta = .319$; $p = .012$) among the predictors. Our results also revealed a negative association of role ambiguity with ESOP ($\beta = .297$; $p = .011$) (because higher scores correspond to greater role clarity). However, counter to our expectations, a significant positive correlation was identified between role overload and ESOP ($\beta = .201$; $p = .012$). The details of these results, as well as the indirect standardized effects (β) are presented in **Table 2**. Even though they were weak, the indirect standardized effects showed the mediating effect of ESOP on the relationship established between work characteristics and job satisfaction, as conceptualized in the Enacted Scope of Nursing Practice model (Déry et al., 2015).

Discussion

This study of nurses in a university-affiliated referral center revealed a relatively low level of ESOP and found empirical support for a previously articulated conceptual model articulating connections between two personal characteristics of nurses (education level and growth need strength) and three work characteristics (role ambiguity, autonomy, role overload) as precursors of ESOP and ESOP as a predictor of job satisfaction (Déry et al., 2016).

Specifically, the nurses in our study obtained an average ESOP score of 3.21 on a possible 6, which suggests that many activities that are part of nurses' theoretical scopes of practice were seen only occasionally or "less than frequently" in their daily work. These results are comparable to those of D'Amour et al. (2012), who showed an average ESOP score of 3.5/6 in a study of 285 nurses in 11 Quebec hospitals caring for adult patients. Other studies, while not using the Actual Scope of Nursing Practice questionnaire (D'Amour et al., 2012), concluded that in many roles and settings, nurses consistently do not apply the full range of their knowledge and skills in their daily work (Furaker, 2009; Hendrich et al., 2008; Oelke et al., 2008).

Certain personal characteristics, such as education level and growth need strength, showed associations with ESOP. Specifically, nurses with bachelor's or higher degrees carried out more complex activities within professional nursing's scope of practice. This was expected, given nurses with bachelor's degrees receive more formal preparation in evaluating complex care situations, communication, coordination, and teaching and would seem more likely to apply this knowledge. Also, perhaps also unsurprisingly, as hypothesized, we found a significant correlation between growth need strength, personal drive for accomplishment, learning, and personal development (Hackman & Oldham, 1976).
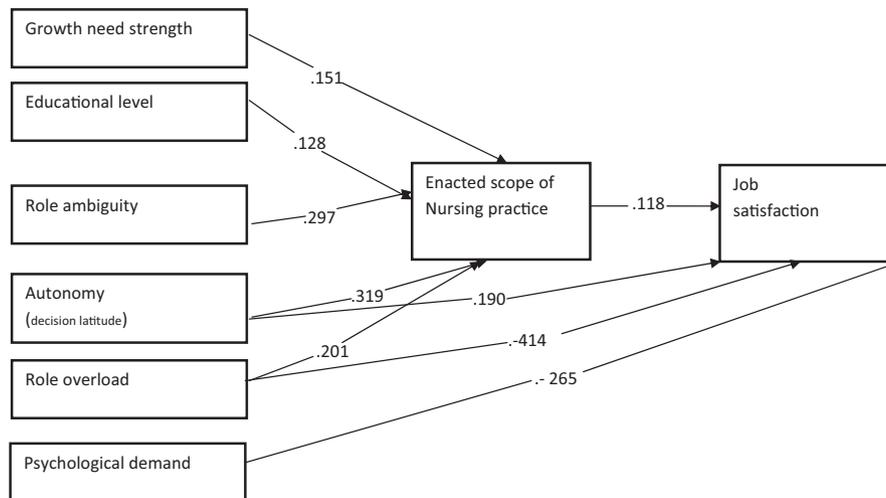
Figure 1. Significant total and direct standardized effects exerted by work characteristics and personal characteristics on enacted scope of nursing practice and job satisfaction.

Table 2. Standardized Effects of Structural Equation Modeling

	Autonomy (decision latitude)	Psychological demand	Role ambiguity	Role overload	Education level	Growth need strength "Would like"	Growth need strength "Job choice"	ESOP
Standardized total effects								
ESOP	.319**	—	−.297*	.201*	.128*	—	.151*	—
Job satisfaction	.228**	−.265**	.035**	−.390*	.015**	.116*	.018**	.118**
Standardized direct effects								
ESOP	.319**	—	−.297*	.201*	.128*	—	.151*	—
Job satisfaction	.190*	−.265**	—	−.414*	.000	.116*	—	.118**
Standardized indirect effects								
Job satisfaction	.038**	—	.035**	.024**	.015**	—	.018**	—

ESOP = enacted scope of nursing practice.
*$p < .05$; **$p < .01$.

Decision latitude, role ambiguity, and role overload were significantly predictive of ESOP. Decision latitude was especially low in this sample, and the levels identified were comparable to those seen in earlier studies of nurses (Lavoie-Tremblay, O'Brien-Pallas, Gélinas, Desforges, & Marchionni, 2008). As predicted, it was positively associated with ESOP. Role ambiguity, a lack of clarity of expectations in relation to team composition and orientation, was expected to track negatively with ESOP and did. Even though the counterintuitive significant relationship between role overload and ESOP was relatively small, it suggests nurses in role overload situations may, at least some of the time, find ways to carry out activities in their full scope of practice. One hypothesis to explain this correlation might be that nurses with a larger number of patients in their care must necessarily delegate the technical aspects of care to others and devote more of their own time to carrying out more complex activities. However, this relationship warrants further investigation. Finally, as predicted, there was a significant positive correlation between ESOP and job satisfaction (β = .118; $p = .006$). Support was also found for certain work characteristics (decision latitude, role overload, psychological demand) as direct predictors of job satisfaction, as has been seen in other literature (Ernst et al., 2004; Zangaro & Soeken, 2007).

In summary, the results of our study clearly showed the significant influence of certain personal characteristics (education level and growth need strength) and work characteristics (role ambiguity, autonomy, role overload) on ESOP. Based on these results, certain recommendations regarding strategies for widening nurses' scope of practice and thereby increasing nurse job satisfaction can be proposed. Job satisfaction may not be the most critical negative consequence of suboptimal ESOP in the context of matched supply and demand for nurses in many

industrialized countries currently, but given the demands of nursing practice and the costs of educating nurses, minimizing dissatisfaction among nurses ought to be a priority. This is especially true that unforeseen trends could change supply of and demand for nurses in unpredictable ways in the future. Negative impacts of low ESOP on job satisfaction could turn out to be only one of many adverse consequences for patients and healthcare systems, but confirming this will require further study.

Based on the results here, managers seeking to expand nurses' actual scopes of practice should consider methods for giving nurses greater decision latitude—removing barriers and encouraging nurses to choose how they achieve higher-level work goals. Two particular strategies would be inclusion of nurses in decision-making processes through interprofessional teamwork (Almost & Spence Laschinger, 2002), and implementation of professional practice models that incorporate three key concepts: ESOP, staffing, and work environment (Dubois et al., 2012) Strong, highly visible nurse leaders at every level of the organization (Hinshaw, 2002) should also promote recognition of the value added by nurses to the delivery of safe, high-quality health care. Finally, it is essential, both for researchers and for nursing managers, to develop and support a culture of learning and knowledge transfer that fosters not only the continuing development of competencies, but also intraprofessional and interprofessional sharing of new knowledge emerging from both clinical innovations and scientific advances in nursing.

A number of limitations of this work should be kept in mind. This study was carried out in a tertiary pediatric setting, and in a specific culture (an urban environment in French Canada) and perhaps results may not be easily generalized to other contexts. However, scope of practice variations and job dissatisfaction in nursing are enduring challenges in nursing internationally. Furthermore, to the extent that the relationships documented here were observed among nurses in an internationally recognized hospital that is a local employer of choice for nurses would suggest that findings likely have relevance elsewhere, but replications will be necessary to verify this. The survey data on which these analyses were based were collected a number of years ago. While a variety of local, regional, and national policy initiatives are leading to greater numbers of nurses around the world holding bachelor's and higher-level credentials as their highest credential, to our knowledge, there have been no changes in required education levels, job titles and descriptions, or management-driven expansions of scope at this institution in particular, in Quebec hospitals in general, or in institutions worldwide since the study was conducted. Nonetheless, it is important to consider the age of the data as a potential limitation. In addition, a large proportion of the variance in ESOP was unexplained by the models tested; considerable work to refine measurement and understanding of this variable remains (especially by broadening the antecedents and predictors connected with it). Given the complexity of the underlying phenomenon, future research should consider blending of qualitative with quantitative data collection and examining nurse, patient, and institutional outcomes of ESOP using a variety of data sources.

Conclusions

Findings of this study suggest that even in a specialized setting where nurses would be expected to work within a broad scope of practice, ESOP is not optimal. Given the extensive societal investments in nursing education, nurses' salaries, and ongoing professional development of nurses, as well as the role of nurses in public well-being worldwide, the limited use of nurses' education and skills is of concern in healthcare systems internationally. The struggles of healthcare leaders around accessibility, quality, and safety of care are making this problem more, rather than less, acute. The results of this study provide the beginnings of an empirical understanding of local factors influencing ESOP in terms of personal and job characteristics, a number of which could be targeted with educational and leadership interventions, and suggest a potentially important role of nurses' ESOP in workforce stability and health system functioning.

Acknowledgments

> **Clinical Resources**
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> - Canadian Nurses Association. Framework for the practice of registered nurses in Canada. https://www.nurseone.ca/~/media/nurseone/files/en/rn_framework_practice_2007_e.pdf?la=en
> - College of Nurses of Ontario. RN and RPN practice: The client, the nurse and the environment. http://www.cno.org/globalassets/docs/prac/41062.pdf
> - College of Registered Nurses of British Columbia. Scope of practice for registered nurses. https://www.crnbc.ca/Standards/Lists/StandardResources/433ScopeforRegisteredNurses.pdf

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A Review of Current Literature on Vital Sign Assessment of Physical Activity in Primary Care

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Abstract

Purpose: To conduct an integrated review of the performance and implementation of two physical activity (PA) assessment tools, the exercise vital sign (EVS) and the physical activity vital sign (PAVS), in U.S. primary care practice.

Design: An integrative review following Whittemore and Knafl's methodology.

Methods: Medline and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were searched. Search terms were "exercise vital sign" OR "physical activity vital sign" AND "primary care". Additional inclusion criteria were studies conducted in the United States, published in English, in primary care, between 2010 and 2016.

Results: Nine studies met inclusion criteria. Five studies reported validity data of the EVS tool, while four studies reported data from the PAVS tool. Compared with the accelerometer, the EVS tool overestimated moderate-vigorous PA, while the PAVS tool demonstrated moderate agreement in identifying those not meeting national PA guidelines. The EVS tool was successfully implemented in large, integrated practices utilizing electronic health record systems. PA documentation increased compared to non-EVS practices. The predictive ability of the PAVS tool for clinical outcomes was shown. Studies of PA assessment tool use in children were not found.

Conclusions: Preliminary evidence on the validity of both the EVS and PAVS tools support cautious use of each as a screening tool in primary care. There were no data on reliability, with limited data on tool use in diverse populations or settings. Data in children, older adults, and diverse population subgroups were lacking.

Clinical Relevance: Two brief exercise vital signs tools have each shown some initial validity for use by primary care clinicians as measures to identify patients not meeting PA guidelines.

Promoting physical activity (PA) in the primary care setting is highly prioritized for prevention and treatment of numerous chronic diseases and for overall quality of life (Garber et al., 2011; Sallis, Matuszak, et al., 2016; U.S. Department of Health and Human Services [USDHHS], 2008). Insufficient PA was the fourth leading contributory cause of death in the United States, with an estimated 200,000 deaths annually in 2005 associated with physical inactivity (Danaei et al., 2009; Kohl et al.,

2012; Lobelo, Stoutenberg, & Hutber, 2014). While insufficient PA is a significant risk factor for increased morbidity and mortality, evidence shows numerous health benefits from engaging in a sufficient volume of PA (Garber et al., 2011). Furthermore, regular PA improves cardiorespiratory and muscular fitness, results in more healthful body composition, enhances bone health, and improves cognitive function, among numerous other health-related benefits (Bauman, Meron, Bull, Buchner,

& Fiatarone, 2016; Garber et al., 2011; Pescatello, 2014; USDHHS, 2008). The beneficial effects of PA occur in a dose-response manner, with a 4% reduction in mortality occurring with every additional 15 min per day within the range of 15 to 100 min of moderate to vigorous exercise per day (Wen et al., 2011).

Despite several decades of research and public health efforts focused on identifying effective ways to tackle the enormous problem of insufficient PA in adults and children in the United States, progress in promotion of PA in primary care remains a particular challenge, although PA promotion in the context of primary care presents a promising opportunity to promote PA behavior change (Berra, Rippe, & Manson, 2015; Dacey, Kennedy, Polak, & Phillips, 2014).

In 2010, one in five U.S. adults (20.3%) met both the aerobic and strength training national PA recommendations (U.S. Centers for Disease Control and Prevention [USCDC], 2011; USDHHS, 2008). Only half (50%) met the physical activity guideline (PAG) target of 150 min of moderate-intensity PA weekly, 75 min of vigorous-intensity activity, or an equivalent combination of both, and just 23.4% met the recommendations for strength training on 2 or more days of the week (AuYoung et al., 2016). Highly concerning is that just one third (36%) of adults reported no leisure time PA (USCDC, 2011). Although the American Heart Association (AHA) recommends that children ages 2 years and older participate in at least 60 min of moderate-vigorous physical activity (MVPA) daily (AHA, 2017; Artinian et al., 2010; USDHHS, 2008), the majority of young children (~2–5 years old) participate in too few bouts of active play to meet current PA targets (USDHHS, 2008). Only 12% of high school students meet the Healthy People 2020 objectives for both aerobic MVPA and strength training (USCDC, 2011). Of concern, a condition characterized by reduced levels of MVPA, inconsistent with long-term health and well-being, has been termed exercise deficit disorder (Faigenbaum, Gipson-Jones, & Myer, 2012; Stracciolini, Myer, & Faigenbaum, 2013). Together with the impact of nature deficit disorder, referring to reduced time spent in nature (Driessnack, 2009), alarming numbers of children are not as physically active as needed to meet the PAG for positive health outcomes (Stracciolini et al., 2013).

With so many Americans not meeting the PAG, primary care physicians and nurses are called upon to do more to identify adults and children with insufficient PA levels. However, in many primary care settings, prevention has often been overshadowed by a focus on disease treatment, with medication prescribing often prioritized over lifestyle adjustment for treatment of disease (Vuori, Lavie, & Blair, 2013). More recently,

position statements by several professional organizations, including the American College of Sports Medicine (ACSM), the American Diabetes Association, and the Preventive Cardiovascular Nursing Association (PCNA), encourage expanding the promotion of PA in health care (Colberg et al., 2010; Garber et al., 2011; PCNA, 2011). National initiatives such as Healthy People 2020 (USDHHS, n.d.), the National Physical Activity Plan, and the ACSM's (n.d.) Exercise is Medicine™ (EIM™) initiative have outlined specific evidence-based strategies and tactics, and offer comprehensive resources to help clinicians promote PA (Berra et al., 2015; Garber et al., 2011; Jakubowski, Faigenbaum, & Lindberg, 2015; Richards & Cai, 2016; U.S. Surgeon General, 2015; see Clinical Resources for links). Healthy People 2020 objectives include two for increasing the proportion of physician office visits that include counseling or education related to exercise (USCDC, 2011). Also identified is the need for additional educational curricula to better prepare and train primary care clinicians to assess insufficient PA participation and to improve PA prescription practices (AuYoung et al., 2016; Dacey et al., 2014; McElwaine et al., 2016; Richards & Cai, 2016).

Primary care clinicians play a key role in the healthcare system. In 2010, approximately 210,000 practicing primary care physicians (including family physicians, general practitioners, general internists, general pediatricians, and geriatricians) practiced in the United States. Americans made 956 million office visits in 2008, with 51.3% to primary care physicians (Naylor & Kurtzman, 2010). While physicians are the largest group of primary care practitioners, nurse practitioners (NPs) represent the fastest growing group of primary care clinicians, providing care on an estimated 600 million patient visits per year (Naylor & Kurtzman, 2010). About 103,000 NPs are expected to be practicing in primary care by 2025 in addition to approximately 30,000 physician assistants (Bodenheimer & Mason, 2016). Registered nurses (RNs) are the largest group of U.S. healthcare professionals, numbering approximately 3.5 million. RNs have long educated patients on medication prescriptions, including instructions on medication dose, proper administration, and possible side effects. RNs also play an important role in health promotion and patient education (Bodenheimer & Mason, 2016). In 2010, one in three adults (34%) seen by a physician or other healthcare professional in the past 12 months reported they were advised to begin or continue to exercise or engage in PA (Barnes & Schoenborn, 2012). Improving primary care clinicians· identification of insufficiently active at-risk patients is a crucial start to addressing this problem, by identifying those who may benefit from receiving an exercise prescription and counseling intervention aimed to improve health

outcomes (Grimstvedt, Der Ananian, Keller, Woolf, Sebren, & Ainsworth, 2012; Jakubowski et al., 2015).

Exercise Vital Sign and Physical Activity Vital Sign Tool Assessment

Assessment of PA using validated measurement tools have been used infrequently in clinical care (Reiser & Schlenk, 2009). However, the use of subjective or objective clinical PA assessment tools as a routine part of the clinician's health assessment has several important purposes: (a) to improve the screening of patient activity behavior, (b) to document baseline patient PA data for tracking and monitoring (as done with other clinical vital signs), and (c) to identify those who may benefit from treatment and trigger an intervention (Reiser & Schlenk, 2009). Two self-report clinical tools to assess exercise vital signs are available: the exercise vital sign (EVS) and the physical activity vital sign (PAVS) instruments are similar clinical tools with the aim of quick identification of patients not meeting the national PAG (Sallis, Baggish, Franklin, & Whitehead, 2016).

