

CLINICAL PRACTICE

Competency of nurse educators in genetics/genomics knowledge

Margot R. De Sevo, PhD, RNC

School of Nursing, Adelphi University, USA.

Correspondence: Margot R. De Sevo. Address: One South Avenue, ALH236, Garden City, NY 11530. Telephone: 516-877-4515. E-mail: desevo@adelphi.edu

Received: May 21, 2012

Accepted: July 2, 2012

Published: January 1, 2013

DOI: 10.5430/jnep.v3n1p123

URL: <http://dx.doi.org/10.5430/jnep.v3n1p123>

Abstract

Background: The Essentials of Baccalaureate Education for Professional Nursing Practice and The Essentials of Genetic and Genomic Nursing: Competencies, Curricula Guidelines, and Outcome Indicators both include competencies expected of nurses working in the 21st century. This research study investigates whether professors currently teaching in baccalaureate programs in the United States possess the knowledge needed to educate nursing students about essential genetics/genomics concepts.

Methods: A random sampling of baccalaureate schools of nursing in the United States was performed. Nurse educators teaching in those schools were asked via three email contacts to complete a 15 item multiple choice questionnaire aimed at testing their knowledge of genetics/genomics. Of the 650 potential subjects, 117 baccalaureate educators completed the questionnaires. Descriptive analyses were performed on the data.

Results: The percent of the 15 items that each of the 117 subjects correctly answered was calculated: mean – 53.3%, median – 53.3%, standard deviation – 14.4. Only 4 of 15 questions were answered correctly by more than 75% of the total subject pool. Although the sample sizes were small, the *t*-test result was significant ($p = 0.005$) between the scores of 26 faculty who responded that they had taken a course in genetics beyond general college biology and the 91 faculty who had not received additional genetics/genomics education.

Conclusion: In general, the educators exhibited a paucity of genetic information, much of which is important for nursing care and practice. This study's findings support the need for nursing faculty to improve their genetics/genomics knowledge base. It was clear from the survey results that taking an additional genetics course beyond biology positively influenced the knowledge of those who responded.

Key words

Nursing education, Baccalaureate, Genetics/Genomics

1 Introduction

Nursing practice in the 21st century is complex. Indeed, in order to prepare baccalaureate educated nurses for their profession, the American Association of Colleges of Nurses (AACN) has developed a document, The Essentials of Baccalaureate Education for Professional Nursing Practice ^[1], that includes “essential” skills that students should be

prepared to perform upon graduation and the educational experiences that they need to be exposed to in order to perform those skills. As stated in its introduction, “This document emphasizes such concepts as patient centered care, interprofessional teams, evidence based practice, quality improvement, patient safety, informatics, clinical reasoning/critical thinking, *genetics and genomics*, cultural sensitivity, professionalism, and practice across the lifespan in an everchanging and complex healthcare environment” [emphasis added]. In addition, the skills related to genetics and genomics are further explicated in the American Nurses Association (ANA) document entitled, *Essentials of Genetic and Genomic Nursing: Competencies, Curricular Guidelines, and Outcome Indicators (Essentials)* ^[2]. That document clearly establishes the “Professional Responsibilities” and “Professional Practices” expected of registered professional nurses.

For nurses to care for clients in the 21st century, they must possess an understanding of the etiology, pathology, and, if available, therapies of a multitude of diseases. Plus, as stated on the *Medicine and the New Genetics* page of the Human Genome Project ^[3] website, “All diseases have a genetic component, whether inherited or resulting from the body's response to environmental stresses like viruses or toxins.” Nurses, therefore, must have a working knowledge of genetics and genomics. Diagnostic tests are being conducted to determine whether or not patients have a genetic susceptibility to an illness and, in some situations, specific therapies are directed at the genetic origin of the disease. For example, women are undergoing genetic analyses to determine whether they carry a mutation in one of two genes (BRCA1 and BRCA2) that confer a high risk of developing breast or ovarian cancer ^[4]. Other patients are receiving chemotherapy determined by the specific genetic mutations in their cancer ^[5]. And still others, because their genetic profile regulates their ability to metabolize certain medications, are having their medication dosages individually adjusted ^[6]. In addition to understanding the basis for these tests and interventions, nurses must be able to provide knowledgeable responses when patients and their families ask questions about their disease, management decisions and treatment regimens.

