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Survey of Nursing Integration of Genomics Into Nursing Practice

Kathleen A. Calzone, PhD, RN, APNG, FAAN¹ [Senior Nurse Specialist], Jean Jenkins, PhD, RN, FAAN² [Senior Clinical Advisor], Jan Yates, PhD, RN³ [Retired-Clinical Nurse Scientist], Georgie Cusack, MS, RN, AOCNS⁴ [Nurse Consultant for Oncology Education], Gwentyth R. Wallen, PhD, RN⁵ [Chief], David J. Liewehr, MS⁶ [Statistician], Seth M. Steinberg, PhD⁷ [Head], and Colleen McBride, PhD⁸ [Chief & Senior Investigator]

¹Research, National Institutes of Health, National Cancer Institute, Center for Cancer Research, Genetics Branch, Bethesda, MD

²National Institutes of Health, National Human Genome Research Institute, Bethesda, MD

³National Institutes of Health, Clinical Center, Bethesda, MD

⁴National Institutes of Health, Clinical Center, Bethesda, MD

⁵Nursing Research and Translational Science, National Institutes of Health, Clinical Center, Bethesda, MD

⁶National Institutes of Health, National Cancer Institute, Center for Cancer Research, Office of the Clinical Director, Biostatistics and Data Management Section, Bethesda, MD

⁷National Institutes of Health, National Cancer Institute, Center for Cancer Research, Office of the Clinical Director, Biostatistics and Data Management Section, Bethesda, MD

⁸Social and Behavioral Research Branch, Head-Public Health Genomics Section National Institutes of Health, National Human Genome Research Institute, Bethesda, MD

Abstract

Purpose—Translating clinically valid genomic discoveries into practice is hinged not only on technologic advances, but also on nurses—the largest global contingent of health providers—acquiring requisite competencies to apply these discoveries in clinical care. The study aim was to assess practicing nurse attitudes, practices, receptivity, confidence, and competency of integrating genomics into nursing practice.

Design—A convenience sample of practicing nurses was recruited to complete an online survey that assessed domains from Roger's Diffusion of Innovations Theory and used family history utilization as the basis for competency assessment.

Methods—Results were tabulated and analyzed using descriptive statistical techniques.

Findings—Two-hundred-thirty-nine licensed registered nurses, 22 to 72 years of age, with a median of 20 years in practice, responded, for an overall response rate of 28%. Most were White (83%), female (92%), and held baccalaureate degrees (56%). Seventy-one percent considered genetics to be very important to nursing practice; however, 81% rated their understanding of the genetics of common diseases as poor or fair. Per-question response rates varied widely. Instrument assessment indicated that modifications were necessary to decrease respondent burden.

Conclusions—Respondents' perceived genomic competency was inadequate, family history was not routinely utilized in care delivery, and the extent of family history varied widely. However, most nurses indicated interest in pursuing continuing genomic education.

Clinical Relevance—Findings from this study can lead to the development of targeted education that will facilitate optimal workforce preparation for the ongoing influx of genetics and genomics information, technologies, and targeted therapies into the healthcare arena. This pilot study provides a foundation on which to build the next step, which includes a national nursing workforce study.

Genomics has emerged as a central science for all health professionals, including nurses (Feero, Guttmacher, & Collins, 2010; Phimister, Feero, & Guttmacher, 2012). Genomics refers to all human genetic variation (encompassing single genes [genetics]) and their interactions, coupled with the influences of the environment, personal lifestyle, and psychosocial and cultural factors (Feero et al., 2010). Health care has increasingly integrated genomic information and technology along the pathways of prevention, screening, diagnosis, prognosis, treatment selection, and monitoring of therapy effectiveness. Health care increasingly demands that registered nurses, who represent the largest contingent of health providers in the United States and the world, use genomic information and technology when providing care (Calzone et al., 2010; U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions, 2010). The integration of genomics into routine health care requires that nurses and other healthcare providers be prepared in genomics. This necessitates an ongoing assessment of the nursing workforce competency in genomics to ascertain the extent of educational initiatives needed, optimal strategies to address deficits identified, and inform policy development to achieve workforce preparedness. Competencies, defined as knowledge, skills, and attitudes, are used to establish for a specific discipline the minimal standards needed to provide responsible, accountable, and safe quality health care. While other investigators have described the deficits in nursing genomic knowledge, few have expanded the assessment to include variables documented to influence the diffusion of an innovation, which may be as important to consider in designing any intervention aimed at improving nursing genomic competency.

Background

The implications of genomics on nursing practice have long been recognized, including calls for the integration of genetics in the curricula, certification, and licensure examinations, and continuing education (Anderson, 1996). The Health Resources Services Administration and the National Institutes of Health convened an expert panel in 2000 on genetics and nursing, discussing implications for education and practice (Health Resources and Services Administration, Bureau of Health Professions, 2000). The panel concluded that to improve patient care, education in genetics is necessary for everyone in the nursing workforce, including faculty, students, and practitioners, and offered recommendations on how to achieve that goal (Health Resources and Services Administration, 2000). Unfortunately, limited progress in the integration of genomics has been achieved by the nursing workforce (Edwards, Maradiegue, Seibert, Macri, & Sitzler, 2006; Hetteberg, Prows, Deets, Monsen, & Kenner, 1999; Prows, Calzone, & Jenkins, 2006; Prows, Glass, Nicol, Skirton, & Williams, 2005). This knowledge deficit persists, with more than 50% of nurses who completed a survey while attending a National Black Nurses Association meeting reporting their genetic knowledge as fair or poor (Spruill, Coleman, & Collins-McNeil, 2009). Of even greater concern is that there is some evidence that practicing nurses may not appreciate the relevance of genomics to their practice, which may limit motivation to learn more (Pfeil & Luo, 2005).