The EVS tool was developed by leading PA experts for use in primary care as part of the EIM™ initiative and consists of two PA assessment questions, typically asked along with other components of the health history, collected with other routine vital signs at an office visit (Sallis, Baggish, et al., 2016). The questions asked are: (a) "On average, how many days per week do you engage in moderate to strenuous exercise like a brisk walk?" and (b) "On average, how many minutes per day do you engage in exercise (or physical activity) at this level?" The responses to these two questions are multiplied by each other to generate the EVS score (i.e., total weekly minutes MVPA). An EVS score of <150 min for adults is an indication of insufficient PA and can prompt the clinician to prescribe exercise or PA or refer to an exercise or other trained professional for specific counseling and implementation support (Faigenbaum et al., 2012).

Developed by primary care physicians, the PAVS tool also utilizes a two-question format to assess past and typical week MVPA: (a) "How many days in the past week have you performed physical activity where your heart beats faster and your breathing is harder than normal for 30 minutes or more (in three 10-minute bouts or one 30-minute bout)?" and (b) "How many days in a typical week do you perform activity such as this?" The responses produce a PAVS score ranging from a minimum of 0/0 to a maximum of 7/7 and are reported as a fraction (i.e., days during past week over days in typical week). The optimal score is 5/5 or higher, reflecting recent and habitual participation in MVPA as per the ACSM national PAG (Greenwood, Joy, & Stanford, 2010).

Either the EVS or PAVS tool can be administered and scored in less than a minute and aims to add important information regarding PA when administered at each primary care visit. A score indicating that an individual is at risk can be used as a flag or trigger for review by the clinician, and to initiate the exercise or activity prescription process. The exercise prescription is a variously defined primary care intervention, comparable to medication prescriptions, which should include specific exercise dosage, modality, intensity, frequency, and duration individualized for each patient, and should address strength training, balance, safety considerations, and other important components, as well as aerobic PA (Sallis, 2011; Sallis et al., 2016; Swisher, 2010). (See Clinical Resources for further description.)

As the earlier addition of smoking status as a vital sign (SVS) aimed to improve rates of tobacco use identification and to prompt increased cessation advice from healthcare professionals (Fiore, 1991), similarly, use of the EVS or PAVS tool aims to increase the likelihood of baseline PA assessment and documentation of baseline PA status, and to trigger prescription for those who are identified as insufficiently active. SVS use increased rates of tobacco use identification (McCullough, Fisher, Goldstein, Kramer, & Ripley-Moffitt, 2009), and its inclusion in clinical practice resulted in greater frequency of smoking cessation counseling in primary care (Boyle & Solberg, 2004). The EVS and PAVS tools are increasingly promulgated as practical tools for use in clinical practice to improve PA assessment and to trigger an exercise prescription (Davis, 2016; Greenwood et al., 2010; Sallis, Baggish, et al., 2016).

Study Aims

Primary care clinicians are highly encouraged to assess PA status and specifically to use the brief self-report EVS (as part of the EIM™ initiative) or PAVS tool for the purpose of appropriately identifying those patients who are insufficiently active (i.e., not meeting the national PAG; Greenwood et al., 2010; Sallis, Baggish, et al., 2016).

However, studies on how well these tools perform in primary care practice are lacking. Data on the accuracy of each of these tools, and how successfully these tools are being utilized for assessment of PA status in primary care practice, may help guide practitioners on their effective use. Thus, the overall aim of this review was to identify and synthesize the literature of the past 6 years (January 2010 to December 2016) on adoption of the EVS or PAVS tool in targeting improvement of PA assessment in primary care settings, including tool performance and implementation. Specific aims were to examine (a) studies addressing the psychometric properties of the EVS or PAVS tool, or (b) studies discussing the use of the EVS

or PAVS tool in practice with attention to where and how the tools have been implemented, and for what purposes (i.e., to improve assessment of PA status, to establish baseline data for monitoring, or to trigger treatment recommendations, such as counseling, for those found insufficiently active in primary care settings).

Methods

An integrative review of EVS and PAVS tool use was conducted using Whittemore and Knafl's (2005) suggested methodology encompassing problem identification, literature search, data analysis, and presentation. Whittemore and Knafl stated that "the literature search process of an integrative review should be clearly documented in the methods section including the search terms, the databases used, additional search strategies and the inclusion and exclusion criteria for determining relevant primary sources" (p. 549).

Search Process and Study Identification

The main search strategy aimed to identify published studies by searching electronic databases (Cumulative Index to Nursing and Allied Health Literature [CINAHL] and Medline) using search terms and Boolean operators (with assistance from a university research librarian) as follows: "exercise vital sign" or "physical activity vital sign" and "primary care" (**Figure 1**). Additional limits included articles published in English between January 2010 and December 2016. We chose 2010 to start our search based on the timing of the introduction of the EVS and PAVS as tools for brief self-report assessment of PA participation in primary care. As a second step, the reference lists and articles cited of potentially eligible studies were examined to further identify potentially relevant studies. A reference management program (EndNote X7.0, Thomson Reuters, Philadelphia, PA, USA) was used to manage articles.

Eligibility. Titles and abstracts were eliminated if inclusion criteria were not met. Studies had to discuss (a) the psychometric properties of the EVS or PAVS tool or (b) the use or implementation of the EVS or PAVS tool in a primary care setting in the United States to be eligible. The focus of this review was on EVS and PAVS tool use in populations in primary care in the United States. Thus, we excluded studies not on the EVS or PAVS tool (i.e., those employing other PA assessment tools) or studies conducted outside the United States. Primary care settings were defined as those delivering healthcare services to adults, adolescents, or children in outpatient hospital clinics or office settings. Titles and

abstracts were reviewed by the primary author (A.W.), and were confirmed by the second author (C.E.G.) using predetermined key data extraction form criteria. One reviewer (A.W.) extracted all data to a preset table.

Quality assessment. Levels of evidence (I–IV) and methodological quality (A, B, C) were determined by the primary author (A.W.) and confirmed by the second author (C.E.G.) for each study, according to "Johns Hopkins Nursing Evidence-Based Practice: Models and Guidelines" (Johns Hopkins Medicine, n.d.).

Data analysis. As per Whittemore and Knafl (2005), data analysis consisted of data reduction (dividing the primary sources into subgroups) and analyzing by topic. Predetermined relevant data from each primary source were organized in a spreadsheet. Data on study author (in alphabetical order), publication year, PA tool used, study purpose, study sample size, study participants, setting, clinician administering the tool, tool data reported, tool implementation methods, and implementation findings study methods were extracted and synthesized in a tabular format. Our organization of the literature, as per Whittemore and Knafl, facilitated comparison of studies and data synthesis related to our study aims.

Results

Figure 1 illustrates the details of the selection process. Database search results identified 86 potential articles (15 from CINAHL and 71 from Medline). Nine duplicates were removed, yielding 77 articles for screening according to a priori criteria established. Nine studies published between 2010 and 2016 met study criteria. **Table S1** provides an overview of the key study characteristics. All studies were conducted in the United States, many in large integrated health systems. Sample sizes ranged from 30 to 1,773,385. Study participants were all adults; ages ranged from 18 to 89 years. Most studies were of mainly Caucasian populations, although one study examined EVS tool use in African-American women (Joseph, Keller, Adams, & Ainsworth, 2016). No studies of EVS or PAVS tool use in adolescent or pediatric populations were identified. Five studies examining the EVS tool were identified (Coleman et al., 2012; Fitzgerald, Ozemek, Jarrett, & Kaminsky, 2015; Grant, Schmittdiel, Neugebauer, Uratsu, & Sternfeld, 2014; Joseph et al., 2016; Young, Coleman, Ngor, Reynolds, Sidwell, & Sallis, 2014. Tool psychometrics were reported in all five of these studies, and implementation of the EVS was also discussed in two of these studies (Coleman et al., 2012; Grant et al., 2014). Four studies reported data on
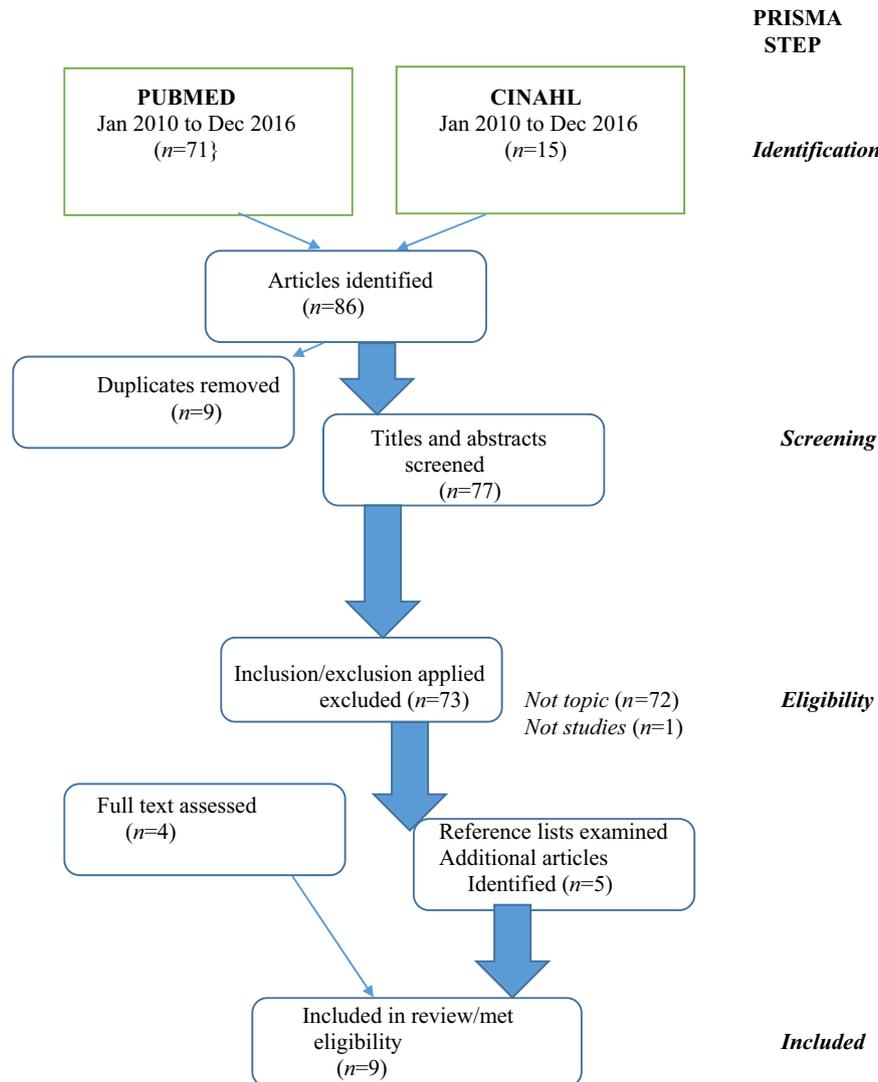
PRISMA
STEP

Figure 1. Literature review results (Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA] diagram). CINAHL = Cumulative Index to Nursing and Allied Health Literature.

PAVS tool psychometrics (Ball et al., 2015; Ball, Joy, Gren, Cunningham, & Shaw, 2016; Ball, Joy, Gren, & Shaw, 2016; Greenwood et al., 2010), with one also discussing implementation (Ball et al., 2015). Studies are summarized (see **Table S1**) and are discussed in the narrative synthesis below.

EVS Tool Accuracy and Validity

EVS data were successfully captured over one and a half years on patient visits at 14 hospitals and 200 medical offices in a large healthcare system. Of these, 86% (n = 1.557 million) of all patient visits (n = 1.793 million) had an EVS recorded in their record. Of those with an EVS recorded, 36.4% were classified as completely inactive;

30.4% were insufficiently active (69.7% not meeting the PAG); and 30.4% were classified as sufficiently active (meeting the 2008 PAG; Coleman et al., 2012). The EVS data captured were validated for accuracy against national population-based surveillance surveys, with median total self-reported minutes per week as measured by the EVS tool found to provide more conservative estimates of PA behavior as compared with national population-based survey data (Coleman et al., 2012).

Participants with EVS data reported in the electronic health record (EHR) were older, were female, had comorbidities, and had less missing data on race or ethnicity as compared with those participants without EVS data collected, demonstrating EVS discriminant validity (Coleman et al., 2012).

A study conducted in 38 adults (43–69 years of age) at Ball State University (Fitzgerald et al., 2015) examined the criterion validity of the EVS tool as compared with objectively measured PA by accelerometry ($p < .05$) for tool validation. Results showed that the EVS tool had good sensitivity and specificity to identify those who met or did not meet the PAG. When compared to accelerometry (gold standard for objective measure of PA), the EVS tool grossly overestimated minutes of MVPA for both men and women (sensitivity 59%; specificity 77%; $p < .05$), and thus may incorrectly identify 50% of patients in practice who should be advised to increase their PA (Fitzgerald et al., 2015). Similarly, a study of 30 highly educated African-American women (mean age = 35.5 years; mean body mass index [BMI] = 31.1) compared EVS status (measured twice) with accelerometer-determined time in MVPA. Spearman correlation coefficients between EVS scores and accelerometer minutes were weak and nonsignificant for EVS at Time 1 and Time 2, showing low criterion validity to predict whether a participant met the 2008 PAG. Sensitivity values for the EVS tool were low, while specificity values were acceptable. Negative predictive values were moderate and relatively stable (Joseph et al., 2016).

A study of EVS using electronic records in adults (N = 622,897) over 18 years of age (without comorbidities) found associations between EVS category and several biomarkers: regularly active patients and irregularly active patients had lower diastolic blood pressure, fasting glucose levels, and HbA1c levels compared with patients who were insufficiently active (Rohm-Young et al., 2014).

PAVS Tool Accuracy and Validity

One small pilot study of clinic patients ($n = 261$) was conducted in two family practice clinics (sites selected at random) in Utah. The PAVS tool was found to be highly correlated with decreased BMI and lower odds of obesity, supporting construct validity of the PAVS tool (Greenwood et al., 2010). Concurrent validity was shown by good agreement of the PAVS as compared with the validated Modified Activity Questionnaire (89.6% agreement; $k = 0.55$, $p < .001$) in identifying the patients who did not meet the PAG. The study sample was selected from EHRs of the patients ($n = 269$) who completed the PAVS questions (Ball, Joy, Gren, & Shaw, 2016). A study conducted of adult primary care patient EHRs ($n = 34,712$) from 2011 to 2013 found a strong association between PAVS score and patient BMI, indicating the tool's predictive ability. Those with a low PAVS score had a higher odds ratio (confidence interval 1.19–3.7) of being overweight or obese, compared with those with a high PAVS score. A moderately strong association with disease burden was reported, supporting the predictive validity of the PAVS data. Data collected using the PAVS tool may be useful for assessing patient disease burden (Ball, Joy, Gren, Cunningham, et al., 2016). A study of a convenience sample of generally healthy men and women who worked as staff at seven health clinics ($n = 45$; >18 years of age) found PAVS responses showed moderate agreement ($k = 0.46$, $p < .001$) of MVPA minutes with PA measured by accelerometry for individuals meeting as compared with those not meeting the PA guidelines, supporting criterion validity. The participatory design of the study, using clinic staff as study participants, offered them an opportunity to be familiarized with the new PAVS tool and educated on its use (Ball et al., 2015).

PA Tool Implementation Findings

Table S1 provides data on the PA tool implementation characteristics. Primary care physicians or medical assistants were identified as staff conducting PA assessment in two studies (Ball et al., 2015; Grant et al., 2014). Health clinic staff were study participants in one study as a method for training them on PA assessment tool use (Ball et al., 2015). NPs or RNs were not specified as the clinicians conducting the PA assessment in any of the studies.

A large integrated healthcare system implemented systematic EVS data collection at four medical centers along with implementation of a new electronic medical record. EVS data on adult patients (18–89 years of age) were collected during outpatient visits and recorded as a single value (total number of minutes of MVPA) along with other vital sign data (Grant et al., 2014). In a quasi-experimental study, the impact of the EVS program in practices with EVS data capture was compared relative to those practices without EVS data capture. A small but significant change in both clinical processes and outcomes related to PA clinical care was associated with EVS data capture ($n = 266,664$ adults) as compared to outpatient visits made at centers without EVS data collection ($n = 429,623$ adults).

Documentation of PA status in physician progress notes increased (26.2% vs. 23.7%) with EVS tool implementation. Patient PA levels and several clinical outcomes, including blood pressure and HbA1c level, showed a small but significant increase versus usual care (Grant et al., 2014). Feasibility of implementation of the EVS tool by clinicians was shown, with some indication of changes in PA-related patient care associated with using the tool for data capture and tracking (Grant et al., 2014).

Discussion

Nine studies examined use of the EVS or PAVS tool in primary care. Several studies of each tool were identified. All studies were of good or high quality. Preliminary evidence of face, discriminant, criterion (with both objective and subjective measures), and predictive validity (of obesity and disease burden) of the EVS tool was found, in addition to accurate patient classification (good sensitivity and specificity). Good concurrent validity (identifying those not meeting the 2008 PAG) and strong predictive ability of the PAVS tool to identify obesity and disease burden were shown. However, there is a lack of data on tool reliability. While each tool demonstrated some accuracy in PA classification, neither tool showed high validity as compared with objective measures. The EVS tool may overestimate MVPA in both men and women and the PAVS may only moderately estimate MVPA. Studies of tool psychometrics varied in terms of sample size, and most were conducted in primarily Caucasian female samples. One small study of exclusively African-American women was conducted (Joseph et al., 2016). Some evidence for health system process changes to improve PA assessment in primary care practice were shown, with the potential to achieve important care outcomes.

Our study summarized existing psychometric data on two PA assessment tools used in primary care practices and highlights that there is limited evidence supporting the use of either tool. Primary care clinicians can use the data from this study to better understand the utility of these tools and to evaluate their suitability for use with their patient populations.

Limitations

A single author screened all of the abstracts and articles, and also performed the data extraction and quality assessment (included studies were confirmed by the second author). Only English-language articles were included, and only U.S. studies were included since the EVS and PAVS tools have not been used outside the United States. However, relevant articles may have been missed. Use of the EVS and PAVS tools to assess PA was examined specifically in primary care settings. The results of this review are based on a relatively small number of studies in mostly female participants.