A number of articles have been published regarding genetics/ genomics information in nursing education. These include articles focusing on the need to incorporate genetics/genomics information in nursing curricula ^[7, 8], reporting on surveys conducted to determine the numbers of programs that include genetics/genomics concepts in their nursing curricula ^[9, 10], describing resources that are available for nurse educators ^[11, 12] and describing the impact genetics/ genomics programs have had on the knowledge of faculty who attended the programs ^[13]. Prows, Glass, Nicol, Skirton and Williams ^[14] have even published an article describing the paucity of genetics/genomics information taught to nursing students both nationally and internationally.

Williams, Prows, Conley, Eggert, Kirk & Nichols ^[15] focus their article on the importance of faculty knowledge in relation to genetics and genomics and provide guidance in ways to access the knowledge. One critical statement within the article, underscores the importance of genetics content: “all nursing faculty share responsibility for incorporating genomic content into their courses, and the presence of a separate course should not be viewed as a substitute.” Many schools of nursing have begun requiring a basic genetics course as foundational for nursing practice, much the way a microbiology course is foundational. But, in the same way that nursing faculty must assist students to understand the relevance of the microbiology content to their patients with infectious diseases or the potential to develop infectious diseases, nursing faculty must be prepared to assist students to see how genetic/ genomic information can impact the health and well-being of their patients.

Thompson and Brooks ^[16] conducted a cross sectional survey to determine how well schools of nursing were implementing the ANA Essentials ^[2] document. Although these authors asked faculty how confident they felt in their genetics/ genomics knowledge, Thompson and Brooks' ^[16] survey did not include specific genetics/ genomics questions to assess the faculty's knowledge of the subject. Even with the broad questions asked of the respondents, 21 of the 47 stated that they were “not at all confident [in their] ability to counsel/ refer patients” and only 14 had received any genetics/ genomics education within the 2 years prior to answering the survey.

There is a lack of information on the current readiness of baccalaureate nursing faculty to incorporate genetics/ genomic information into their courses as a means of educating their students regarding the content in the ANA Essentials ^[2]

document. The purpose of this study is to answer the question: Do faculty currently teaching in baccalaureate programs in the United States possess the knowledge needed to educate nursing students about genetics/ genomics concepts?

2 Subjects and methods

2.1 Survey development

Based on the objectives listed in the ANA Essentials ^[2] and principles of item writing ^[17], a short questionnaire was developed to assess the knowledge base of baccalaureate faculty currently teaching in the United States. Fifteen, multiple choice items covering basic genetic/ genomic definitions, inheritance patterns, referral actions, pedigree development, cultural issues, insurance issues, and the like were developed. A query was sent via email to all of the professors of genetics at Adelphi University and all members of ISONG (International Society of Nurses in Genetics) to ask for their help in the development of the questionnaire. Three professors and 4 ISONG members responded that they would be willing to review the questions for accuracy, clarity and comprehensiveness. After the initial set of responses was reviewed, the questions were edited and sent back to the experts. Additional comments were again obtained and the questions were edited a second time. Demographic questions were then added to the survey, including age, geographic location of the school of nursing, decade of graduation from the baccalaureate program, and major teaching focus.

Once the edited questionnaire was complete, and IRB approval from the Institutional Review Board at a mid-size university was obtained, a pilot study was performed; twenty faculty completed the questionnaire. After completing the survey, no faculty member reported that the questions were unrelated to genetics/ genomics or that the survey was arduous or unreasonable to complete.

