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ORIGINAL RESEARCH

Facilitating faculty competency to integrate genomics into nursing curriculum within a private US University

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Background: This quasi-experimental study explored full-time nurse faculty competency in genomics and genetics using a validated measure prior to and following educational sessions during one academic semester. The findings represent the researchers' efforts to educate nurse faculty and to support their competency in genomics and genetics as information shared with students is only as robust as faculty knowledge.

Methods: Faculty who consented to participate completed the Genomic Nurse Concept Inventory (GNCI©) to measure their knowledge of the concepts surrounding genomics and genetics prior to the education intervention and then following all three education sessions. The education sessions were carried out over a semester using a lunch and learn forum.

Results: Our first assumption was that 50% of faculty would score below 70% on the pretest. Eligible nurse faculty 29/48 (60%) completed the GNCI© and scores show they had limited knowledge in three areas: nomenclature of genes and gene function, inheritance patterns, and the clinical application of genomics to human disease. Over half of nurse faculty 17/29 (59%) scored less than 70% on the GNCI© supporting our first assumption. The second assumption that over 85% of faculty would score at least 70% on the GNCI© after the education was not supported. The education sessions improved scores on the GNCI© in the 12/29 (41%) faculty who completed the measures prior to and after the intervention.

Conclusion: Despite the growing knowledge about genomics/genetics and the application to clinical practice, health professionals like nurses are not competent in these concepts. Nursing faculty require competency in genomics and genetics in order to integrate these concepts in nursing curricula. Outcomes of this project show the need to provide education and support for nurse faculty in genomics and genetics.

Keywords: education, genetics, genomics, incorporation, knowledge, undergraduate bachelors program

Introduction

Since the sequencing of the human genome,[1] health care professionals are using this information to identify health problems in patients despite the lack of presenting symptoms. Since 1998, the American Association of Colleges of Nursing (AACN), in the *Essentials of Baccalaureate Education for Nursing Professional Practice,* requires minimum standards of nursing professionals to include the ability to conduct risk assessments and health histories.[2] Many advanced practice programs have already integrated genomics into the curriculum with the expectation that graduates are able to identify the indicators of inherited diseases.[3] Health care practitioners have integrated

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genomics into the prevention, screening, treatment, prognostic determination, and management of treatment effectiveness in many specialties.[4] Regardless of the program, nursing faculty must be knowledgeable of the trends in genomic testing and the concepts associated with genomics.

Nursing is the largest of all health care disciplines, and competency in genomics is critical.[4] Genetics is the study of heredity, whereas genomics is defined as the study of genes and their functions.[5] Jenkins and Calzone[6] provided an outline of a strategic plan to establish what the minimum nursing competencies in genomics should be for both practicing nurses and faculty teaching in nursing school. Education and competencies in genomics for nurses who provide genomic information to patients and nurse faculty who are educating nursing students are imperative.[4,7] Nurse faculty knowledge and confidence in teaching these concepts were evaluated using a descriptive design study using the Genetic/Genomic Nursing Practice Survey. This measure has been used to assess practitioner factors influencing their competency.[8] The sample consisted of 20 fulltime faculty with 15% being teaching instructors, 50% assistant professors, 20% associate professors, and 15% full professors. In total, 85%–100% had a working knowledge of genomics/genetics and knew how to take a family pedigree looking at genetic risks as they were related to cancer, the nursing role in genetic counseling, role of family history in medication management, and the link between some diseases and genetic variants. However, there were gaps in knowledge on inheritance patterns, and only 55% were aware of the Essential Competencies and Curricular Guidelines in Genetics and Genomics. Eighty percent of faculty did not have any genetic content in their own curriculums, and 70% had not attended courses that had significant genetic materials. Advanced nursing practice program faculty also have limited competency on how to integrate these concepts into the advanced nursing curriculums.[9]

Investigators surveyed over 830 nursing professionals on the construct of genomics.[4] Many respondents felt they had limited knowledge of genomics and felt their senior leadership placed little value on genomics in practice. Unfortunately, the nursing profession has yet to incorporate the core genomics competencies into nursing assessment in a comprehensive manner.[10–12] It is important to consider what nursing students know about genomics and genetics when they enter nursing school. Many students may have had exposure to genomics and genetics courses in high school. Therefore, nurse faculty should have at least a similar exposure to these concepts as their students.