Conclusions

Initial evidence of the accuracy and validity of two clinical tools (EVS and PAVS) used to assess the PA status of adult patients in primary care settings is promising. However, there is a lack of data on tool reliability. There is some evidence of successful implementation of the EVS tool supported by EHR systems for data capture in large, integrated health systems. However, these tools have not been well studied in diverse populations, in the elderly, or in diverse subpopulations, and have not been adapted for use in children. Further high-quality evaluation of EVS and PAVS assessment tool psychometrics is needed, as are additional data on successful implementation strategies in order to assist primary care clinicians to better care for insufficiently active, at-risk primary care populations.

Implications

Better understanding of PA measurement tool psychometrics and factors supporting tool use as part of primary care health assessment can enhance appropriate use of these tools. However, while there is some evidence from our study supporting the accuracy and validity of these tools, the data are based on a relatively small number of studies. Additional evaluation of each PA assessment tool and more evidence on their reliability are needed to inform current practice by primary care clinicians. Further research on these two PA assessment tools, which appear promising for use by primary care clinicians, is indicated to facilitate the appropriate use of these tools, and may ultimately improve identification and care of insufficiently active patients.

Clinical Resources

- **Exercise is Medicine®. Healthcare Providers' Action Guide**. http://www.exerciseismedicine. org/assets/page_documents/HCP_Action_Guide(5). pdf
- **Kaiser Permanente. Prescription to Move** (#Rx2Move). http://www.kpihp.org/rx2move/
- **National Physical Activity Plan**. physicalactivityplan.org. http://www.physicalactivityplan.org/ NationalPhysicalActivityPlan.pdf

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Table S1. Summary Profile of Studies Reviewed (*n*=9)

CLINICAL SCHOLARSHIP

Classification of Heat-Related Illness Symptoms Among Florida Farmworkers

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Abstract

Background: Farmworkers working in hot and humid environments have an increased risk for heat-related illness (HRI) if their thermoregulatory capabilities are overwhelmed. The manifestation of heat-related symptoms can escalate into life-threatening events. Increasing ambient air temperatures resulting from climate change will only exacerbate HRI in vulnerable populations. We characterize HRI symptoms experienced by farmworkers in three Florida communities.

Methods: A total of 198 farmworkers enrolled in 2015–2016 were asked to recall if they experienced seven HRI symptoms during the previous work week. Multivariable logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the association between selected sociodemographic characteristics and reporting three or more symptoms. Latent class analysis was used to identify classes of symptoms representing the HRI severity range. We examined sociodemographic characteristics of the farmworkers across the latent classes.

Results: The mean age ($\pm SD$) of farmworkers was 38.0 (± 8) years; the majority were female (60%) and Hispanic (86%). Most frequently reported symptoms were heavy sweating (66%), headache (58%), dizziness (32%), and muscle cramps (30%). Females had three times the odds of experiencing three or more symptoms (OR = 2.86, 95% CI 1.18–6.89). Symptoms fell into three latent classes, which included mild (heavy sweating; class probability = 54%), moderate (heavy sweating, headache, nausea, and dizziness; class probability = 24%), and severe (heavy sweating, headache, nausea, dizziness, muscle cramps; class probability = 22%).

Conclusions: Farmworkers reported a high burden of HRI symptoms that appear to cluster in physiologic patterns. Unrecognized accumulation of symptoms can escalate into life-threatening situations if untreated. Our research can inform interventions to promote early recognition of HRI, on-site care, and appropriate occupational health policy. Administrative or engineering workplace controls may also reduce the manifestation of HRI.

Clinical Relevance: This study advances the current knowledge of HRI symptoms in farmworkers and moves beyond reporting individual symptoms by utilizing latent class analysis to identify how symptoms tend to co-occur together in this population. It acknowledges multiple symptoms occurring as a result of occupational heat exposure and highlights the importance of symptom recognition.

The Centers for Disease Control and Prevention (CDC) estimates that 3,442 deaths in the United States were attributable to heat-related illness (HRI) between 1999 and 2003 (CDC, 2006). This number is most likely underestimated given that criteria to determine heat-related deaths vary by state (CDC, 2006) and heat exposure may not be recorded as the primary cause of death (Berko, Ingram, Saha, & Parker, 2014, July 30; Leigh, Du, & McCurdy, 2014; Oberlin, Tubery, Cances-Lauwers, Ecoiffier, & Lauque, 2010; Ostro, Roth, Green, & Basu, 2009). Increasing ambient temperatures resulting from climate change are a recognized climate-related occupational hazard (Schulte et al., 2016) and have profound effects on human health (Perera, 2017). Average surface temperatures have been rising since 1901, with the past decade (2006–2015) being the warmest ever recorded (Environmental Protection Agency, 2017). Populations most adversely impacted by HRI include the elderly, children, low-income, and outdoor workers, including farmworkers (Balbus & Malina, 2009; Schulte et al., 2016). Farmworkers' risk for heat-related death is nearly 20 times greater than that of other outdoor workers (Centers for Disease & Prevention, 2008). Between 1992 and 2006, 423 occupational heat-related deaths were reported in the United States, including 68 associated with crop work (Jackson & Rosenberg, 2010). Six of the 68 crop worker deaths occurred in Florida, a state with a consistently hot and humid climate (Jackson & Rosenberg, 2010).

Factors that increase farmworker susceptibility to HRI include low income, lack of education, language barriers, poor housing conditions, and fear of deportation (Culp, Tonelli, Ramey, Donham, & Fuortes, 2011). Farmworkers report that they often delay or fail to seek medical treatment, frequently prioritizing work duties over health because of their socioeconomic vulnerability (Thierry & Snipes, 2015). When farmworkers are paid by a piece rate, they may not want to stop work to take rest breaks or to hydrate. Healthcare providers who serve farmworkers also acknowledge a lack of occupational and environmental health training, including training about HRI (Kelley, Flocks, Economos, & McCauley, 2013). Furthermore, in rural areas where farm work takes place, rapid access to emergency care may be limited due to distance and lack of transportation (Hoerster et al., 2011). Out of

139 who died from HRI in Florida from 2005 to 2012, 40% were not treated in an emergency room or hospital prior to death (Harduar Morano, Watkins, & Kintziger, 2016).

HRI occurs when innate thermoregulatory capabilities are overwhelmed by a consistently high core body temperature (Hanna & Tait, 2015). Mechanisms that promote thermal regulation include evaporative cooling, conduction, radiation, and convection (Becker & Stewart, 2011; Hanna & Tait, 2015; Jacklitsch et al., 2016). Evaporative cooling of the skin can be disrupted in hot and humid environments, accelerating dehydration and electrolyte imbalance. When thermal balance is disrupted, a series of symptoms can manifest, including heat rash, excessive sweating, peripheral edema, headache, heat cramps, nausea-vomiting, fainting, and, in severe cases, coma and death (Becker & Stewart, 2011; Bethel & Harger, 2014; Hanna & Tait, 2015). Symptoms such as excessive sweating and reddening of the skin are common and reflect the physiological response to heat. If interventions are not taken to reduce core body temperature, more serious cardiac and neurological symptoms develop, indicating a worsening medical condition (Becker & Stewart, 2011; Hanna & Tait, 2015). Dehydrated workers can develop cardiac arrhythmia and become disoriented and unaware of their worsening symptoms, potentiating further health decline and work-related injuries. Although, the body has compensatory mechanisms to counter the effects of HRI, many risk factors can compromise these mechanisms, including excessive body mass (Becker & Stewart, 2011; Hanna & Tait, 2015), age (Becker & Stewart, 2011; Hanna & Tait, 2015), limited fluid intake (Bethel & Harger, 2014), smoking (Pantavou, Lykoudis, & Nikolopoulos, 2016), medications (Becker & Stewart, 2011; Hanna & Tait, 2015), chronic health conditions (Becker & Stewart, 2011; Hanna & Tait, 2015; Harduar Morano et al., 2016), lack of rest breaks at work, gender (Harduar Morano et al., 2016; Pantavou et al., 2016), and outdoor work (Bethel & Harger, 2014; Xiang, Bi, Pisaniello, & Hansen, 2014). Fortunately, if identified early, HRI is both preventable and treatable (Glazer, 2005).

There are emerging data regarding the extent of farmworker recognition of HRI symptoms. In a cross-sectional survey of 300 North Carolina farmworkers, 94% reported

working in conditions of extreme heat, and 40% reported at least one HRI symptom ever while working in agriculture (Mirabelli et al., 2010). In a study of 405 Georgia farmworkers, more than one third reported they experienced at least three heat-related symptoms during the previous week (Fleischer et al., 2013). In-person interviews conducted with 100 Oregon migrant farmworkers revealed that 64% experienced an HRI symptom during the previous work week, most commonly heavy sweating (50%) and headache (24%; Bethel & Harger, 2014). A study of 106 sugarcane harvesters in Central America reported that 82% experienced at least one HRI symptom, 59% experienced two, and 42% experienced three or more during the previous week. The most common symptoms reported among these sugarcane workers were headache (51%), tachycardia (35%), and muscle cramps (25%; Crowe, Nilsson, Kjellstrom, & Wesseling, 2015).

The purpose of the current study is to describe the prevalence and clustering of HRI symptoms experienced by farmworkers in three agricultural communities in Florida during hot summer months, and to identify subgroups of farmworkers with differential HRI symptom profiles using latent class analysis (LCA), a statistical technique that can be used to identify subgroups based on categorical data responses (Lanza, Collins, Lemmon, & Schafer, 2007; Lanza & Rhoades, 2013). This method may provide empirical evidence for stratifying farmworkers into HRI risk categories based upon the symptoms experienced to aid in early identification of severe HRI and prompt preventive or medical interventions.

Methods

Study Design and Population

The Girasoles (Sunflower) study utilizes a prospective cohort of seasonal and migrant farmworkers to investigate the impact of working in hot and humid environments and the extent of HRI in Florida. Girasoles is a collaborative effort among researchers at Emory University, the University of Florida, and the Farmworker Association of Florida (FWAF), a grassroots organization. The FWAF is a membership organization with more than 10,000 members who work primarily in the vegetable, citrus, mushroom, sod, fern, and foliage industries in 15 counties in Florida. The FWAF works in communities composed of low-income, ethnic-minority, migrant, and seasonal farmworkers, many of whom are undocumented. Most of these farmworkers have little formal education and speak little or no English; therefore, all written materials, including the informed consent, were read aloud. This article focuses on farmworkers in the Apopka, Pierson, and Immokalee communities during

the summer months of 2015 to 2016. Trained community workers from the FWAF recruited a convenience sample of farmworkers through phone calls, home visits, and community events.

Farmworkers were eligible if they were 18 to 54 years old, had worked in agricultural settings for at least 2 weeks prior to the study, did not have type I diabetes mellitus, and were not currently pregnant. Farmworkers reported to the study site for consent, an occupational heat-related illness survey, and clinical assessment. The university institutional review board reviewed and approved all procedures.

Measures

A demographic, health, and work characteristics survey adapted from previously used occupational HRI surveys with farmworker populations (Fleischer et al., 2013), was administered in the farmworkers' primary language by trained interviewers. Survey items included questions about seven HRI symptoms experienced during the previous work week: heavy sweating, headache, sudden muscle cramps, nausea or vomiting, confusion, dizziness, or fainting while working. Each response was recorded as "yes, experienced" if reported in the last week; otherwise, "no." The number of reported symptoms was summed and classified into a dichotomous variable indicating three or more symptoms experienced. We ascertained the ambient temperature and relative humidity during the time of recall from the Florida Automated Weather Network.

Statistical Analysis

Variables were summarized using means and standard deviations for continuous variables and frequency counts and percentages for categorical variables. The relationship of "reporting 3 or more HRI symptoms" with participant demographic (age, gender, nationality), health-related (body mass index [BMI], history of hypertension or diabetes, alcohol consumption, smoking), and work-related variables (work type, days worked per week, hours worked per day) was assessed with multivariable logistic regression. First, a generalized linear mixed model adjusting for the random effect of participants clustering in households was compared to a model without such adjustment; based on fit statistics Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC; lower values indicating a better fit), the simpler model had a better fit and is reported.

LCA (Lanza et al., 2007), a data-driven approach to identify subgroups within our population, was used to describe the classification of reported symptom types

during the previous week. Model selection strategy included evaluating the likelihood ratio G^2 statistic, AIC, and BIC (lower values indicating a better fit), the entropy statistic (higher values indicating better class separation; values of ≥0.6 indicate acceptable model discrimination; Zhu et al., 2016), and consideration of class composition as physiologically plausible. Item response probabilities were used to determine if classes could be distinguished from one another and to assign meaningful categories. A general guideline is to use 0.5 as the cutoff (Berglund, 2016); due to sample size considerations, a conservative cutoff of 0.4 for item response probabilities was used to determine membership of particular symptoms within each latent class. SAS version 9.4 (Cary, NC, USA) was used for all statistical analyses, and LCA was performed by using the PROC LCA software, which is publicly available at http://methodology.psu.edu (Lanza et al., 2007).

Results

Farmworkers' ages ranged from 19 to 54 years, with a mean age ($\pm SD$) of 38 (± 8) years. Of the 198 farmworkers in the sample, 61% were female, 86% were Hispanic, 63% were of Mexican origin, and 82% spoke Spanish as their primary language (**Table 1**). Nearly half were married and on average had 6.5 (± 4) years of education. The majority of farmworkers were overweight or obese (79%), a quarter reported drinking alcohol, and 14% had ever smoked. On average, farmworkers in our sample had been working in U.S. agriculture for about 12 (± 7.8) years, worked 5.1 (± 0.9) days per week, and 7.5 (± 1.4) hours per day. The mean ambient temperature for the previous work week was 84°F (28.9°C) with a relative humidity of 74%.

During the previous work week, 84% of participants reported experiencing at least one symptom and 40% reported three or more symptoms. The average number of symptoms experienced was 2.2 ($SD \pm 1.7$). The frequency of the type of HRI symptoms reported during the previous week were heavy sweating (66%), headache (58%), dizziness (32%), muscle cramps (30%), nausea-vomiting (24%), fainting (10%) and confusion (9%; **Table 2**). In multivariable modeling, we found that females had a three times greater odds of experiencing three or more symptoms compared to males (odds ratio [OR] = 2.67; 95% confidence interval [CI] 1.10–6.50), controlling for other variables of interest. No other characteristics were found to be significantly associated with reporting more symptoms (**Table 3**).

Multiple latent class models were constructed and model fit statistics were compared (**Table 4**). Balancing

Table 1. Demographic, Health, and Work Characteristics in Summer, Florida 2015–2016 (total sample, $N = 198$)

Characteristics	n	% or mean (SD)
Years of age	198	38.0 (8.2)
Gender		
Male	78	39%
Female	120	61%
Hispanic	169	86%
Nation of origin		
United States	3	2%
Mexico	125	63%
Haiti	28	14%
Guatemala	34	17%
Other[a]	8	4%
Primary language		
Spanish	163	82%
Haitian Creole	28	14%
Other[b]	7	4%
Married	88	45%
Years of education	198	6.5 (4)
Health-related		
Body mass index		
Normal (18.5 to <25)	41	21%
Overweight (25 to <30)	87	44%
Obese (≥30)	69	35%
Drinks alcohol	51	26%
Smoked ever	27	14%
Work-related		
Primary work type		
Nursery	61	31%
Fernery	70	35%
Crop	67	34%
Years in U.S. agriculture	198	12.0 (7.8)
Days worked per week	197	5.1 (0.9)
Hours worked per day	198	7.5 (1.4)

[a]Other nations of origin include Dominican Republic, El Salvador, Honduras, and Puerto Rico.
[b]Other languages include Canjobal, Mam, and Zapotec.

model selection criteria and physiological interpretability, we chose a three-class model with classes designated as mild (heavy sweating; class probability = 54%), moderate (heavy sweating, headache, nausea-vomiting and dizziness; 24%), and severe (excessive sweating, headache, dizziness, nausea-vomiting, sudden muscle cramps and fainting; 22%; see **Figure 1**). Model entropy was 0.72, indicating moderately distinct class separation. When comparing the distribution of sociodemographic characteristics across the latent classes, we found that a higher proportion of females were in the moderate and severe symptom classes (54% female in mild vs. 70% female in moderate and severe symptom classes; $p = .04$). No other meaningful differences were found.

Table 2. Heat-Related Illness Symptoms Among Farmworkers in Summer, Florida 2015–2016 (total sample, $N = 198$)

Characteristics	n	% or mean (SD)
Heat-related illness symptoms reported		
Heavy sweating	130	66%
Headache	115	58%
Dizziness	63	32%
Muscle cramps	59	30%
Nausea/vomiting	47	24%
Fainting	20	10%
Confusion	18	9%
Number of heat-related illness symptoms		
None	32	16%
1	41	21%
2	43	22%
3	30	15%
4	30	15%
5	11	6%
6	5	3%
7	2	1%
Average number of heat-related illness symptoms	194	2.2 (1.7)

Note. Missing values are excluded from the table; percentages are based on nonmissing data.

Table 3. Association of Selected Characteristics With Reporting Three or More Symptoms of Heat-Related Illness

Characteristics	Unadjusted OR (95% CI)[a]	Adjusted OR (95% CI) [a]
Years of age (reference = 19–31)		
32–37	0.77 (0.33, 1.80)	0.83 (0.34, 2.03)
38–42	0.46 (0.21, 1.05)	0.53 (0.22, 1.30)
43–54	0.44 (0.17, 1.11)	0.58 (0.20, 1.62)
Gender (reference = male)		
Female	2.13 (1.15, 3.95)	2.67 (1.10, 6.50)
Nationality (reference = Mexican)		
Other	0.96 (0.53, 1.75)	1.38 (0.59, 3.26)
Years of education	1.04 (0.96, 1.13)	1.03 (0.94, 1.14)
Body mass index	1.00 (0.94, 1.07)	0.99 (0.92, 1.07)
Reported hypertension or diabetes (reference = no)	0.59 (0.31, 1.16)	0.70 (0.33, 1.50)
Drinks alcohol (reference = no)		
Yes	1.10 (0.57, 2.12)	2.06 (0.88, 4.81)
Smoked (reference = never)		
Ever	0.60 (0.25, 1.46)	0.98 (0.33, 2.91)
Work type (reference = nursery)		
Fernery	0.58 (0.28, 1.19)	1.13 (0.44, 2.94)
Crop	0.82 (0.40, 1.70)	0.69 (0.26, 1.81)
Days worked per week	0.84 (0.60, 1.17)	0.90 (0.60, 1.35)
Hours worked per day	0.93 (0.76, 1.15)	0.90 (0.68, 1.17)

Note. OR = odds ratio; CI = confidence interval.
[a]Mutually adjusted estimates are based on farmworkers who had completed data for all variables ($n = 192$).