2.2 The sample

A list of all accredited baccalaureate nursing programs – 558 in total -- was obtained from the AACN website ^[18]. The colleges were listed in alphabetical order and numbered consecutively. Using a random numbers table, a random sample of 20% of the programs was selected. The researcher then obtained, from the respective school's' websites, the email addresses of the faculty members teaching at each of the 28 schools of nursing. A total of 715 emails requesting their participation was sent to the faculty members. A link to the anonymous questionnaire on SurveyMonkey™ (www.surveymonkey.com) was included in the email. Three separate requests were sent to the faculty members – one in December 2011, one in January 2012, and one in February 2012. During that time, 43 emails were returned as undeliverable and 22 faculty wrote stating that they did not teach on the baccalaureate level. Of the 650 potential subjects, 134 questionnaires were returned, with 120 respondents stating that they do teach baccalaureate nursing students – a return rate of 18.5%. Of the 120 baccalaureate respondents, only 117 completed the questionnaire, however. Results are based on the responses of the 117 baccalaureate faculty who submitted complete data sets.

3 Results

The random sampling resulted in the selection of schools from all geographical areas of the United States, although the list was skewed toward schools of nursing in the southeast and midwest regions. Of the 28 schools in the United States represented, 9 were located in the southeast region and 12 in the midwest region. The highest academic degrees obtained by the 117 respondents were: 1 – baccalaureate, 99 – master's, and 17 beyond the master's. When asked specifically regarding genetics/genomics education, 26 (22.2%) stated that they had received formal genetics/ genomic education after graduating with a baccalaureate degree while 91 (77.8%) faculty stated that the only genetics/ genomics education they had had was in general college biology class. Additional characteristics of the 117 baccalaureate educators is shown in Table 1.

Table 1. Characteristics of Sample Subjects (N=117)

| Characteristics of Survey Subjects | | N (% of those responding) |
|---|---|---------------------------|
| Region of the United States | Northeast | 20 (17.1%) |
| | Southeast | 33 (28.2%) |
| | West | 16 (13.7%) |
| | Midwest | 48 (41.0%) |
| Areas of Primary Instruction | Community/ Public Health | 15 (12.8%) |
| | Maternal/ Newborn | 14 (12.0%) |
| | Medical/ Surgical | 55 (47.0%) |
| | Pediatrics | 8 (6.8%) |
| | Psychiatric/ Mental Health | 6 (5.1%) |
| | Other, including non-nurses and no response | 19 (16.3%) |
| Decade Graduated with a Baccalaureate Degree in Nursing | 1951-1960 | 2 (1.7%) |
| | 1961-1970 | 4 (3.4%) |
| | 1971-1980 | 47 (40.2%) |
| | 1981-1990 | 28 (23.9%) |
| | 1991-2000 | 27 (23.1%) |
| | 2001-2010 | 4 (3.4%) |
| | Other, including non-nurses and no response | 5 (4.3%) |
| Age | 25-30 | 0 |
| | 31-40 | 9 (7.7%) |
| | 41-50 | 31 (26.5%) |
| | 51-60 | 57 (48.7%) |
| | 61-70 | 19 (16.2%) |
| | 71-75 | 1 (0.9%) |

Do faculty currently teaching in baccalaureate programs in the United States possess the knowledge needed to educate nursing students about genetics/ genomics concepts? A description of each question, with the number and percent of faculty who responded correctly to the question, appears in Table 2. The percent of the 15 items that each of the 117 subjects correctly answered was calculated. The mean, median, and standard deviation of the total sample were 53.3%, 53.3%, and 14.4, respectively.

Twenty-six of the total sample stated that they had had genetics/ genomics education after graduating from college while 91 of the educators stated that their genetics/ genomics education was solely obtained in their college-level general biology classes. The results of the 2 sub-groups were calculated: those with advanced education (N=26) —mean – 61.5%, median – 60%, standard deviation – 18.2; those who reported having no additional genetics/genomics education (N= 91) mean – 51%, median – 53.3%, standard deviation – 12.3. When a t-test was performed on the data from the 2 sub-groups, a significant difference was noted ($p = 0.005$) (see Table 3).