Despite the lack of genomics experts, the integration of genomics into undergraduate nursing programs can be done by faculty who are passionate about genomics.[13] Nurse faculty champions are ideal to facilitate nurse faculty education about genomics and genetics and to support the successful integration of these concepts into nursing curriculum.[11] Limited faculty knowledge and competency in genomics and genetics erodes confidence in the integration of accurate and up-to-date information into the nursing program curriculum.[14] A plethora of genomic and genetics resources exists,[15] but faculty and students are unclear about reputable resources, their accessibility, and organizing and integrating the information into either curriculum or nursing practice. A study conducted in 2013 examined the knowledge of 117/650 (18%) nurse faculty on genomics and genetics across baccalaureate nursing programs in the United States;[16] the study revealed they had limited knowledge in all aspects of genomics/genetics. The investigators in the current study recognized the lack of comfort with genomics and genetics information among faculty colleagues, and sought to examine the faculty's knowledge of these concepts through this study.

The specific aims of this study included the assessment of genomics competency in our nurse faculty using a standardized measure, creation and implementation of 30-minute education sessions addressing faculty regarding limited knowledge on genomics and genetics, and conducting a follow-up assessment to evaluate the impact of the education sessions on faculty member's genomic competence. The hypotheses were as follows: 1) at least 70% of nurse faculty will score less than 50% on the Genomic Nurse Concept Inventory (GNCI©)[17] prior to completing or reviewing the educational topics and 2) at least 85% of nurse faculty will score greater than 70% on the GNCI© after completing or reviewing the educational topics.

Materials and methods

Design

This was a quasi-experimental study that used a pre-test/post-test design.

Participants

Only full-time faculty, either professional practice or tenured/tenure track faculty, who attended the spring 2016 back-to-school workshop were eligible to participate in this study.

Data collection

Faculty competence in genomics was measured using the GNCI©,[17] a 31-item tool designed to measure genomic

competency in nurses. Permission to use this tool was obtained from the investigator who developed the GNCI©. The original testing of the GNCI© was found to have adequate discriminatory power with a Cronbach's alpha of 0.84. Researchers established early psychometrics for the GNCI© in a group of 705 nursing students of whom 8.4% had taken a previous genetics course and reported a Cronbach's alpha of 0.77.[18] More recently, Ward et al[19] applied factor analysis to further validate the GNCI© in 758 nursing students and reported an internal consistency of inventory of 0.87.

Faculty who agreed to participate in the current study signed the informed consent form and completed the GNCI©[17] during the workshop. Topics for the education sessions were chosen based on the lowest scoring topics identified following analysis of the pre-test scores on the GNCI©. The topics of the education sessions included 1) general nomenclature-gene function and deoxyribonucleic acid (DNA); 2) inheritance disorders/impact on patient education and prognosis, and 3) clinical application of genomics to disease. The three education sessions were held over the course of the spring semester at least 3 weeks apart. Each topic was repeated three times over a 1.5-hour period allowing the faculty to choose among three options. Information for the education sessions was taken from an online genetics program.[20] Attendees received an information packet of all the materials covered during the educational sessions. Faculty not in attendance or who did not consent to be part of the study also received the educational materials. Following the three education sessions, a post-test using the GNCI© was given to all faculty who completed the pre-test to examine the impact of the education sessions on faculty competency in genomics. SPSS version 23.0 was used for data analysis. Descriptive analyses were done using frequencies for the demographic variables.

Ethical consideration

Ethical approval for this study was obtained from the University Institutional Review Board. Before collection of data and educational intervention, a written and signed consent form was gathered from all the participants.

Results

A total of 67 faculty attended the back-to-school workshop with 48 faculty eligible to participate in the study. Twenty-nine faculty (60%) consented to be in the study and completed the pre-test. Only 12/29 scored over 50% on the GNCI© as part of the pre-test. Only 12/29 (41%) completed both the pre-test and post-test surveys. The characteristics of the total sample are given in Table 1.

Table 1 Characteristics of participants who completed pre-test and pre-test/post-test

Characteristic	Number (%) Completing pre-test	Number (%) Completing pre-test/ post-test
Completed GNCI©	29/48 (60)	12/29 (41)
Female	28/29 (97)	11/12 (91)
Taught genetics	2/29 (7)	0/12 (0)
Ever taken genetics class	4/29 (14)	0/12 (0)
Tenure/tenure	11/29 (59)	6/12 (50)
Professional practice track	17/29 (38)	6/12 (50)
No response	1/29 (3)	
Attended all education sessions	N/A	3/12 (25)
Attended two education sessions		5/12 (42)
Attended one education session		4/12 (33)
	Mean years (range)	**Mean years (range)**
Teaching experience	11.5 (0–47)	9.5 (2–26)
Teaching at the current institution	7 (0–25)	4.4 (1.5–15)

Abbreviation: GNCI©, Genomic Nurse Concept Inventory.