Table 4. Fit Statistics for Latent Class Analysis Models of Heat-Related Illness Symptoms

N classes	G^2	AIC	BIC	Entropy
2	84.6	114.6	163.9	0.72
3	62.4	108.4	184.0	0.72
4	50.1	112.1	214.0	0.73
5	43.0	121.0	249.3	0.74
6	36.8	130.8	285.4	0.78
7	31.5	141.5	322.4	0.75

Note. AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria.

Discussion

Farmworkers in this study report a high burden of HRI symptoms that cluster in physiologic patterns ranging from mild to severe. Previous HRI literature differentiates mild from severe HRI when symptoms progress from heat exhaustion to heat stroke and the body is no longer able to thermoregulate its internal cooling mechanisms (Jacklitsch et al., 2016). The results of this study challenge the traditional classification of mild or severe HRI symptom burden by elucidating three distinct physiologically meaningful clusters of symptoms. This LCA approach is a first step toward identifying co-occurring symptoms and away from subjectively classifying groups of symptoms as mild or severe. Additionally, the three-class model has value in a clinical setting for classifying the severity of an HRI illness. For individuals experiencing HRI, this model may better equip them to determine when their symptoms progress to a point that they need to rest or to seek treatment. From a public health standpoint, these classifications also have value as the basis for HRI prevention policies. Unrecognized accumulation of symptoms can escalate into life-threatening situations if untreated. Our research can inform interventions to promote early recognition of HRI, on-site care, and appropriate occupational health policy. Administrative and/or engineering workplace controls may also reduce the manifestation of HRI.

Similar to previously reported gender differences in HRI symptom reporting (Spector, Krenz, & Blank, 2015) we observed that females reported more symptoms. Gender differences in symptom reporting may be due in part to cultural biases that prevent the willingness of men to disclose the occurrence of severe symptoms (Hunter, Fernandez, Lacy-Martinez, Dunne-Sosa, & Coe, 2007). Male Latino farmworkers are traditionally viewed as resilient to adversity, strong, stoic, and resourceful in their workplace (Roy, Tremblay, Robertson, & Houle, 2015). Biological factors such as high body surface to mass ratio and or morphology and adipose distribution among
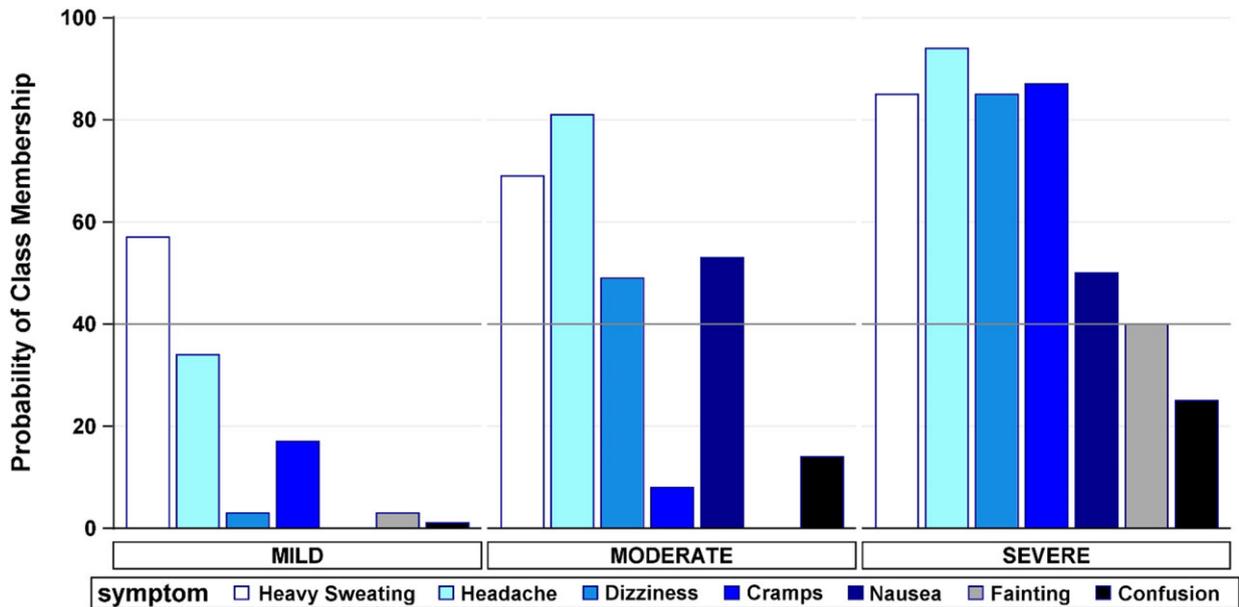
Figure 1. Latent class analysis on seven heat-related illness symptoms: class membership and item probabilities.

women could also contribute to this difference (Hanna & Tait, 2015). We did not observe a correlation between number of symptoms reported and BMI as other studies have reported, and this could be due to our unique study population. Consistent with previous reports of age-associated trends in HRI among other farmworker populations (Spector et al., 2015), younger individuals were more likely to experience three or more symptoms relative to older participants.

Many farmworkers believe their work environments can be unsafe, yet they often have little control over their working conditions and lack proper heat hazard training (Kelley et al., 2013). In the current study, despite participants reporting a high burden of HRI symptoms, only 16% reported receiving training on HRI prevention practices. This finding is consistent with other occupational researchers reporting 77% of farmworkers in Georgia lack heat training or access to regular breaks, shade, or medical attention (Fleischer et al., 2013). Currently, Washington and California are the only states that have established heat hazard regulations in order to prevent HRI in farmworkers (Mirabelli et al., 2010). The International Council of Nurses (ICN) works closely with the National Nurses Council and other labor organizations to raise awareness of potential occupational hazards and at-risk settings. The ICN believes it is the ethical, moral, and legal responsibility of healthcare stakeholders, including government and political officials, to ensure that workers' rights to a healthy and safe workplace are protected (ICN, 2017). Employers also have a duty to protect workers

from recognized workplace hazards such as HRI under the Occupational Safety and Health Act by providing water, rest, and shade. Unfortunately, the guidelines lack protocols and necessary surveillance to ensure adequate provision of water, rest, and shade. The lack of Occupational Safety and Health Administration oversight, coupled with a lack of required education in most states, underscores the need for farmworkers and growers to understand co-occurrence and severity of symptoms of HRI and how to seek medical attention for themselves or co-workers when dangerous symptoms occur. Occupational health and safety nurses have a unique and critical role in the field to assess dangerous risks to health, respond to illness with early life-saving treatment, report work-related incidents, and educate workers about HRI prevention. Nurses are also called to conduct, translate, and implement important research findings efficiently so workers live healthier, more productive lives.

Recognizable symptoms of HRI should serve as signals to take preventative action against a heat-induced cascade of physiological symptoms that could end in death. Symptom awareness by the farmworkers can effectively occur in the field, and occupation health nurses should be a part of this process through practice and research. The need for continued development of HRI prevention strategies will continue to grow in light of population aging trends and an increased prevalence of chronic disease, making workers more vulnerable to HRI. Successful interventions for farmworkers must be based

on knowledge of the pattern and prevalence of such symptoms in the population. Although we have previously reported on the strong community interest in health effects associated with working in hot environments (Flocks, Kelley, Economos, & McCauley, 2012; Mac et al., 2017), more research is needed to develop, implement, and evaluate successful, culturally appropriate interventions.

Limitations

Our study design and data collection efforts were dependent on strong engagement from farmworker community members, yielding a convenience sample of farmworkers. Our sample population is mainly Hispanic workers with specific heat, humidity, and other environmental exposures due to their occupational tasks. For these reasons, our data may not be generalizable to other populations. Symptoms were recalled from the previous week, making them subject to recall bias. In our LCA, we were able to determine three underlying subgroups in our sample based upon their pattern of symptoms. However, we may have enrolled healthier, more motivated farmworkers that may be more knowledgeable about HRI prevention practices and may not have experienced more severe symptoms. In addition, our sample size may not have allowed us to capture the full spectrum of symptoms experienced in this population. We may have observed different underlying symptom profiles with a more robust sample size. Lastly, we were not able to determine the temporal order of symptom occurrence.

Conclusions

This study advances the current knowledge of HRI symptom classification and moves beyond symptom and illness characterization. It acknowledges multiple symptoms occurring as a result of heat exposure and raises awareness of how symptoms cluster together. Unrecognized accumulation of symptoms may lead to life-threatening situations, and early recognition of HRI is essential in keeping farmworkers safe and healthy in their workplace. Ideally, early recognition of symptom clusters by occupational health nurses or emergency clinicians could reduce the overall prevalence and morbidity associated with HRI. Further investigation using symptom recall at the end of several workdays could lead to better estimates of HRI risk and reporting of HRI cases. Ultimately, future nursing and public health research should evaluate if HRI symptom clusters are predictive of objective health outcomes.

Acknowledgments

Clinical Resources

- American Nurses Association. Healthy work environment: http://nursingworld.org/MainMenu-Categories/WorkplaceSafety/Healthy-Work-Environment
- Centers for Disease Control and Prevention. Recommendations: https://www.cdc.gov/niosh/topics/heatstress/recommendations.html
- Occupational Health and Safety Administration. Heat illness index of educational resources, using the heat index, training, and online toolkit: https://www.osha.gov/SLTC/heatillness/index.html
- American Academy of Family Physicians. Heat-related illnesses: http://www.aafp.org/afp/1998/0901/p749.html
- Migrant Clinicians Network. Heat-related illness: http://www.migrantclinician.org/issues/heat-stress.html
- Centers for Disease Control and Prevention. Heat stress: https://www.cdc.gov/niosh/topics/heatstress/default.html
- National Weather Service. Heatwave: https://www.weather.gov/media/owlie/heatwave.pdf
- Occupational Safety and Health Administration. Occupational heat exposure: https://www.osha.gov/SLTC/heatstress/prevention.html
- Occupational Safety and Health Administration. Protecting workers from the effects of heat: https://www.osha.gov/OshDoc/data_Hurricane_Facts/heat_stress.pdf

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PROFESSION AND SOCIETY

Recent Trends in Baccalaureate-Prepared Registered Nurses in U.S. Acute Care Hospital Units, 2004–2013: A Longitudinal Study

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Abstract

Purpose: To examine the trends in baccalaureate (bachelor of science in nursing)–prepared registered nurses (BSN RNs) in U.S. acute care hospital units and to project the growth in the number of BSN RNs by 2020.

Design: This is a longitudinal study using the Registered Nurse Education Indicators data (2004–2013) from the National Database of Nursing Quality Indicators.

Methods: The level of BSN RNs in each unit was operationalized as the proportion of nurses holding a baccalaureate degree or higher among all the nurses in a unit. Our sample included 12,194 unit-years from 2,126 units of six cohorts in 377 U.S. acute care hospitals. A hierarchical linear regression model was used to examine the trends in BSN RNs and to project future growth in the number of BSN RNs when controlling for hospital and unit characteristics and considering repeated measures in units over time and clustering of units within hospitals.

Results: The proportion of BSN RNs in U.S. acute care hospital units increased from 44% in 2004 to 57% in 2013 (a 30% increase); when combining all cohorts, this rate increased from 44% in 2009 to 51% in 2013. On average, the proportion of BSN RNs in a unit increased by 1.3% annually before 2010 and by 1.9% each year from 2010 on. The percentage of units having at least 80% of their nurses with a baccalaureate degree or higher increased from 3% in 2009 to 7% in 2013. Based on the current trends, 64% of the nurses working in a hospital unit will have a baccalaureate degree by 2020, and 22% of the units will reach the 80% goal by 2020.

Conclusions: There was a significant increase in the proportion of BSN RNs in U.S. acute care hospital units over the past decade, particularly after 2010. However, given the current trends, it is unlikely that the goal of 80% nurses with a baccalaureate degree will be achieved by 2020.

Clinical Relevance: The U.S. nursing workforce is under educational transformation in order to meet the increasing healthcare needs. To help accelerate this transformation, further advocacy, commitment, and investment are needed from all healthcare stakeholders (e.g., policymakers, executives and managers of healthcare facilities, nursing schools, etc.).

Nurses compose the largest healthcare workforce in the United States. There were 2.75 million registered nurses (RNs) working in healthcare settings in 2014, of whom 61% (or over 1.6 million) worked in hospitals (Bureau of Labor Statistics, 2015). Given the dramatic changes within the U.S. healthcare system, such as the aging of the baby boomers and the expansion of health insurance coverage (Department of Health and Human

Services, 2015; Garfield, Damico, Cox, Claxton, & Levitt, 2016), nurses will likely have an even greater role in improving quality of care and patient outcomes (National Academies of Sciences, Engineering, and Medicine, 2015). Consequently, it is critical to build a competent nursing workforce to meet the increasing and complex healthcare needs in the United States.

One strategy for preparing a competent nursing workforce is to advance nurse education, particularly by promoting the number of baccalaureate (bachelor of science in nursing)–prepared registered nurses (BSN RNs). Increasing evidence has demonstrated that higher nurse education is associated with better quality of care and patient outcomes (Aiken et al., 2014; McHugh & Ma, 2013). In a seminal study of 168 U.S. general acute care hospitals with 232,342 surgical patients, the researchers found that hospitals with higher proportions of nurses holding a baccalaureate degree (BSN) or higher had significantly lower surgical patient mortality and failure-to-rescue (Aiken, Clarke, Cheung, Sloane, & Silber, 2003). This study was replicated in the United States with more recent data of 665 hospitals and 1.3 million patients (Aiken et al., 2011) and internationally with similar results (Aiken et al.,2014; Ridley, 2008; Van den Heede et al., 2009). The linkage between higher proportion of BSN RNs and lower mortality rates has been further supported by findings from a panel study of 134 hospitals over time (1999–2006; Kutney-Lee, Sloane, & Aiken, 2013). Further complementing the results of large-scale studies, a detailed study of the dose response of care by BSN RNs in a single large U.S. hospital showed that better patient outcomes were associated with more hours of patient care by BSN RNs; and the hospital could financially benefit from hiring more BSN RNs (Yakusheva, Lindrooth, & Weiss, 2014).

Acting on the basis of growing evidence of a linkage between more BSN RNs and better patient outcomes, the Institute of Medicine (IOM) recommended in its milestone report, The Future of Nursing: Leading Change, Advancing Health, that 80% of U.S. RNs should have at least a baccalaureate degree in nursing by 2020 (80/20 goal; IOM, 2011). This recommendation was immediately supported, for the first time in history, by the Tri-Council, an alliance between the main nursing organizations in the United States, including the American Association of Colleges of Nursing, the American Nurses Association, the American Organization of Nurse Executives, and the National League for Nursing (Tri-Council of Nursing, n.d.). Since the report was released, a variety of initiatives (e.g., The Future of Nursing: Campaign for Action) have been carried out to achieve this 80/20 goal, and some changes have been noted. A 2014 survey of nursing schools by the American Association of Colleges of Nursing (AACN) indicated a 4.2% enrollment growth in entry-level baccalaureate programs and a 10.4% increase in "RN-to-BSN" programs for RNs with associate degrees or diplomas from 2013–2014 (AACN, 2015).

While there is mounting evidence demonstrating the significance of promoting baccalaureate education for nurses, empirical evidence illustrating the recent trends in BSN RNs in clinical settings over time is rare. Such evidence is critical for a better understanding of the ongoing educational transformation of the nursing workforce. To address the gap, the purpose of this study was twofold: (a) to illustrate the recent trends in BSN RNs using unit-level data (2004–2013) of U.S. acute care hospitals from a national database; and (b) to estimate whether the 80/20 goal is achievable based upon the current trend and, if not, how far away from it we remain.

Methods

Data and Sample

This was a longitudinal study using the Registered Nurse Education Indicators data (2004–2013) from the National Database of Nursing Quality Indicators (NDNQI). The NDNQI was founded in 1998 by the American Nursing Association with the mission of aiding nurses in efforts to improve care quality and patient safety and has been owned by Press Ganey, Inc. since 2014 (Montalvo, 2007). The NDNQI is a national nursing quality measurement data repository in the United States that enables researchers to compare the quality of hospital nursing and nursing-sensitive patient outcomes at the unit level. Over 2,000 hospitals nationwide were submitting nursing and patient outcomes data to the NDNQI by 2014.

One of the NDNQI's endeavors is to collect data on nurses' education (RN education indicator) at the unit level from NDNQI member hospitals. RN education data in each eligible unit were collected by trained nursing staff in NDNQI member hospitals and reported quarterly to the NDNQI. Submitted information includes the number of eligible RNs on a unit and the number of RNs at each educational level (i.e., diploma, associate degree, bachelor's degree, master's degree, and doctorate degree). For nurses with multiple degrees, only the highest nursing degree is counted. RNs (full-time, part-time, and per-diem RNs) are eligible for this report if they were unit based, with direct patient care responsibilities for at least 50% of their time, and listed on the staffing roster during the reporting quarter. RNs who were on temporary vocational or medical leave were included, too. However, RNs were excluded if they were contract or agency nurses or not assigned to a specific unit.

In this study, the unit of analysis was the unit-year. We annualized the proportion of BSN RNs across quarters in each year from 2004 to 2013 for each unit. To be included in this study, units must have at least three quarters of RN education data in each year; units must also have at least 5 consecutive years of RN education data to ensure a sufficient amount of data for modeling time trends and projections. Units were categorized into different cohorts based on the first year a unit submitted data to the NDNQI. For example, cohort 2004 included units that submitted three or four quarters of data each year since 2004 and until 2013. In total, there were six unit cohorts (cohorts 04, 05, 06, 07, 08, and 09).