Table 2. Question Topics with Numbers and Percentages of Respondents Who Answered Correctly (N=117)

| Question Number | Topic of Question | Respondents Who Answered Correctly – N (%) |
|-----------------|---|--|
| 1 | Meaning of the term “allele” | 63 (53.8%) |
| 2 | Meaning of the term “polymorphism” | 69(59.0%) |
| 3 | Awareness of the fertility implications of a reciprocal translocation | 18(15.4%) |
| 4 | Physiological implications of being a parent of a child with an autosomal recessive illness | 49(41.9%) |
| 5 | Relationship between environmental insults and the development of a somatic cell mutation | 65(55.6%) |
| 6 | Differences among the following tests: genetic screening test, diagnostic tests, prenatal screening tests, and predictive tests. | 13(11.1%) |
| 7 | Probability of a daughter of a carrier of an X-linked genetic disease being a carrier for the disease. | 75(64.1%) |
| 8 | Potential of developing breast cancer as a woman carrying one allele for the BRCA1 gene mutation but also engaging in positive lifestyle choices. | 97(82.9%) |
| 9 | Implications of being screened for gene mutations related to specific ethnic groups. | 112(95.7%) |
| 10 | Legal protection from possible discriminations related to one’s genotype. | 89(76.1%) |
| 11 | Ability to decipher a genetic nomenclature | 56(47.9%) |
| 12 | That a client with a family history of a genetic disease should be referred to a genetic counsellor | 95(81.2%) |
| 13 | Ability to decipher standard symbols used in a 3 generation family pedigree | 42(35.9%) |
| 14 | Implications of a statement of the penetrance of a genetic disease. | 84(71.8%) |
| 15 | Ability to determine that a 3 generation pedigree depicted a mitochondrial inheritance pattern. | 14(12.0%) |
| | | Mean – 53.3% |
| | | Median – 53.3% |
| | | Stand.Dev. – 14.4 |

Table 3. Comparison of correct responses from subjects who reported NOT having taken a course in genetics/ genomics after graduating from their baccalaureate programs – (N=91) to those subjects who reported that they HAD taken a course in genetics/ genomics in addition to their basic biology course (N = 26)

| Question number | Correct responses of subjects who reported NOT having taken a course in genetics/ genomics after graduating from their baccalaureate programs – (N=91) N (%) | Correct responses of subjects who HAD taken a course in genetics/ genomics in addition to their basic biology course – (N=26) N (%) |
|-----------------|--|---|
| 1 | 45(49.5%) | 18 (69.2%) |
| 2 | 45(49.5%) | 24 (92.3%) |
| 3 | 12(13.2%) | 6 (23.1%) |
| 4 | 34(37.4%) | 16 (61.2%) |
| 5 | 48(52.7%) | 17 (65.4%) |
| 6 | 8(8.8%) | 5 (19.2%) |
| 7 | 57(62.6%) | 18 (69.2%) |
| 8 | 77(84.6%) | 20 (76.9) ** |
| 9 | 86(94.5%) | 26 (100%) |
| 10 | 68(74.7%) | 21 (80.8%) |
| 11 | 41(45.1%) | 15 (57.7%) |
| 12 | 73(80.2%) | 22 (84.6%) |
| 13 | 33(36.3%) | 9 (34.6%) ** |
| 14 | 67(73.6%) | 17 (65.4%) ** |
| 15 | 6(6.6%) | 8 (30.8%) |
| | Mean 51%* | Mean 61.5%* |
| | Median 53.3%; | Median 60%; |
| | Stand. Dev. 12.3 | Stand. Dev. 18.2 |

* Significant difference – $p = 0.005$

** Percentages of correct responses from those who have taken an additional course that were below the percentages of correct responses from those who have NOT taken an additional course.