The following findings are representative of the 12 nursing faculty who completed both the pre-test and post-test measures. There were no differences in the average number of years teaching or responses in the pre-test. All but one nursing faculty member were female. The average number of years that the nursing faculty had taught was 9.5 years (range, 2–26 years) (Figure 1). The group was evenly divided between faculty who were tenured/tenure track and professional practice. The educational sessions were well attended overall; but only 3/12 (25%) were able to attend all the three education sessions, 5/12 (42%) attended two of the three education sessions, and 4/12 (33%) attended only one of the education sessions.

Hypothesis 1: pre-test scores

The hypothesis that at least 70% of faculty who completed the GNCI© would score below 50% on the pre-test survey was supported. Of the total sample of 29 faculty who completed the pre-test, 17/29 (59%) scored below 50%. This hypothesis was supported; of the faculty who completed both pre-test and post-test, 7/12 (58%) scored less than 50% correctly in the GNCI© pre-test.

Hypothesis 2: post-test scores

Following the three education sessions, we hypothesized that at least 85% of faculty would score greater than 70% on the GNCI©. While all 12 faculty who completed both

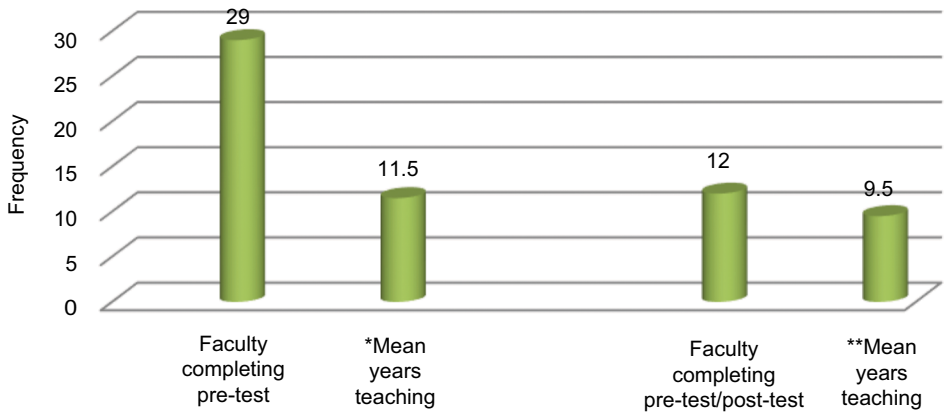

Figure 1 Representation of the faculty who completed pre-test vs pre-test/post-test and mean years of teaching experience.
Notes: Mean years of academic teaching experience for faculty completing the pre-test only* and both the pretest and post-test**.

the measures scored greater than 50% on the GNCI© after the education sessions, only 3/12 (33%) scored more than 70% following the education sessions. This hypothesis was not supported.

Discussion

While the findings of this study did not support Hypothesis 2, this study has opened further dialogue about the need for nursing faculty support as it integrates genomics and genetics into the nursing curriculum. Faculty scores on the GNCI© were similar to those in previous studies,[12,21] and reflect the continued need to support nursing faculty's need for increased knowledge and competency in genomics and genetics. Their findings suggested that only 33%–59% of faculty answered correctly to the items on the GNCI©. Nursing students have been assessed on their knowledge of genomics, and it has been found that they require knowledgeable nursing faculty to provide them with the background knowledge in genomics concepts.[21] The education sessions were offered midday on a day when the faculty indicated would be the most convenient. The current study methodology has not been used in previous studies and is the first effort to use a more personal approach to educating nurse faculty about genomics and genetics.

The GNCI© is a validated and reliable measure to assess faculty competency on genomic concepts and has been used in several studies,[17,18,22] The GNCI© measures nurse faculty's understanding of foundational concepts of genomics, where there are faculty weaknesses and misconceptions regarding genomics. In the current study, faculty had specific weaknesses in the basics of DNA, inheritance, and conditions with genetic implications. Investigators created opportunities to provide education sessions to faculty colleagues in small groups and through printed materials to address these weaknesses on three separate occasions throughout the 2016 spring semester. However, it may not have been sufficient to ensure higher levels of genomic competencies in nurse faculty. Despite faculty in the current study having a mean of 11.5 years of teaching experience, the content related to genomics/genetics has typically been taught as an individual (stand-alone) course. Faculty may be engaged in their own teaching responsibilities and only cover the necessary genomic/genetic content in their courses. However, nurse faculty may not feel knowledgeable about the genomics/genetics concepts that are not required in their courses.