An advantage of the NDNQI database is that units are consistently and systematically classified into a certain type based on the patient population, type of care provided, and patient acuity level. This enables comparative analysis of units across hospitals. For this study, we included five adult unit types: critical care, step-down, medical, surgical, and medical-surgical combined. These units represent the vast majority of adult units reporting data to the NDNQI. They also are the most common units within acute care hospitals. The final analytic dataset consisted of 12,194 unit-years from 2,126 units in 377 acute care hospitals.

Variables

Unit BSN RNs. The level of BSN RNs in each unit was operationalized as the proportion of RNs holding a baccalaureate degree or higher among all the RNs in a unit. A time variable (named t) was generated to reflect the numbers of years from the baseline year, which varied by cohorts. A dummy variable named *flag* was also created to indicate whether a year was before or after 2010 (i.e., *flag* = 0 before 2010, *flag* = 1 from 2010 on). This variable was used to compare time trends before and after the release of The Future of Nursing report.

Covariates. Hospital- and unit-level characteristics at baseline were included as covariates. Hospital-level covariates were ownership, bed size, teaching status, Magnet status, and geographic location. Hospital ownership was categorized as nonprofit, profit, or government-owned. Hospital size was measured by the number of staffed beds and grouped into two categories (small, ≤299 beds; large, ≥300 beds). Teaching status was classified as teaching and nonteaching. Hospitals were also identified based on their Magnet status. Given the geographic locations, hospitals were classified as those located in the metropolitan area versus those out of metropolitan areas. A unit-level variable indicating unit type was included, too.

Analysis

Baseline characteristics (both hospital- and unit-level) were described first for each cohort. Levels of BSN RNs were then described for each cohort by unit type. BSN RN levels were plotted to show visually how the proportion of BSN RNs changed over time. Given the complex data structure that units clustered within hospitals and measures were repeated within units over time, a three-level hierarchical linear regression model was employed to examine whether there was a difference in the trends of growth in the number of BSN RNs before and after the release of the IOM's Future of Nursing report, when controlling for baseline hospital and unit characteristics. Random intercepts at both hospital and unit level were included to account for the cluster of units within hospitals and repeated measures within units. Our preliminary analysis suggested no significant differences in the overall trends by unit cohort. Therefore, regression models were conducted across all cohorts. Finally, based on the estimates of current trends in the growth in the number of BSN RNs from the above model, we projected the level of BSN RNs by 2020 and compared it with the recommended 80% goal.

Results

Table 1 describes the hospital- and unit-level characteristics at baseline. Of the 2,126 units, there were 547 (25.7%) critical care units, 299 (14.1%) step-down units, 426 (20.0%) medical units, 335 (15.8%) surgical units, and 519 (24.4%) medical-surgical combined units. These units were from 377 acute care hospitals, of which the majority were nonprofit (88.3%) and located in metropolitan areas (87.0%), 47.1% were teaching hospitals, 29.2% had at least 300 beds, and 7.7% were Magnet hospitals. There were some differences in hospital characteristics at baseline across cohort, such as hospital size, teaching status, and Magnet status.

Table 2 presents the unit percentage of BSN RNs at the baseline year for each cohort by unit type. Overall, the percentage of BSN RNs at baseline slightly varied by cohort from 36% (cohort 2005) to 44% (cohort 2004). In each cohort, the percentage of BSN RNs varied by unit types, and critical care units had the highest levels of RNs holding bachelor's degrees or above at baseline. For example, in cohort 2004, the percentage of RNs holding a baccalaureate degree varied from 49% in critical care units to 36% in medical-surgical combined units.

Figure 1 (also shown in **Table S1**) illustrates the trends in BSN RNs at the unit level in each cohort from 2004 to 2013. The percentages of BSN RNs increased

Table 1. Hospital Characteristics and Unit Types at Baseline

	Cohort						
	2004	2005	2006	2007	2008	2009	Overall
Hospital characteristics							
Ownership							
Nonprofit	59 (88.1%)	59 (91.9%)	67 (93.1%)	47 (97.9%)	45 (86.2%)	56 (88.3%)	333 (88.3%)
Profit	3 (4.5%)	0	3 (4.2%)	0	4 (7.6%)	5 (7.7%)	15 (4.0%)
Government-owned	5 (7.5%)	13 (18.1%)	2 (2.8%)	1 (2.1%)	4 (7.6%)	4 (6.2%)	29 (7.7%)
Bed size (≥ 300 beds)	27 (40.3%)	21 (29.2%)	21 (29.2%)	8 (16.8%)	14 (26.4%)	19 (29.2%)	110 (29.2%)
Teaching hospitals	34 (50.8%)	31 (43.1%)	35 (48.6%)	17 (35.4%)	22 (41.5%)	23 (35.4%)	162 (43.0%)
Location (metro area)	61 (91.1%)	63 (87.5%)	63 (87.5%)	42 (87.5%)	46 (86.8%)	53 (81.5%)	328 (87.0%)
Magnet hospitals	13 (19.4%)	3 (4.2%)	3 (4.2%)	2 (4.2%)	3 (5.7%)	5 (7.8%)	346 (91.8%)
Unit characteristics							
Unit types							
Critical care	113 (30.6%)	93 (25.4%)	115 (27.3%)	59 (22.5%)	63 (22.4%)	104 (24.4%)	547 (25.7%)
Step-down	52 (14.1%)	48 (13.1%)	54 (12.8%)	34 (13.0%)	40 (14.2%)	71 (16.7%)	299 (14.1%)
Medical	65 (17.6%)	79 (21.6%)	89 (21.1%)	57 (21.8%)	54 (19.22%)	82 (19.3%)	426 (20.0%)
Surgical	55 (14.9%)	58 (15.9%)	62 (14.7%)	42 (16.0%)	55 (19.6%)	63 (14.8%)	335 (15.8%)
Medical-surgical combined	84 (22.8%)	88 (24.0%)	102 (24.2%)	70 (26.7%)	69 (24.6%)	106 (24.9%)	519 (24.4%)

Note. A cohort was defined based on the first year that units submitted nurse education data to the National Database of Nursing Quality Indicators (NDNQI). For example, cohort 2004 includes units that submitted nurse education data to the NDNQI since 2004.

Table 2. Unit Levels of BSN RNs (% of BSN RNs) at Baseline by Unit Types

	Cohort, mean % (*SD*)					
	2004	2005	2006	2007	2008	2009
Overall (all units)	44.2 (19.4)	36.0 (17.9)	40.4 (17.5)	40.2 (19.5)	41.6 (19.8)	42.7 (18.1)
Critical care units	49.3 (19.3)	44.4 (16.5)	46.5 (17.4)	47.0 (18.5)	50.2 (18.5)	51.8 (17.2)
Step-down units	45.9 (21.0)	37.5 (20.7)	40.2 (17.4)	41.3 (17.5)	36.5 (18.5)	40.3 (18.0)
Medical units	46.5 (18.3)	35.8 (17.4)	37.6 (16.8)	35.5 (17.0)	39.5 (20.6)	40.9 (16.1)
Surgical units	42.9 (19.2)	33.5 17.6)	41.1 (17.3)	37.9 (21.1)	37.3 (18.9)	41.2 (16.5)
Medical-surgical combined units	35.5 (16.8)	28.3 (14.3)	35.8 (17.6)	39.2 (21.0)	41.8 (19.6)	37.8 (18.8)

Note. BSN = bachelor of science in nursing; RN = registered nurse.

significantly over time in all cohorts. For example, for units in cohort 2004, the percentage of BSN RNs increased by approximately 30% from 44% in 2004 to 57% in 2013. Despite the differences in percentages of BSN RNs at the baseline years, our preliminary analyses (see **Figure 1**) indicated that there were no significant cohort differences in the trends in BSN RNs.

We also analyzed the proportion of units with ≥50% and ≥80% BSN RNs (**Table S2**). Overall, the percentage of units with ≥50% nurses with a BSN degree increased from 35% in 2009 to 52% in 2013 (a 47% increase); the percentage of units with ≥80% nurses with a BSN degree increased from 3% in 2009 to 7% in 2013 (a 73% increase). Although critical care units had the highest proportion of units with ≥50% nurses with a BSN degree in 2009, it had the lowest increase rate from 2009 to 2013. Medical-surgical combined units had the highest rate of increase (150%) in the proportion of units with ≥80%

BSN RNs, from 2% in 2009 to 5% in 2013; and surgical units had the lowest rate of increase (55%) in the proportion of units with ≥80% BSN RNs, from 3.28% in 2009 to 5% in 2013.

Table 3 shows estimates of the differences in trends in BSN RNs before and after 2010 when controlling for hospital and unit characteristics at baseline. There was a significant difference in trends in BSN RNs before and after 2010 as indicated by the interaction term (coefficient = 0.63, $p = .000$). On average, the proportion of BSN RNs increased by 1.3% annually in the years before 2010; and it increased by 1.9% each year after 2010. In other words, the average increasing rate after 2010 was 1.5 times the rate in years before 2010.

Table 4 presents the estimates of proportion of BSN RNs in the future based upon the current trends, both overall (all units) and by unit types. By 2020 there will be a projected 64% RNs that provide direct patient care
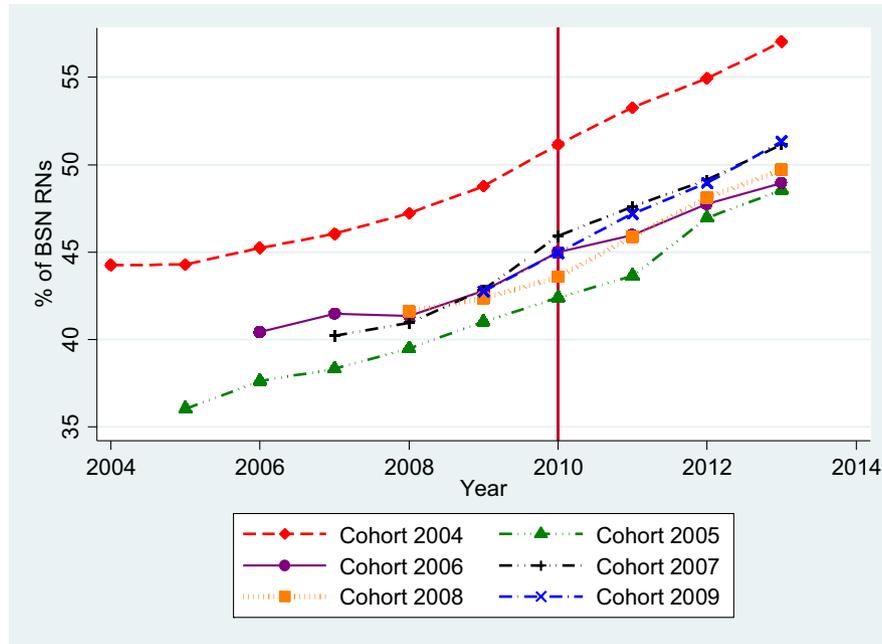
Figure 1. Unit percentage of registered nurses (RNs) holding a bachelor's degree or above. BSN = bachelor of science in nursing.

Table 3. Trends in Growth in the Number of BSN RNs Before and After 2010

	Coefficient	p	95% confidence interval
Years from baseline year (*t*)	1.27	.000	1.13 to 1.40
Years from 2010 when current year ≥2010 (interaction term)	0.63	.000	0.40 to 0.86
Cohort 2004 (reference group)			
Cohort 2005	−1.23	.334	−3.72 to 1.26
Cohort 2006	0.40	.755	−2.10 to 2.89
Cohort 2007	1.00	.472	−1.73 to 3.73
Cohort 2008	2.98	.032	0.26 to 5.69
Cohort 2009	3.69	.008	0.97 to 6.40
Critical care (reference group)			
Step-down	−7.63	.000	−8.92 to −6.34
Medical	−11.19	.000	−12.37 to −10.02
Surgical	−12.17	.000	−13.43 to −10.92
Medical-surgical combined	−10.98	.000	−12.13 to −9.82
Non-Magnet (reference group)			
Magnet	1.63	.236	−1.07 to 4.32
Nonprofit			
Profit	−3.59	.334	−10.88 to 3.70
Government-owned	−1.59	.561	−6.96 to 3.78
Small hospital (≤299 beds)			
Large hospital (>300 beds)	1.80	.227	−1.12 to 4.72
Nonteaching hospital			
Teaching hospital	7.40	.000	4.40 to 10.39
Nonmetro area			
Metro area	10.61	.000	6.06 to 15.15

Note. The interaction is between the numbers of years from baseline year (each cohort had different baseline years) and the variable indicating whether a year is before 2010 or not (variable = 0 if it is before 2010, and variable = 1 from 2010 on); therefore, the coefficient for the annual increase in the proportion of BSN RNs for years from 2010 on is 1.90 (1.27 + 0.63). BSN = bachelor of science in nursing; RN = registered nurse.

Table 4. Projections of Proportion of BSN RNs

	% of BSN RNs						
	By 2020	By 2025	By 2026	By 2027	By 2028	By 2029	By 2030
Overall	64.40	73.88	75.78	77.67	79.57	81.47	83.36
Critical care units	71.64	81.12	83.02	84.91	86.81	88.71	90.60
Step-down units	63.63	73.11	75.01	76.91	78.80	80.70	82.60
Medical units	63.78	73.26	75.16	77.05	78.95	80.85	82.74
Surgical units	61.00	70.48	72.38	74.27	76.17	78.07	79.96
Medical-surgical combined units	59.93	69.41	71.31	73.21	75.10	77.00	78.90

Note. BSN = bachelor of science in nursing; RN = registered nurse.

holding at least a BSN degree; critical care units would have the highest proportion of BSN RNs (72%), whereas medical-surgical combined would have the lowest (60%). The 80% goal will not be reached until at least 2029 (81%); critical care units will likely be the first to reach the 80% goal by 2025, and by 2031 units of all types will achieve the 80% goal. In general, 22% of the units in this study will reach the 80% goal by 2020 and 57% of the units will reach the goal by 2023 (**Table S3**). **Table S3** also displays the predicted proportion of units with ≥50% and ≥80% nurses with a BSN degree by 2020, 2025, and 2030.

Discussion

In this study, we examined the recent trends in BSN RNs in U.S. acute care hospital units between 2004 and 2013 using data from a national nursing quality database. Our findings provide empirical evidence illustrating the ongoing educational transformation of the nursing workforce, particularly in hospital care settings.

Our study shows that there is a consistent increase in the proportion of BSN RNs in acute care hospital units, and this increase appears to have begun several years before the 2010 IOM report of The Future of Nursing was released. In our study, for example, we found that in cohort 2004 approximately 44% of the nurses providing direct patient care on a unit had BSN degrees in 2004, and this number reached 57% in 2013; across cohorts, 51% of RNs held a baccalaureate degree or higher in 2013. Our finding is similar to that of the National Sample Survey of Registered Nurses (NSSRN). The NSSRN is a national survey conducted by the Health Resources and Services Administration (HRSA) between 1977 and 2008 and aimed at examining the characteristics of U.S. registered nurses. Data from the NSSRN indicated that approximately 45% and 50% of the RNs held a bachelor's degree or higher in 2004 and 2008, respectively (HRSA, n.d.). Data from the National Nursing Workforce Survey

showed that there were about 61% RNs holding a baccalaureate or higher degree (Budden, Zhong, Moulton, & Cimiotti, 2013). Using data from the Integrated Post-Secondary Education System, Buerhaus, Auerbach, and Staiger (2016) estimated that the proportion of nursing graduates with baccalaureate degrees increased from 45% in 2002 to 53% in 2012; in 2011, there were more BSN graduates than associate degree in nursing (ADN) graduates for the first time. Despite slight differences in the estimates of proportion of BSN RNs, which are mainly due to the different sampling strategies employed in each study, a common theme of a consistent and significant increase in the proportion of BSN RNs is conclusive across studies.

Our findings also suggest that the increase in the proportion of BSN RNs in acute care hospital units accelerated from 2010 on. In our sample, we found that on average the proportion of BSN RNs on a unit increased by 1.3% annually before 2010 and 1.9% annually in 2010 and after. In 2010, the IOM published the milestone report of The Future of Nursing. Although we cannot claim a causal relation between the publication of this report and the accelerated increase in the number of BSN RNs, our finding does suggest that the publication of The Future of Nursing report may have contributed to this change. This report has drawn extensive media coverage that raised national attention to improving nurse education nationwide and resulted in various initiatives nationwide for promoting nurse education. For example, shortly after the report was published, the American Association of Retired Persons and the Robert Wood Johnson Foundation jointly initiated the Future of Nursing: Campaign for Action. One of its aims is to promote more efficient articulation between associate degree and baccalaureate nursing programs and help state action coalitions develop local and regional strategies to increase the number of nurses with BSNs (Campaign for Action, n.d.). Another example is the Magnet Designation Program, which recognizes healthcare organizations for high-quality patient care,

excellent nursing practice, and innovations in professional nursing practices. It now requires hospital applicants to provide evidence documenting progress or effort toward achieving a nursing workforce of 80% BSNs. In addition, hospitals also show increasing and strong preference in hiring BSN RNs (AACN, 2016; Bates, Chu, & Spetz, 2016), and nursing schools have demonstrated their commitment by implementing new models to educate more BSN RNs (Close & Orlowski 2015; Gaines & Spencer 2013). These changes well demonstrate the influence of national initiatives on nursing workforce development.