4 Discussion

Although not generalizable to the entire population of nurse educators, important findings are evident in the survey results. Most important, a significant difference ($p = 0.005$) in genetics/ genomics knowledge was noted between those faculty members who have taken a course in the specialized content in addition to their college-level biology course and those who state that their genetics/genomics knowledge is reliant on a course taken during their basic nursing education. The many discoveries that have been documented in this complex subject area require faculty to acknowledge the limitations of their basic education and to seek additional, current educational opportunities.

Indeed, over-all, the educators exhibited a marked paucity of genetics/ genomics knowledge, much of which is important for nursing care and practice. In only 4 of the 15 questions did more than 75% of the subjects respond correctly: patients' genotypes do not always result in disease, importance of screening patients from susceptible ethnic groups for the presence of genetic mutations, legal protection for clients with genetic diseases, and importance of referring high risk clients to genetic counselors. Interestingly, in each of the cases, the questions related more to nursing practice than to the science of genetics.

In addition, fewer than 15% of the respondents knew the impact of carrying a reciprocal translocation, why genetic screening tests are conducted, and the characteristics of mitochondrial inheritance. And, fewer than 50% of respondents knew that the parents of a child with an autosomal recessive illness are likely to be disease-free, the phenotype of a child with an additional Y chromosome, and which symbol is used to depict a generation on a 3 generation pedigree.

5 Limitations

Even though a strength of the current study resides in the fact that the schools where the research subjects teach were randomly selected, there are limitations to the generalizability of results. It is not known how representative those who responded are in comparison with all nurse educators teaching at the baccalaureate level. In addition, the fact that all of the subjects teach in schools of nursing in the United States – most especially in the southeast and midwest regions—any conclusions relating to those who teach in other countries is precluded. There also was a dearth of respondents who identified themselves as teaching pediatrics or maternal/ newborn content. Since genetics content is often taught in the childbearing and childrearing courses, this fact may have biased the results. Plus, one cannot know if those faculty who chose to respond to the questionnaire were different from all baccalaureate nurse educators. The study's findings and discussion should be considered within these limitations.

6 Conclusion

It is critical for nursing faculty to be well versed in genetics/ genomic issues. The AACN^[1] and ANA^[2] documents provide blueprints for the content required for nursing practice, but faculty expertise is needed to ensure that this content is delivered. The findings of the current study demonstrate that many baccalaureate nursing faculty teaching in the United States do not possess that knowledge. Indeed, the study results add to the findings of Thompson and Brooks^[16] who cite the lack of confidence nursing faculty have in their own knowledge of genetics/ genomics. But also shown here, as in Prows et al.^[13] research, those who state that they have taken a course in genetics/ genomics in addition to a basic biology class do improve their knowledge of this important content. The findings also highlight the importance of the strategies for accessing genetics/ genomics knowledge as cited by Williams et al.^[15].

The science of the genome is as critical to the health and well-being of individuals as is psychology, biology, microbiology, pathophysiology, and the like. This study's findings support the need for nursing faculty to improve their genetics/ genomics knowledge. Indeed, the majority of faculty who responded to the questionnaire graduated from their formal educational program well before the Human Genome Project^[18] was completed in 2003. Yet, over 75% of the

respondents have taken no course in genetics/genomics to acquire that knowledge. It was clear from the survey results that taking an additional genetics/genomics course beyond biology positively influenced faculty members' knowledge base.

Acknowledgement

Jane White, PhD, RN, Associate Dean for Grants and Research, Adelphi University, Manuscript assistance; Patricia Eckhardt, PhD, MBA, RN, Statistical and Research Editor and Consultant, Assistance with survey development.