The educational sessions were presented during a lunch and learn format while faculty ate, and often they had to rush to the sessions and then back to teach class immediately following the conclusions of the sessions. All faculty, however, were given written materials so they would have the same information if they were not able to attend the educational sessions. Attempting to address complex content during a busy workday may have accounted for the limited retention of this new knowledge. In addition, the educational sessions were well attended by most faculty even if they were not part of the study. The sessions were held in the only faculty lounge, and faculty may have felt that the environment was not conducive to learning. In addition, only 3/12 (25%) of faculty who completed the pre-test and post-test attended all the three educational sessions, 5/12 (42%) attended just two, and the remaining 4/12 (33%) attended just one educational session. Likely, this format and location of the sessions were not conducive to the best learning environment for faculty who are now being asked to integrate the topics of genomics/genetics into their already packed curriculums.

In the academic university where this study took place, many changes to the nursing program have occurred

including the implementation of a more compressed undergraduate curriculum. In addition, genetics content is being integrated into the Bachelors to Doctorate of Nursing Practice/Family Nurse Practitioner. Historically, genomics and genetics were taught in a stand-along course, and taught by a single faculty member.

The overall objective of this study was to measure the knowledge of nurse faculty on genomics and genetics. However, limitations included a sample size that was too small to make statistical inferences. This study was done with a convenience sample of faculty who attended the back-to-school workshop, and only 29/48 faculty who attended the workshop participated in this study. Further, the environment was not completely conducive to completing the GNCI© pre-test as faculty completed the survey during a lunch break in the midst of a chaotic environment. The findings of this single academic institution study support the need to assist faculty in their understanding of the concepts of genomics and genetics. The AACN has established competencies in genomics and genetics, curricula guidelines, and outcome indicators.[23] A component of faculty investigator support is the integration of the AACN Essentials into the nursing curriculum. Integrating the concepts of human genetics into nursing curriculums and barriers to this success were evaluated in 2000.[24] More recently, faculty in a private academic center in the East[25] evaluated the effectiveness of an online course for nurse practitioners. Their findings indicated that genomics and genetics may be effectively and feasibly taught as an independent online course in graduate program.

Conclusion

The faculty champions in this private academic center set out to determine whether faculty were prepared to integrate genomic concepts into the nursing curriculum. Jenkins and Calzone[26] reported that many faculty have limited capacity to integrate genomics into their curriculums, and while education about these concepts was useful, other methods to support faculty exist. It is critical to support the integration of these concepts into nursing curricula.[27] This support may include web-based resource, models of curricula that have integrated these concepts, faculty mentors, and didactic modules that support faculty in the incorporation of genomics into nursing curriculum.

Faculty like nurses in practice remain unprepared to integrate what can be learned from these resources into practice and into the nursing curricula.[28] Organizing the available resources for ease of access and use for nursing faculty is considered to ensure the faculty's competencies in genomics and genetics and their eventual independent integration of the concepts into the nursing curricula.

The investigators of this study and faculty champions in the integration of genomics and genetics into curricula will conduct ongoing assessment of the competency of nurse faculty and the knowledge of genomics/genetics in pre-licensure nursing students. An interprofessional team approach may be warranted to ensure that faculty teaching and students graduating from the bachelors, masters, and doctoral programs are prepared to integrate these genomic/genetic knowledge and skills into clinical practice.[25,27] The ultimate goal will be to ensure that our nursing students have at least a minimum working knowledge of the concepts of genomics and genetics as recommended by the AACN.[23]

Lastly, the use of genomics and genetics in clinical practice and nursing care (requiring literacy in these concepts is rapidly increasing). Nursing education programs and research in this area are critical.[29] In addition, the use of genomics and or genetics in clinical practice is present in many disciplines, and the education of nurses on these concepts will better prepare them to identify, assess, monitor, and support the care of patients with genetically informed diseases and common diseases with a genetic component.

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Author contributions

LMB, LB, GD, LH, and DJC made contributions to the revision of this manuscript. LMB, LH, and DJC specifically did a review of the revisions made following their completion to ensure completion. LB and GD further reviewed the responses to the reviewers to ensure all items were addressed by the first author, LMB. LMB conducted the initial responses and revisions to the manuscript with support from GD in review of the analysis findings. GD completed Figure 1 to include in the revisions of this work. LMB, LB, GD, LH, and DJC made substantial contributions to the development, data collection procedures, data interpretation, and the drafting of this manuscript. All the authors participated in the intervention and participated in the education sessions provided for participants. LMB and GD performed

the statistical analysis for the data in this study to address the specific hypotheses, while LMB, LH, and DJC completed further data analysis on the findings from the pre-test and post-test scores on the measure. All authors contributed toward data analysis, drafting and revising the paper and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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