Despite the consistent and significant increase in the proportion of BSN RNs, our findings suggest that the goal of 80% BSN RNs by 2020 is unlikely to be achieved in acute care hospitals. Based on the current trend, our estimates indicate that it will be 2029 that 80% of hospital RNs will be BSN prepared, and that nurses on critical care units will reach this 80% goal first (by 2025), compared to other unit types. There are many reasons that challenge the achievement of this 80/20 national goal. One of them is the shortage of faculty and other resource constraints of nursing schools to enroll more BSN students. According to the AACN, there was a nurse faculty vacancy rate of 8.3% nationwide in 2013; 79,659 qualified applicants were turned away from nursing baccalaureate and graduate programs in 2012; on average, doctoral-prepared and master's degree–prepared nurse faculty holding title of "professor" were 61 and 57 years old, respectively (AACN, n.d.). The small difference in wage premium of BSN RNs and ADN or Diploma RNs also discourage AND or Diploma RNs from pursuing a baccalaureate degree (Spetz & Bates, 2013). In addition, some hospital executives and administrators are reluctant to invest more money and resources to hire BSN RNs. However, researchers have estimated that, in addition to better quality of care and patient outcomes, increasing BSN RNs can be cost saving by improving patient outcomes such as reducing readmissions (Yakusheva et al., 2014).

Findings from our study have several implications for accelerating the progress of achieving the goal of 80% of RNs holding a baccalaureate degree. First, further efforts are needed to promote national recognition of the importance of advancing nursing education in health care, as well as policy and financial support from federal, state, and local government. Both findings from our study and previous research have suggested that such support can have a significant impact on the transformation of the nursing workforce (Aiken, Cheung, & Olds, 2009). Second, administrators in hospitals and other healthcare facilities should commit to more investment in hiring BSN RNs or support employed AND or Diploma RNs to

obtain a baccalaureate degree. Researchers have shown that RN-to-BSN is the fastest growth pathway for RNs to obtain a baccalaureate degree (e.g., a 10% increase from 2013 to 2014) (AACN, 2015). It was also found that in hospitals that provided tuition and other benefits (e.g., more flexibility in scheduling) or value and respect higher nursing education, RNs were more likely to enroll in RN-to-BSN programs (Spetz & Bates, 2013). Last but not least, researchers need to provide more evidence demonstrating the business case of having more BSN RNs providing care to patients.

Our study has some limitations. Although the NDNQI collects data from a large sample of hospitals nationwide, participation of hospitals in NDNQI data submission is voluntary. Therefore, hospitals with certain characteristics may be overrepresented or underrepresented. Specifically, there are a higher proportion of large (>300 beds) and not-for-profit hospitals in our sample, when compared to 2011 American Hospital Association data (Choi, Boyle, & Dunton, 2014). In addition, only data from NDNQI-affiliated hospitals were used; thus, one should be cautious when generalizing the results from this study to other hospitals or other healthcare settings (e.g., nursing homes, rehabilitation centers, and home care agencies). Our projections of the proportion of BSN RNs in acute care hospital units were based on the current trends; thus, it is conservative.

Conclusions

To our knowledge, this is the first longitudinal study using unit-level data from hospitals nationwide to examine the trends in BSN RNs over a decade (2004–2013). Our findings provide unique insights into the current ongoing educational transformation of the nursing workforce. Despite the significant increase in BSN RNs, results from our study suggest that further efforts and commitment from healthcare stakeholders (e.g., policymakers, executives and managers of healthcare facilities, nursing schools, etc.) are needed to advance nursing education and promote the use of BSN RNs, which in turn will result in superior quality of care and better patient outcomes as researchers have suggested.

Acknowledgments

analyst at the National Database of Nursing Quality Indicators.

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Clinical Resources

- American Association of Colleges of Nursing. Advancing healthcare transformation: A new era for academic nursing. http://www.aacn.nche.edu/AACN-Manatt-Report.pdf
- Campaign for Action. The future of nursing: Campaign for action. http://campaignforaction.org/
- Institute of Medicine. The future of nursing: Leading change, advancing health. http://www.nationalacademies.org/hmd/Reports/2010/The-Future-of-Nursing-Leading-Change-Advancing-Health.aspx

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Table S1. Percentage of BSN RNs (Mean/*SD*) in Acute Care Hospital Units by Unit Cohort

Table S2. Percentage of Units With 50% or 80% BSN-RNs Over Time by Unit Type

Table S3. Projections of Percentage of Units With at Least 50% or 80% BSN-RNs by Unit Type

PROFESSION AND SOCIETY

A Multicountry Perspective on Cultural Competence Among Baccalaureate Nursing Students

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Abstract

Purpose: To assess cultural competence among nursing students from nine countries to provide an international perspective on cultural competence.
Design: A descriptive, cross-sectional design.
Methods: A convenience sample of 2,163 nursing students from nine countries was surveyed using the Cultural Capacity Scale from April to November 2016.
Results: The study found a moderate range of cultural competence among the students. The ability to teach and guide other nursing colleagues to display culturally appropriate behavior received the highest competence rating, while the ability to discuss differences between the client's health beliefs or behaviors and nursing knowledge with each client received the lowest competence rating. Differences in cultural competence were observed between students from different countries. Country of residence, gender, age, year of study, attendance at cultural-related training, the experience of taking care of patients from culturally diverse backgrounds and patients belonging to special population groups, and living in a multicultural environment were identified as factors affecting cultural competence.
Conclusions: The international perspective of cultural competence among nursing students provided by this study serves as a vital preview of where nursing education currently stands in terms of providing the necessary preparatory competence in the cultural aspect of care. The variation of cultural competence among nursing students from different nations should serve as a cue for designing a focused yet multimodal nursing education program in guiding them to be culturally sensitive, culturally adaptive, and culturally motivated.

Clinical Relevance: The training of nursing students in providing competent culturally appropriate care should be ensured considering that adequate preparation of nursing students guarantees future competent nursing practice, which can positively impact the nursing profession in any part of the globe.

Currently, the world is experiencing the highest rate of human mobility ever recorded. Global migration presents new challenges to communities that receive immigrants and migrants (Oberoi et al., 2013). Each migrant and immigrant group has different norms and practices that inevitably impact the day-to-day work of health professionals (Cruz, Colet, Bashtawi, Mesde, & Cruz, 2017; Oberoi et al., 2013). Nurse professionals who are adequately trained are more likely to provide culturally competent care. This study investigated the cultural competence among nursing students in various countries to present an international perspective of cultural competence.

Background of the Study

Cultural competence is an essential component of quality nursing care. Culturally competent nursing care requires adequate knowledge, skills, and values that promote quality care for patients from diverse cultural and religious backgrounds (Seeleman, Suurmond, & Stronks, 2009). Cultural competence is defined as care that is responsive to diverse patient populations and to cultural factors that can influence health and health care, such as language, communication styles, beliefs, attitudes, and behaviors. Having competence in providing culturally sensitive and unbiased care assists in the reduction of disparities in health care (Cruz, Estacio, Bagtang, & Colet, 2016).

In previous years, lots of attention has been focused on cultural competence among nurses and nursing students (Cruz, Estacio, et al., 2016). This indicates the paramount importance given to ensuring culturally competent care in the nursing profession. The emergence of cultural competence as a significant issue in the healthcare system is attributed to the publication of the Institute of Medicine (IOM) report, "Unequal Treatment," which underscored the significance of cultural competence (Campinha-Bacote, 2011). In this report, the importance of cultural competence development among healthcare workers was highlighted to eliminate racial or ethnic disparities in healthcare settings (Campinha-Bacote, 2011). In nursing, working across various cultures has been termed as transcultural nursing. Previous studies have proposed different models to describe this

concept, which likewise provided theory-based frameworks for exploring the cultural care needs of patients as well as guidance for practicing culturally appropriate care among nurses (Campinha-Bacote, 2007; Jirwe, Gerrish, & Emami, 2006). Despite increasing attention focused on the development of cultural care competency models in the healthcare field, there is still no consensus as to the meaning and dimensions of cultural competence among nurses (Shen, 2015).

Nurses are in a constant process of improving their cultural competence. An approach to realize this refinement is through addressing the following constructs: cultural awareness, cultural knowledge, cultural skills, cultural encounters, and cultural desires. It is posited that by working on the constructs, the nurses will have improved competence in taking care of their culturally diverse patients (Campinha-Bacote, 2007). An increase in nurses' awareness, as well as changes in their attitudes and behaviors that contribute to providing culturally appropriate nursing care, must continue as they care for clients whose languages, customs, values, lifestyles, beliefs, and behaviors are different from theirs (Wells, 2000). According to Betancourt, Green, and Carrillo (2002), cultural training facilitates the development of clinical cultural competence. With this, it was suggested that cross-cultural training must be required for the professional development of healthcare providers.

Adequate training should be provided to nursing students to promote development of their cultural competence. As the future of the nursing profession, nursing students must be adequately prepared with essential knowledge, skills, and attitudes in providing nursing care that is culturally sensitive. Nursing education institutions around the world have made substantial efforts to incorporate cultural competence development into the curricula for nursing students (Carey, 2011). Development of cultural competence is a continuing effort that progresses over time and requires a lifelong commitment (Calvillo et al., 2009). Thus, nursing students should be continuously encouraged to participate in self-awareness and self-reflection about values, prejudices, and stereotypes throughout their education and nursing careers (Mesler, 2014). Since cultural competence development is a continuous process, assessment of cultural competence should also be done continuously.

Aims

This study was conducted to (a) assess the cultural competence of nursing students from nine countries; (b) examine the association between the respondents' characteristics and cultural-related background with their cultural competence; and (c) identify the influence of the respondents' characteristics and cultural-related background on the cultural competence score.

Methods

Design, Participants, and Settings

This study employed a descriptive, cross-sectional design. The study was conducted in nine countries: Chile, India, Iraq, Oman, Philippines, Saudi Arabia, South Africa, Sudan, and Turkey. A convenience sample of 2,163 bachelors of science in nursing (BSN) students (response rate = 87.3%) from all of the participating countries was included in this study. The participants were recruited from the nursing schools in each country with which the authors are affiliated. Only those participants who fulfilled the following criteria were invited to participate: (a) full-time BSN student, (b) registered in second- to fourth-year level, (c) with previous or current clinical exposures, and (d) voluntarily indicated his or her intention to participate. Students of any of the researchers were excluded to prevent possible coercion.

Instrument

A two-part self-administered questionnaire survey was used to collect data from the participants. Part 1 was designed by the researchers to gather data on the respondents' characteristics and cultural-related experiences. The respondents' characteristics included country of residence, gender, age, and academic level. Cultural-related experiences included attendance at cultural diversity training in the past 12 months, an experience of taking care of patients from diverse cultural backgrounds and patients belonging to special population groups in the previous 12 months, and whether they are living in a multicultural environment. Patients belonging to special population groups included patients who have special healthcare needs, such as children, pregnant women, elders, and members of the lesbian, gay, bisexual, and transgender community. A multicultural environment is a community where people with diverse cultural and racial backgrounds live together.

Part 2 was the 20-item Cultural Capacity Scale (CCS; Perng & Watson, 2012). The scale consists of items that reflect the cultural knowledge, sensitivity, and skills of the respondents. A 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*) is used to rate the responses, with possible scores from 20 to 100. A high score implies high cultural competence. The English version was used in the respondents from India, Philippines, and South Africa. The Arabic version (CCS-A) was utilized in Iraq, Oman, Saudi Arabia, and Sudan. Finally, the Turkish version and the Spanish version were used in Turkey and Chile, respectively. The English version had a computed Cronbach's alpha of 0.96, and a unidimensional and hierarchical construct established by Mokken scaling analysis (Perng & Watson, 2012). The CCS-A's computed Cronbach's alpha was 0.96 and the intraclass correlation coefficient (ICC) of the 2-week test-retest scores was 0.88. The CCS-A exhibited excellent content validity and good construct validity. Exploratory factor analysis (EFA) revealed a single factor with an explained variance of 57.4% (Cruz, Colet, et al., 2017). Similarly, the Spanish version exhibited excellent reliability (Cronbach's alpha of 0.95 and an ICC of 0.85), as well as excellent content validity (Item-Level Content Validity Index = 1, Scale-Level Content Validity Index by Averaging = 1) and construct validity (EFA revealed a single factor with a cumulative contribution rate of 52.2%; Cruz, Machuca Contreras, Ortiz López, Zapata Aqueveque, & Vitorino, 2017). Finally, the Turkish version had also manifested an excellent reliability (Cronbach's alpha = 0.96, test-retest correlation = 0.90) and acceptable content validity (Content Validity Index = 0.98) and construct validity established by EFA (a single factor explaining 59.02% of the variance; Gözüm, Tuzcu, & Kirca, 2016). For this study, the computed Cronbach's alpha of the tool was 0.94.

Data Collection and Ethical Consideration

The study protocol was approved by the Institutional Review Board of King Saud University College of Medicine in Saudi Arabia (Project No. E-16-1859). It was also reviewed by each participating university, and letters of support were received from them. Following the same protocol, data collection was performed from April to November 2016 in the classrooms. Before data collection, a full disclosure of the participants' rights, the nature and risks of the study, the benefits of the study, and voluntary participation were explained to the respondents. The researchers coordinated with the assigned lecturers in each class to provide about 20 to 25 min at the end of their classes for data collection. The lecturers were asked to leave the classroom during this time. Written informed consent was secured from the respondents before they were presented with the questionnaire. Confidentiality was upheld throughout the research process.

Statistical Analysis

The demographic characteristics of the respondents were analyzed using descriptive statistics. Means and standard deviations were reported for cultural competence. An independent-samples t test, one-way analysis of variance with Tukey honest significant difference test, and Pearson product moment correlation were employed to examine the association of the demographic characteristics and cultural competence score, accordingly. Multiple regression analysis was performed to examine the influence of the respondents' characteristics and cultural-related backgrounds on the cultural competence score. Statistical software (SPSS version 22.0, IBM Corp., Armonk, NY, USA) was used to perform all the data analyses at a .05 level of significance.

Results

The respondents were fairly evenly distributed from the nine countries, with South Africa contributing the largest sample and Sudan the smallest sample. The majority of the respondents were women, and the mean age was 22.52 years. The students were also fairly evenly distributed from second- through fourth-year levels. Regarding cultural-related experiences, more than half of the students had not attended cultural-related training and had not experienced caring for patients from culturally diverse backgrounds in the past 12 months. Conversely, the majority of the students lived in a culturally diverse environment and had taken care of patients belonging to special population groups in the past 12 months (**Table 1**).

Association of the Demographic Characteristics and Cultural Competence

As indicated in **Table 2**, the overall mean score was 69.38 (SD = 13.75, range = 20–100). Item 8, the ability of the student to "teach and guide other nursing colleagues to display culturally desirable behavior during nursing care for clients from diverse cultural groups," received the highest mean score, while item 20, the ability to "discuss the differences between the client's health beliefs or behaviors and nursing knowledge with each client" received the lowest mean score.

The cultural competence score varied significantly by country. Students from Iraq reported significantly higher cultural competence compared to students from other nations, except for Turkey (p = .230). Contrarily, Indian and Saudi nursing students had significantly lower cultural competence scores compared to the other nationalities, except for students from South Africa.

Furthermore, there was a weak positive correlation between age and cultural competence. Men had significantly higher cultural competence than women. Fourth-year students reported significantly higher cultural competence compared with second-year (p < .001) and third-year (p < .001) students.

Regarding cultural-related experiences, students who had attended cultural diversity–related training, who had experienced taking care of patients from culturally diverse backgrounds and patients belonging to special population groups, and who lived in a culturally diverse environment had significantly higher cultural competence than those without similar experiences (**Table 3**).

Influence of the Respondents' Characteristics on the Cultural Competence

The regression model was statistically significant (F [16, 2,145] = 35.66, p < .001) and accounted for 20.4% of the variance in cultural competence. As revealed in **Table 4**, all the demographics and cultural-related experiences were significant factors. Specifically, students from India, Oman, Philippines, Saudi Arabia, and South Africa had poorer cultural competence than the students from Iraq in certain respects. Furthermore, men scored higher on cultural competence compared to women. An increase in the cultural competence score was revealed for every increase in the age of the students. Moreover, students from the second- and third-year levels had significantly lower cultural competence than fourth-year students. Students who had attended cultural-related training, who had taken care of patients from culturally diverse backgrounds and patients belonging to special population groups in the past 12 months, and who were living in culturally diverse environments reported significantly higher cultural competence than students without similar experiences.

Discussion

This study was conducted to assess the cultural competence of BSN students from nine countries. Two main findings are discussed in this section: (a) the students exhibited a moderate range of cultural competence, and (b) the cultural competence of the students was associated with and influenced by their demographic profiles and cultural-related experiences.

First, this study proposes that the composite cultural competence score of the students was within the moderate range of cultural competence. This overall good score pertains to the collective view of the students and does not necessarily reflect that all students had a reasonably

Table 1. Demographic Characteristics of the Respondents ($n = 2,163$)

Demographic characteristics		n	%
Country of residence	Chile	255	11.8
	India	265	12.3
	Iraq	218	10.1
	Oman	221	10.2
	Philippines	258	11.9
	Saudi Arabia	200	9.2
	South Africa	368	17.0
	Sudan	155	7.2
	Turkey	223	10.3
Gender	Male	556	25.7
	Female	1,607	74.3
Age (mean years $\pm$ SD)		22.52 $\pm$ 4.88	
Year of study	Second year	726	33.6
	Third year	792	36.6
	Fourth year	645	29.8
Cultural-related experiences			
Attendance at cultural-related training in the past 12 months	Yes	908	42.0
	No	1,255	58.0
Taken care of culturally diverse patients in the past 12 months	Yes	983	45.4
	No	1,180	54.6
Live in a culturally diverse environment	Yes	1,194	55.2
	No	969	44.8
Taken care of patients belonging to special	Yes	1,876	86.7
population groups in the past 12 months	No	287	13.3

good score. Nursing students from each country exhibited varying levels of competence in cultural care as reported in the findings. This would denote that educational development strategies or pathway arrangement of future nurses for each nation about cultural care competency need some degree of variation and multifaceted consideration. However, such uniqueness of curriculum planning for each country might still require a multimodal approach towards enhancing learning opportunities and capacities concerning their resources. Furthermore, cultural skills, cultural desires, cultural encounters, cultural knowledge, and awareness are the tenets of overall cultural care preparation in these nations (Johnson, MacDonald, & Oliver, 2016).