References

- [1] The Essentials of Baccalaureate Education for Professional Nursing Practice. <http://www.aacn.nche.edu/education-resources/BaccEssentials08.pdf> (7 May 2012, date last accessed).
- [2] Essentials of Genetic and Genomic Nursing: Competencies, Curricula Guidelines and Outcome Indicators (2nd Ed.) <http://www.genome.gov/pages/careers/healthprofessionaleducation/geneticscompetency.pdf> (7 May 2012, date last accessed).
- [3] Human Genome Project: Medicine and the New Genetics http://www.ornl.gov/sci/techresources/Human_Genome/medicine/medicine.shtml (25 June 2012, date last accessed).
- [4] WebMD: Breast cancer health center: Breast cancer (BRCA) gene test. <http://www.webmd.com/breast-cancer/breast-cancer-brca-gene-test> (25 June 2012, date last accessed).
- [5] Oncology Stat: Two Targeted Agents Best Chemotherapy in BRAF-Mutant Melanoma. http://www.oncologystat.com/news/Two_Targeted_Agents_Best_Chemotherapy_in_BRAF-Mutant_Melanoma_US.html (25 June 2012, date last accessed).
- [6] Genelex: CYP Phenotype Dosage Recommendations. <http://www.healthanddna.com/healthcare-professional/dosing-recommendations.html> (25 June 2012, date last accessed).
- [7] Prows CA, Latta KK, Hetteberg C, Williams JK, Kenner C, Monsen RB. Preparation of undergraduate nursing faculty to incorporate genetics content into curricula. *Bio Res Nursing*. 1999; 1: 108-112. PMID:11232049
- [8] Hetteberg C, Prows CA. A checklist to assist in the integration of genetics into nursing curricula. *Nursing Outlook*. 2004; 52: 85-88. PMID:15073588 <http://dx.doi.org/10.1016/j.outlook.2004.01.007>
- [9] Monsen RB. Genetics in basic nursing program curricula: A national survey. *Mat Child Nursing J*. 1984; 13: 177-185. PMID:6569301
- [10] Hetteberg C, Prows C, Deets C, Monsen RB, Kenner CA. National survey of genetics content in basic nursing preparation programs in the United States. *Nursing Outlook*. 1999; 47: 168-174. [http://dx.doi.org/10.1016/S0029-6554\(99\)90092-1](http://dx.doi.org/10.1016/S0029-6554(99)90092-1)
- [11] Tonkin E, Calzone K, Jenkins J, Lea D, Prows C. (2011). Genomic education resources for nursing faculty. *J Nursing Sch*. 2011; 43: 330-340. PMID:22034967 <http://dx.doi.org/10.1111/j.1547-5069.2011.01415.x>
- [12] Calzone KA, Jerome-E'Emilia B, Jenkins J, Goldgar C, Rackover M, Jackson J, et al. Establishment of the genetic/genomic competency center for education. *J Nursing Sch*. 2011; 43: 351-358. PMID:21981551 <http://dx.doi.org/10.1111/j.1547-5069.2011.01412.x>
- [13] Prows CA, Hetteberg C, Johnson N, Latta K, Lovell A, Saal HM, et al. Outcomes of a genetic education program for nursing faculty. *Nursing Educ Persp*. 2003; 24: 81-85. PMID:12743977
- [14] Prows CA, Glass M, Nicol MJ, Skirton H, Williams J. Genomics in nursing education. *J Nursing Sch*. 2005; 37: 196-202. PMID:16235858 <http://dx.doi.org/10.1111/j.1547-5069.2005.00035.x>
- [15] Williams JK, Prows CA, Conley YP, Eggert J, Kirk M, Nichols F. Strategies to prepare faculty to integrate genomics into nursing education programs. *J Nursing Sch*. 2011; 43: 231-238.
- [16] Thompson HJ, Brooks MV Genetics and genomics in nursing: Evaluating essentials implementation. *Nurse Educ Today*. 2011; 31: 623-627. PMID:21093123 <http://dx.doi.org/10.1016/j.nedt.2010.10.023>
- [17] Oermann MH, Gaberson KB, ed. Evaluation and testing in nursing education (3rd ed.). New York: Springer Publishing Company, Inc., 2006.
- [18] Member Schools. Available from: http://www.aacn.nche.edu/membership/member-schools?search=&name=&state=&category_id=&x=14&y=9 (December 2011, date last accessed).
- [19] Human genome project. Available from: http://www.ornl.gov/sci/techresources/Human_Genome/project/about.shtml (25 June 2012, date last accessed).