Analysis of the cultural competence items revealed that the nursing students' highest competence was towards teaching and guiding nursing colleagues to display culturally appropriate and responsive behavior during nursing care. This may be explained by the contemporary curricula wherein transcultural nursing is included as one of the primary foci or complements of fundamentals in nursing care, as well as the aligning of universally appropriate standards of practice for culturally competent care that nurses around the world may apply to direct clinical practice, education, research, and administration

(Douglas et al., 2011). However, educational approaches used in teaching cultural content as well as the inclusion of cultural content in the nursing curricula may not be sufficient (Esposito, 2013). That is, nursing students could feel falsely reassured of the level of their cultural care knowledge. While cultural care knowledge sharing through education is getting attention among nursing students, their familiarity and consideration towards health belief patterns and differences of clients have been compromised (see **Table 2**). This is reflected in their low competence in collecting information on each client's health and illness beliefs or behaviors, as well as in discussing differences between the client's health beliefs or behaviors and nursing knowledge with each client (see **Table 2**). This could crucially affect their overall cultural competence because health beliefs and practices are fundamental aspects of the health-promotive and -educative aspect of caring. Moreover, culture is one of the modifying variables on the major constructs of perception as indicated in the Health Belief Model (Campinha-Bacote, 2011). The low competence of the students in assessing the clients' health and illness beliefs or behaviors and their difficulty of adequately explaining to the clients the differences between their health beliefs or behaviors and the nursing knowledge can lead to the inability of the nursing students to influence

Table 2. Cultural Competence Among the Respondents ($N = 2{,}163$)

Items	Mean $\pm$ SD
1. I can teach and guide other nursing colleagues about the differences and similarities of diverse cultures	3.59 $\pm$ 1.03
2. I can teach and guide other nursing colleagues about planning nursing interventions for clients from diverse cultural backgrounds	3.52 $\pm$ 0.98
3. I can use examples to illustrate communication skills with clients of diverse cultural backgrounds	3.61 $\pm$ 0.98
4. I can teach and guide other nursing colleagues about the communication skills for clients from diverse cultural backgrounds	3.52 $\pm$ 1.01
5. I can explain the influences of cultural factors on one's beliefs/behavior towards health/illness to clients from diverse ethnic groups	3.50 $\pm$ 1.00
6. To me collecting information on each client's beliefs/behavior about health/illness is very easy	3.28 $\pm$ 1.05
7. I can teach and guide other nursing colleagues about the cultural knowledge of health and illness	3.51 $\pm$ 0.99
8. I can teach and guide other nursing colleagues to display appropriate behavior, when they implement nursing care for clients from diverse cultural groups	3.62 $\pm$ 1.03
9. I am familiar with health- or illness-related cultural knowledge or theory	3.31 $\pm$ 0.99
10. I can explain the influence of culture on a client's beliefs/behaviors about health/illness	3.51 $\pm$ 1.02
11. I can list the methods or ways of collecting health-, illness-, and cultural-related information	3.33 $\pm$ 0.99
12. I can compare the health or illness beliefs among clients from diverse cultural backgrounds	3.37 $\pm$ 0.96
13. I can easily identify the care needs of clients from diverse cultural backgrounds	3.35 $\pm$ 1.01
14. When implementing nursing activities, I can fulfill the needs of clients from diverse cultural backgrounds	3.52 $\pm$ 1.03
15. I can explain the possible relationships between the health/illness beliefs and culture of the clients	3.41 $\pm$ 1.01
16. I can establish nursing goals according to each client's cultural background	3.47 $\pm$ 1.01
17. I usually actively strive to understand the beliefs of different cultural groups	3.60 $\pm$ 1.08
18. When caring for clients from different cultural backgrounds, my behavioral response usually will not differ much from the client's cultural norms	3.50 $\pm$ 1.08
19. I can use communication skills with clients of different cultural backgrounds	3.59 $\pm$ 1.06
20. I usually discuss differences between the client's health beliefs/behaviors and nursing knowledge with each client	3.25 $\pm$ 1.15
Overall cultural competence score	69.38 $\pm$ 13.75

Table 3. Association Between Demographics and Cultural Competence ($N = 2{,}163$)

Demographic characteristics		Mean $\pm$ SD	Statistical test	p
Country of residence	Chile	70.77 $\pm$ 10.78	$F = 17.48$	<.001*
	India	64.68 $\pm$ 17.28		
	Iraq	76.19 $\pm$ 12.26		
	Oman	69.80 $\pm$ 9.72		
	Philippines	68.63 $\pm$ 12.18		
	Saudi Arabia	64.62 $\pm$ 15.37		
	South Africa	68.01 $\pm$ 12.13		
	Sudan	70.37 $\pm$ 16.80		
	Turkey	73.00 $\pm$ 13.32		
Gender	Male	71.36 $\pm$ 13.23	$t = 3.96$	<.001*
	Female	68.69 $\pm$ 13.86		
Age (Mean years $\pm$ SD)			$r = 0.16$	<.001*
Year of study	Second year	67.28 $\pm$ 13.66	$F = 39.34$	<.001*
	Third year	68.11 $\pm$ 14.32		
	Fourth year	73.30 $\pm$ 12.27		
Cultural-related experiences				
Attendance at cultural-related training in the past 12 months	Yes	73.13 $\pm$ 14.17	$t = 11.08$	<.001*
	No	66.67 $\pm$ 12.78		
Taken care of patients from diverse cultural backgrounds in the past 12 months	Yes	72.85 $\pm$ 12.31	$t = 11.14$	<.001*
	No	66.49 $\pm$ 14.21		
Live in a culturally diverse environment	Yes	72.45 $\pm$ 12.64	$t = 11.75$	<.001*
	No	65.60 $\pm$ 14.12		
Taken care of patients belonging to special population groups in the past 12 months	Yes	70.25 $\pm$ 13.52	$t = 7.44$	<.001*
	No	63.70 $\pm$ 13.92		

*Significant at .001 level.

Table 4. Multiple Regression Analysis: Factors Influencing Cultural Competence ($N = 2,163$)

Predictor variable	ß	SE-b	t	p	95% CI
Country of residence (reference group: Iraq)					
Chile	0.17	1.20	0.14	.888	−2.18, 2.52
India	−4.78	1.21	−3.94	<.001*	−7.16, −2.40
Oman	−4.50	1.23	−3.65	<.001*	−6.92, −2.08
Philippines	−3.08	1.22	−2.53	.011***	−5.46, −0.70
Saudi Arabia	−7.88	1.36	−5.81	<.001*	−10.54, −5.22
South Africa	−10.94	1.14	−9.59	<.001*	−13.17, −8.70
Sudan	−1.12	1.34	−0.83	.405	−3.75, 1.51
Turkey	0.22	1.21	0.18	.858	−2.15, 2.58
Gender (reference group: female)					
Male	1.80	0.63	2.86	.004**	0.57, 3.04
Age	0.35	0.07	5.19	<.001*	0.22, 0.48
Year of study (reference group: fourth year)					
Second year	−4.22	0.76	−5.53	<.001*	−5.72, −2.73
Third year	−4.35	0.67	−6.49	<.001*	−5.67, −3.04
Attendance at cultural-related trainings in the past 12 months (reference: no)					
Yes	2.17	0.59	3.66	<.001*	1.01, 3.33
Taken care of patients from culturally diverse backgrounds in the past 12 months (reference: no)					
Yes	5.92	0.63	9.37	<.001*	4.68, 7.16
Live in a culturally diverse environment (reference: no)					
Yes	4.21	0.63	6.69	<.001*	2.98, 5.45
Taken care of patients belonging to special population groups in the past 12 months (reference: no)					
Yes	1.84	0.92	2.00	.046***	0.04, 3.65

Note: The cultural competence score was the dependent variable. β = unstandardized coefficients; CI = confidence interval; SE-b = standard error of unstandardized coefficient of beta. $R^2 = 0.210$; adjusted $R^2 = 0.204$.
*$p < .001$, **$p < .01$, ***$p < .05$.

the clients to change their incorrect health beliefs or behaviors.

Second, the students' cultural competence was shown to be associated with and influenced by their demographic profiles and cultural-related experiences. Differences across countries were observed in this study. Filipino students, who had multiple exposures to different cultures around the globe, including histories of being colonized by several countries, had surprisingly lower competence scores compared to nursing students from Iraq, Turkey, Sudan, and Oman. This interesting finding could be explained by how the curriculum in each country integrates and utilizes these multiple cultural exposures in strengthening the cultural competence of the students. Although such exposure is different in nations where multicultural workforces and movement of nurses from one cultural setting to another offer multicultural experiences and expectations (Gannon & Pillai, 2010), these kinds of experiences should be coupled with and guided by comprehensive cultural content and should be supervised closely by the instructors to ensure that these experiences are within the desired cultural content (Reeves & Fogg, 2006). Furthermore, although nursing curricula in the Philippines have long integrated the concepts of transcultural nursing, the

students' clinical exposure and care are often directed towards fellow Filipino clients, unlike students in the Middle Eastern countries, where clinical duties and even lectures allow the students to be exposed to various nationalities of patients, professionals, and professors. These assumptions, however, need to be validated in future studies.

Another interesting finding is that Saudi and Indian nursing students had significantly lower cultural competence than students from almost all of the remaining countries. Transcultural nursing is not extensively covered in baccalaureate nursing programs in these countries, which may explain this finding (Cruz, Alquwez, et al., 2017; Indian Nursing Council, 2015). Although the students learn to take care of patients from culturally diverse backgrounds through practice in clinical areas, they are not equipped with a strong theoretical base, which is critical in practicing culturally competent care. Besides, nursing education in Saudi Arabia is still influenced by cultural and societal stigmas despite significant developments (Mebrouk, 2008).

Other variables, such as age, gender, and years of study, also played important roles in the determination of cultural proficiency. These findings are congruent with the

findings of earlier studies (Cruz, Alquwez, et al., 2017; Reyes, Hadley, & Davenport, 2013). However, such variables should not form a reference or an excuse for lack of cultural competence. Cultural competence is needed to understand diverse beliefs and practices and to guide health practitioners such as nurses in enhancing patient adherence to the treatment regimen (Barksdale, 2009).

Cultural care competency is indeed affected by cultural understanding that is honed through culture-related experiences, as the study suggests. This would indicate that certain life events that are substantially evocative of cultural awareness and significance of cultural diversity would further supplement the cultural care knowledge that the nursing students acquire throughout their journey up the academic ladder. This finding is supported by a previous comparative analysis wherein cultural competence among graduating nursing students was significantly better than the cultural competence among lower year nursing students (Reyes et al., 2013). Likewise, the actual care of patients belonging to special population groups and the exposure to a culturally diverse environment creates a synergistic impact on their overall foundation as culturally sensitive nurses. However, the pivotal joint in this process is still the students' desire and motivation, regardless of country of origin, to involve themselves in the overall process of cultural competence (Gibbs & Culleiton, 2016).

Limitations

The study included a large total sample size from various countries. However, recruitment of the participants was done using convenience sampling. Also, samples were taken only from institutions that were accessible by the authors. These aspects limit the generalizability of the findings. It is recommended that researchers conduct future studies with larger sample sizes that include more institutions to capture more diverse population groups from each country. The study also used self-reports, but the researchers employed measures to minimize bias brought about by self-reports, such as assuring the students of the confidentiality of the data and their identities, excluding the students of any of the researchers, providing thorough explanation of the purpose and the importance of the study, and ensuring the students that their participation in the study would not affect their grades or marks in any of their courses. Lastly, future researchers might consider conducting longitudinal studies to better understand the development of cultural competence among nursing students.

Conclusions

This study presented a multicountry perspective of cultural competence among BSN students. Varying levels of cultural competence were observed from the nine countries; however, the shared cultural competence perspective was within a moderate range. Various predictors of cultural competence were identified, including country of residence, gender, age, year of study, attendance at cultural-related training, having been able to care for patients from culturally diverse backgrounds, living in a culturally diverse environment, and having been able to care for patients belonging to special population groups. The international perspective of cultural competence among nursing students provided by this study serves as a vital preview of where the world of nursing education currently stands in terms of providing the necessary preparatory competence in the cultural aspect of care. In light of this, more efforts and strategies should be implemented by nursing education around the world to ensure the development of nursing students' cultural competence. Nursing education programs must be adaptive to the distinct sets of cultures thriving within a given country. This will enable students to capture appropriate cultural context, which can guide them to be culturally sensitive, culturally adaptive, and culturally motivated.

Relevance to Clinical Practice

The study underscores the importance of the development of cultural competence among nursing students while they are still under training for their future roles as nurses. The training of nursing students in providing competent culturally appropriate care should be ensured, considering that adequate preparation of nursing students guarantees future competent nursing practice, which can positively impact the nursing profession in any part of the globe. Therefore, meticulous preparation and planning are necessary when including cultural competence in nursing curricula. Higher education institutions offering nursing programs may benefit the most by including a cultural competence course that best adapts to the diversity of culture in their respective countries. Moreover, the variation of cultural competence among nursing students from different nations should serve as a cue for designing a focused yet multimodal nursing education program in guiding them to be culturally sensitive, culturally adaptive, and culturally motivated. While it is important to have international standards of providing culturally appropriate care, modifications regarding content and methods may be necessary for developing national nursing curricula to include the socially and culturally relevant contexts of the country.

Clinical Resources

- National Institutes of Health. Cultural respect. https://www.nih.gov/institutes-nih/nih-office-dire ctor/office-communications-public-liaison/clear-communication/cultural-respect
- NursingTimes. https://www.nursingtimes.net/roles/ nurse-educators/ensuring-cultural-safety-in-nurse-education/5090500.article
- Transcultural Nursing Society. Transcultural nursing standards of practice. http://www.tcns.org/TCN StandardsofPractice.html

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PROFESSION AND SOCIETY

Nursing Gender Pay Differentials in the New Millennium

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Abstract

Background: The gender pay gap in the United States is an ongoing issue, affecting women in nearly all occupations. Jobs traditionally associated with men tend to pay better than traditionally female-dominated jobs, and there is evidence to suggest within-occupation gender pay differences as well.
Purpose: We compared and contrasted gender wage disparities for registered nurses (RNs), relative to gender wage disparities for another female-dominated occupation, teachers, while controlling for sociodemographic factors.
Methods: Using data in the American Community Survey, we analyzed the largest U.S. random representative sample of self-identified RNs and primary or secondary school teachers from 2000 to 2013 using fixed-effects regression analysis.
Results: There is greater disparity between nurse pay by gender than in teacher pay by gender. In addition, the net return in wages for additional education is higher for school teachers (21.7%) than for RNs (4.7%).
Conclusions: Findings support preferential wages for men in nursing, more so than for men in teaching.
Clinical Relevance: The substantial gender disparities are an indirect measure of the misallocation of resources in effective patient care.

The gender pay gap in the United States varies by geography, educational attainment, and occupation, but continues to be substantial across all three dimensions. Proctor, Semega, and Kollar (2016) reported that in 2015, women working full time in the United States were paid 80% of what men were paid. Although the rate of change towards pay equity has narrowed since 1960, the overall gender gap, given current trends, is not expected to disappear until 2152 (American Association of University Women [AAUW], 2016). Not only is the trend towards convergence slow, but the variation across different sectors in the U.S. economy remains substantial. ln 2015, the pay gap was smallest in the US state of New York (women were paid 89% of what men were paid) and largest in Wyoming (women were paid 64% of what men were paid).

While the pay gap partly reflects women's and men's choices of occupation, women experience pay gaps at every education level and in nearly every line of work. Jobs traditionally associated with men tend to pay better than traditionally female-dominated jobs that require the same level of skill (Hegewisch & Hartman, 2014). Indeed, a study of 50 years of U.S. workforce data concluded that an influx of women into a previously male-dominated profession results in the average wages for the occupation as a whole actually decreasing (Levanon, England, & Allison, 2009).

This lowered wage due to an influx of females is the basis for the most prominent explanation of the gender wage disparity, known as occupational segregation. Women are concentrated in certain types of occupations such as education and social services (including nursing),

while men are typically concentrated in the fields of science, technology, engineering, math, and finance. Occupations with especially large female concentrations have lower wages: an excess supply of women in careers such as nursing and teaching, due to occupational segregation, forces down wages for everyone in that occupation. However, this clearly does not explain within-occupation gender differences in pay. For within-occupation pay differences, an additional explanation is access to workplace authority (Bishu & Alkadry, 2017; McGuire & Reskin, 1993), which remains an understudied topic in nursing. Disparities exist in workplace authority when persons equally qualified are denied access to positions of authority based on attributes such as race and gender, or other non-work-related traits (Huffman & Cohen, 2004).

Methods

In this article, we compared and contrasted gender wage disparities for nurses, relative to gender wage disparities for school teachers. Our data did not permit us to test the importance of workplace authority on gender pay differentials, an important topic for future research. Though ethnicity pay differentials have been found to be important in other research, particularly Black–White pay differences (Cohen, 2001; Elliott & Smith, 2004; Oritz & Roscigno, 2009), we did not explicitly model ethnicity pay differentials in this article; however, we did control for ethnicity and other sociodemographic factors in our analysis. Rather, our focus was on estimating recent trends in male–female pay differences for registered nurses (RNs). We found substantial pay disparities that seemed not to have decreased in recent years (when controlling for hours of work). Moreover, consistent with the research cited above, we found substantial variation in gender pay differences by region, with those in the northeastern and western regions experiencing the least discrimination.

The American Community Survey (ACS, 2015) is an ongoing, extensive governmental survey of the population that includes basic demographic information, wages, hours of work, and employment status, with consistently defined variables key to our analysis. A representative sample of about 30,000 RNs, and twice as many teachers, is contained in each year's sample of the ACS. All the data are available online without charge through the DataFerrett website or Integrated Public Use Microdata Series (IPUMS) website. Our sample, from 2000 to 2013, was limited to those who self-identified as RNs (or primary or secondary school teachers) in their current or most recent job, without any wage restriction.

Table 1. Descriptive Statistics: Data for the Natural Logarithm (Log) of Real Wage Regressions (American Community Survey 2000–2013)

	RN sample	Teacher sample
Educational attainment	15.188 (1.558)	16.263 (1.849)
Age	44.807 (11.617)	43.222 (12.823)
Male	0.081 (0.272)	0.233 (0.423)
Male × (time trend)	0.586 (2.363)	1.607 (3.666)
White	0.800 (0.399)	0.815 (0.388)
Hispanic	0.024 (0.156)	0.042 (0.200)
Black	0.077 (0.267)	0.080 (0.271)
Married	0.681 (0.465)	0.680 (0.466)
Number of children	0.989 (1.139)	0.898 (1.111)
Log (weekly hours worked)	3.555 (0.377)	3.553 (0.508)
Log (real annual wage)	10.736 (0.789)	10.259 (1.137)
Sample size (n)	427,080	965,878

Note. Values are sample means (SD). The American Community Survey is a stratified random sample of approximately 295,000 addresses monthly (or 3.5 million per year). It is the largest household survey that the U.S. Census Bureau administers on an ongoing basis. The survey results are available online without charge. The means for the binary variables are given as fractions (i.e., 0.800 = 80%). RN = registered nurse.

All wages were in real 2013 dollars (nominal trends over the business cycle did not follow real trends: real wages rose somewhat during the beginning of the recession, and then fell a little in the most recent data).

Results

Pay Differentials Between Males and Females

The sample characteristics were as expected (**Table 1**): the sample was mostly White, female, and middle aged. Only 8% of nurses were male, but 23% of teachers were male. About 80% of nurses and teachers in the United States are White; the RN sample was slightly older (44.8 years) than the teacher sample (43.2 years), but slightly less educated on average (15.2 years vs. 16.3 years of schooling), undoubtedly due to the better-established tradition of obtaining master's degrees for teachers and the presence of associate degree– or diploma-prepared nurses currently in the workforce. Weekly hours of work were about the same, though nurses had higher wages (due to working more weeks per year than teachers).

As can be seen in **Figure 1**, real wages for nurses rose over the sample period on average, more so for female RNs than for male RNs, though the wage differential remained otherwise constant for the 2000 to 2009 period, then again for the 2011 through 2013 period. Real wages for teachers actually declined slightly over our sample period, slightly more for male teachers than for female teachers.
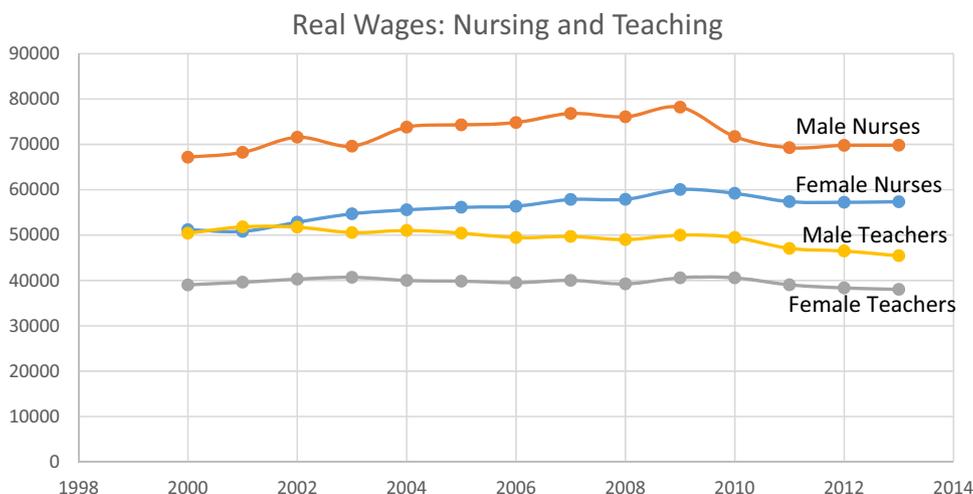
Figure 1. Female and male annual wages for registered nurses and teachers, 2000–2013.

As is typical in the literature, we estimated separate log-linear multiple regressions for each of our four groups (female nurses, male nurses, female teachers, male teachers), comparing not only their individual regression coefficients one to another, but also forming overall regression indices (Regression Gini Index [RGI]) that summarize the difference between the female–male regression planes for each of our occupation gender pairs.

Tables 2 and **3** summarize our basic findings. **Table 2** shows a basic demand characteristics model with education, age (as a proxy for on-the-job investments), male, and hours of work. **Table 3** supplements this basic model with sociodemographic variables. We controlled for general business cycle fluctuations, and individual state market condition differentials, by including dummy variables for each year and for each state.

It is interesting to note that the returns to education were higher for school teachers than for RNs, in part because the variation in education was greater (*SD* of 1.56 for RNs, *SD* of 1.85 for teachers [see **Table 1**]), and partly because teachers' pay was more tightly tied to education as an institutional pricing feature. For each year of educational attainment, nursing wages increased by 4.8% (teaching wages increased by 21.8%). Age was included as a control for on-the-job learning, and it was relatively low for RNs and teachers compared to other professions—indicating far less than a 1% increase in real wages for each additional year of age.

As shown in **Table 2**, without controls for usual hours of work per week, male RNs and male teachers were paid higher than females (precisely 27.9% more for male RNs, and precisely 19.6% more for male teachers). When controlling for hours of work per week, the gender pay differential dropped to 10% for nurses and about 15% for

Table 2. Nursing and Teacher Pay Differentials Without Full Demographic Controls: Dependent Variable Is the Natural Logarithm of Real (Inflation-Adjusted) Wages

	Registered nurses		Primary/secondary teachers	
	No hours adjusted	Hours adjusted	No hours adjusted	Hours adjusted
Intercept	9.808	5.561	6.424	2.429
Educational attainment	0.048	0.043	0.218	0.132
Age	0.001	0.003	0.002	0.007
Male	0.279	0.098	0.296	0.146
Male × (time trend)	−0.005	−0.001[a]	−0.006	−0.002
Log(weekly hours worked)		1.178		1.446
R^2	.0410	.3500	.1511	.5444
Sample size (*n*)	427,325	427,080	966,494	965,878
F-test: year effects	<.0001	<.0001	<.0001	<.0001
F-test: state effects	<.0001	<.0001	<.0001	<.0001

Note. All specifications included separate dummy variables for each year (whose joint *F*-test is given in the "year effects" row as the probability significance) and separate dummy variables for each state (whose joint *F*-test is given in the "state effects" row as the probability significance). Attempts to include a "number of weeks worked" per year available were highly collinear with the year dummy variables and other variables, and so had to be dropped from the analysis.
[a] All coefficients were significant at better than the 1% level, except for this one.

teachers. The interaction of a time trend with the male dummy indicates the direction of change in the pay differential over time. Though the negative coefficient indicates that over time the male premium is falling, it is practically and often statistically insignificant in its magnitude. That is, the gender wage premium is robust over this sample.

Table 3. Nursing and Teacher Pay Differentials With Some Demographic Controls: Dependent Variable Is the Natural Logarithm (Log) of Real (Inflation-Adjusted) Wages

	Registered nurses		Primary/secondary teachers	
	No hours adjusted	Hours adjusted	No hours adjusted	Hours adjusted
Intercept	9.963	5.480	6.301	2.365
Educational attainment	0.047	0.043	0.217	0.131
Age	0.001	0.004	0.002	0.007
Male	0.275	0.102	0.297	0.148
Male × (time trend)	−0.005	−0.001[a]	−0.006	−0.002
White	−0.135	−0.049	0.107	0.027
Hispanic	−0.145	−0.094	0.162	0.075
Black	−0.086	−0.081	0.216	0.094
Married	−0.039	0.035	0.081	0.055
Number of children	0.001[a]	0.031	0.003	0.015
Log (weekly hours worked)		1.190		1.445
R^2	.0439	.3534	.1534	.5456
Sample size (n)	427,325	427,080	966,494	965,878
F-test: year effects	<.0001	<.0001	<.0001	<.0001
F-test: state effects	<.0001	<.0001	<.0001	<.0001

Note. All specifications included separate dummy variables for each year (whose joint F-test is given in the "year effects" row as the probability significance) and separate dummy variables for each state (whose joint F-test is given in the "state effects" row as the probability significance). Attempts to include a "number of weeks worked" per year available were highly collinear with the year dummy variables (due to availability), and so had to be dropped from the analysis.

[a]All coefficients were significant at better than the 1% level, except for these.

While in **Table 3** the overall demand determinants of wages (age as a training proxy, education for general human capital, and a male dummy variable for unexplained [disparate] differential pay) are the same, there were surprising reversals between nurses and teachers when additional demographic variables were added to the model. These additional demographic controls came be viewed as more supply-side determinants: race, marital status, and number of children in the household. Again, the returns to education were higher for school teachers than for RNs (4.7% for RNs, 21.7% for teachers), virtually unchanged from the prior specification. Likewise, the returns to age were virtually unchanged in the presence of additional sociodemographic control variables.

Without controls for usual hours of work per week, male RNs and male teachers make about 30% more than females, as indicated in **Table 2**. But this was cut by about two thirds for nurses in the **Table 3** results, where the gender pay differential dropped to 10% for nurses and to about half for teachers (a 15% higher salary for male teachers than for female teachers), given the same age,

the same education, and working in the same market. Again, there was no significant trend in improvement for the gender disadvantages experienced by women.

Table 3 also suggests rather profound differences in the sociodemographic premiums between the nursing and teaching samples. For school teachers, unmarried Asians earn less than other groups; in nursing, they earn considerably more. As an explanation, recent literature suggests that some gender-segregated markets operate differently than all other labor markets (McGregory, 2013). Historically, queuing theory in employment studies has demonstrated that employers prefer to hire White men, followed by non-White men, White women, and non-White women (Toney, 2005). Interestingly, this queuing theory does not hold in nursing. While White men retained their position of preference, they were followed by minority RNs, internationally educated nurses (IENs), and, lastly, White female nurses educated in the United States (Hayden, 2013; Jones & Gates, 2004; Toney, 2005). Even among IENs, non-White IENs earn a greater wage than White IENs (Hayden, 2013).

Significance of the Male–Female Pay Differentials: Regression Gini Index for Disparities

Unexplained gender differentials in pay relative to productivity characteristics provide an index of the misallocation of patient care resources. Hence, the RGI developed in this section provides a macro-indicator of the clinical misallocation of resources regarding nursing-centered patient care. To develop this index, and to employ it for comparison with the teaching sector, we juxtaposed the experience of nurses, by gender, to gender pay differentials among teachers using regression analysis. This was an "as if," or counterfactual, experiment: if female nurses were rewarded at the same rate as male nurses with respect to their productivity characteristics (i.e., paid as males with the same productivity characteristics), how much would the nursing gender pay differential shift? The oldest continually employed counterfactual experiment in all of social science, which still retains its usefulness today, is the Gini index (Gini, 1955). It was initially created more than a century ago to study income inequality. We briefly discuss the original Gini index, and then suggest a generalized, regression-based extension of it that we employed as a very convenient way to summarize the difference between male and female regressions. We call this generalized Gini index the RGI.

Gini's counterfactual experiment is easy to describe and implement, though it may be unfamiliar to many. First, the population is ordered by individual income, from poorest to richest. Then a Lorenz curve is grafted
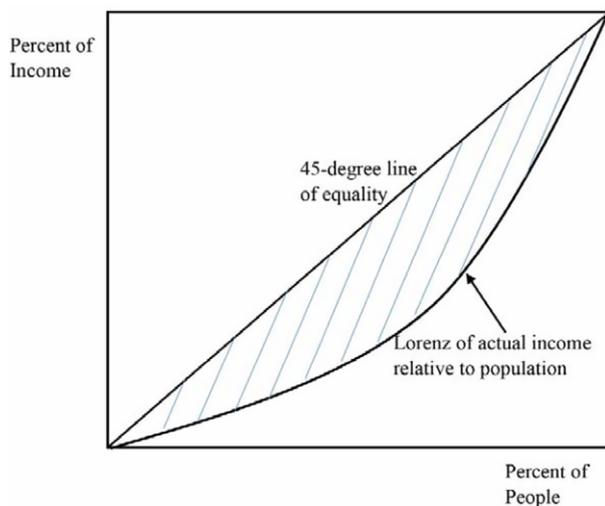
Figure 2. The Gini index (lower left-hand poorest corner, to upper right-hand richest corner).

that plots individuals with their percentile place in the numbered population on the horizontal axis against their percentile place in the income distribution along the vertical axis (the Lorenz curve is the curved line in **Figure 2**, for a population with some income inequality). If everyone had the same income, and there was perfect equality, then this graft would lie along the 45-degree line in a Lorenz graph as the 45th percentile of the person so numbered, and would account for the 45th percentile of the income distribution. When income is unequal, this graph is curved inward towards the southeast corner of the graph.

The regular Gini index is based on the difference between people's position in the income distribution (the Lorenz curve based on an income-ordered population, from poorest to richest) and people's position in the income distribution if everyone had the same income. The Gini index is the average difference between the 45-degree line (if there were complete equality) and the Lorenz curve, of actual inequality (the shaded area in **Figure 2**), multiplied by 2. That is, the Gini index is the average percentile shift between one's actual income position and equal income position.

The RGI simply replaces the 45-degree line with the male wage regression, and replaces the Lorenz curve with the female regression, and does the same comparison: what is the percentile shift in women's wages, on average, if each woman was treated like a man with the same age, educational attainment, in the same labor market, at the same time, etc.?

We applied the Gini counterfactual logic by estimating separate regressions for males and females, and then examining how much percentile wage increase there

Table 4. Regression Gini Index: Gini Measures Based on Female/Male Nonparametric Regressions

	Registered nurses	Teachers
Overall	.20	.14
Northeast	.16	.13
South	.23	.18
Midwest	.23	.14
West	.14	.13

would be if female nurses were paid on the same basis as male nurses. (Again, this corresponds to the Gini counterfactual experiment: what is the average percentile shift in incomes that would occur when going from the Lorenz curve of actual incomes to the 45-degree lines of perfect equality?) Our comparison regressions are considerably more complex that those in **Tables 2** and **3**, as we included dummy variables for each age in our sample, and for each level of education attainment, so that these variables were no longer restricted to linear effects. Indeed, we used dummy variables for every value of the right-hand side independent variables, except for usual hours of work per work, which we left as the only continuous variable. This allowed for complete matching of a female nurse (or teacher) to the corresponding male nurse (or teacher) in our Gini comparisons. It was, therefore, a largely nonparametric comparison: each age-education-ethnicity-family size cell was compared for males and females. Otherwise, in addition to the added complexity allowed in returns to characteristics, the only basic change in the model was the removal of the male × trend interaction because it was so small in magnitude and generally statistically insignificant, despite the enormous sample size.

An RGI value of 0 indicates no difference between males and females on average. A positive value indicates disparate treatment of females, relative to males, based on differences in their market wage functions. This percentile shift model for comparison aggregates to Gini coefficients, bounded between −1 (males receive the maximum disparate treatment with no wage overlap) and 1 (females receive the maximum disparate treatment with no wage overlap to the males—the lowest wage male makes more than the highest wage female), and was previously employed by Butler, Johnson, and Wilson (2012) and Wilson, Butler, and Butler (2016) and conceptually developed by Butler and McDonald (1987).

Table 4 presents the RGIs for nurses and compares then with the same RGIs for teachers. Overall, there was more gender inequality in nurses' pay than there was in teachers' pay (.2 signifies considerably more inequality than .14). Because of regional disparities in pay cited in other studies, we also calculated the Gini indices by

region. For our sample, the northeastern and western regions were the least disparate in their wage payments for both nurses and teachers.

Discussion

While the large random sample of nurses we employed ensures that the sample estimates generalized to the population, there are more variables that we wish we could have included in the analysis. In particular, it may have been useful to have data on the complete employment history of males and females in order to examine whether interruptions in the employment of women relative to men played any role in the measured disparities. In addition, more detail in the type of work (e.g., for nurses who worked in the emergency department, the operating room, or on medical/surgical units) would have been interesting to include in the estimation, had that historical data been available.

In general, there was greater disparity between nurse pay by gender than in teacher pay by gender. This seems to be reflected in **Figure 1**, but is not so apparent in the regressions in **Tables 2** and **3**. One of the reasons for this difference in findings is that our RGI was based on nonparametric, more or less exhaustive (in the main effects) specification of the models, and **Tables 2** and **3** are more traditional aggregate specifications that impose linear effects of age and educational attainment on the model structure.

While more education is one way to increase individual earnings, it is not effective against the gender pay gap: at every level of academic achievement, women earn less than men (AAUW, 2016). Although pay gaps reflect in part women's and men's choices of occupation, it is disheartening that even within female-dominated professions such as nursing and teaching, women earn less than men. As noted in the present study, the gap in nurse pay by gender is greater than the gap in teacher pay by gender.

The well-known glass ceiling experienced by many women is one of the ways discrimination is manifested in the workforce by denying women equal access to promotions. In a systematic review of the gender pay gap, a common theme noted by Bishu and Alkadry (2017) was that subjective appraisals in the workplace continue to deny women and minorities career opportunities that could likely result in better economic outcomes with lifelong implications.

Even more noteworthy is that men experience significant advantages in female-dominated occupations, hence confirming the presence of the glass escalator (Wingfield, 2009) that facilitates the advancement and upward mobility phenomenon for men as opposed to the obstructive glass ceiling that women often encounter. Indeed, it has been noted that "while women climb the ladder in female-dominated professions, their male peers glide past them on an invisible escalator, shooting straight to the top" (Goudreau, 2012, para 3).

Implications

Women continue to face wage discrimination in nearly all occupations, particularly those dominated by males. Attitudinal or organizational biases that prevent equally qualified persons from advancing in their organizations intensify over time, potentially leading to inequalities in income and status.

Workplace discrimination, particularly race- and gender-based discrimination, has been studied widely and is prevalent across the globe. However, further analysis on factors such as disparity to access in workplace authority by gender and other variables known to influence wages must be completed to fully understand the basis behind male–female wage discrimination in nursing. While some disparity in earnings may be partially explained by racial and ethnic bias, many differences cannot be explained and are likely due to gender discrimination, even in the female-dominated profession of nursing.

Clinical Resources

- Equal Pay Act of 1963. https://www.eeoc.gov/laws/statutes/epa.cfm
- U.S. Equal Employment Opportunity Commission. Sex-based discrimination. www.eeoc.gov

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