The Diffusion of Innovations (DOI) was the theoretical framework that guided this project (Rogers, 2003). Four dimensions serve as the foundation for this theory: (a) the innovation, in this case genetics and genomics information; (b) the communication channels used for dissemination; (c) time; and (d) the social system in which the innovation is being introduced, in this case the healthcare community that encompasses the healthcare providers, healthcare provider professional organizations, and consumers of healthcare. Additionally, adopter (the nurse) characteristics are antecedents that play a critical role in the diffusion of an innovation, critical among them being knowledge. Other antecedent adopter attributes contribute to adoption, including attitudes the adopter has about the advantage offered by the innovation. The constructs identified in the DOI model provided the framework for studying factors that potentially influence the diffusion of genetics nursing education. Study outcomes confirmed one portion of the model, the relationship of individual variables, on the participant's decision about innovation adoption. Study outcomes validated that the DOI model was useful in guiding the examination of other influencing variables (Jenkins, 1999).

Materials and Methods

Aims

The aims of this study were to (a) assess practicing nurse attitudes, practices, receptivity, confidence, and competency in integrating genomics into nursing practice and (b) pilot test the survey instrument to determine the feasibility of an online survey method of data collection and evaluate the degree of respondent burden and survey response rates to establish whether this method of data collection will be adequate for future target population evaluations.

Instrument

The survey tool used in this study was developed using the domains for measurement selected from the constructs of Rogers DOI theory (Rogers, 2003). The survey was modified with permission from a previously validated instrument that was developed and used to assess family physicians' (FPs') competency in genomics (Jenkins, Woolford, Stevens, Kahn, & McBride, 2010). The FP survey instrument was developed as an online tool by a multidisciplinary team consisting of FPs, a behavioral scientist, online survey designers, and genetic-genomic experts. Each item was reviewed for content validity by outside content experts as well as a convenience sample of FPs. A second phase of item analysis occurred through a pilot online survey with a convenience sample of FPs. Factor analysis was then used to revise the survey instrument. The final FP survey instrument included assessments of knowledge and competency, attitudes, receptivity, confidence, and decision domains from the DOI theory (Jenkins et al., 2010). The use of family history was used as a benchmark for genetic-genomic competency and evidence of practice integration. This was selected because family history has been recognized as the cheapest most widely accessible genetic test and is incorporated into nursing competencies applicable to all registered nurses regardless of academic preparation, clinical role, or specialty (Berg et al. 2009; Consensus Panel on Genetic/Genomic Nursing Competencies, 2009). Validation of the FP instrument involved structural equation modeling (SEM), which evaluated whether the instrument items aligned with the DOI domains, and establishing the directionality of the associations to the DOI domain. SEM found the comparative fit index (.93, > .9), the Tucker Lewis index (.92, > .9), the root mean square error of approximation (.039; 90% confidence interval [.036, .042], < .08), and the standardized root mean square residual (.056, < .1), all indicating the instrument items were an adequate fit to the DOI model. Standardized path weights were all statistically significant ($p < .001$; Jenkins et al., 2010).

This validated FP survey instrument served as the foundation in the development of the nursing survey instrument. The domains of knowledge, persuasion, and decision from the DOI theory were replicated in the nursing survey utilizing the same questions but leveled for nursing practice. Table 1 reviews the conceptual and operational definitions for each of the domains measured and the corresponding questions in the instrument.

Each survey item was reviewed for content validity and leveled for entry level nursing practice by nursing experts and genomic experts. The instrument was pilot tested for online usability by a convenience sample of five nurses representative of the target population (U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions, 2010). The final nursing survey instrument contained 43 questions consisting of multiple choice, dichotomous yes or no, and Likert scale questions.

Attitudes and receptivity—Assessments of complexity and advantages of integrating genomics into practice were used to evaluate attitudes and receptivity. Questions included assessments about perceived importance, advantages, and disadvantages of integrating genomics into practice. Attitudes regarding the complexity of integrating family history into practice were also assessed.

Confidence—Questions focused on confidence in discussing genetics with patients; confidence in determining the family history information needed to evaluate patients' genetic susceptibility; and confidence associated with each of the Essential Competencies.

Competency and knowledge—The competency and knowledge domain included receiver assessments of personal innovativeness and knowledge of the genomics of common disease. Knowledge questions focused on the value nurses placed on family history; understanding of the role of genomics in common diseases such as cancer, heart disease, and diabetes; and self-reported knowledge elements of family history collection. Family history was selected as the competency benchmark because it is not dependent on new technology, has been demonstrated as a sensitive yet inexpensive genetic test, remains widely underutilized, and is part of the role of all nurses.

Social system—Questions about the social system assessed supervisory support for nurses using genomics and institutional financial support for genomic continuing education.

Decision and adoption—The decision and adoption domain was measured through questions about provider intent to learn more about genomics and perception of the value and relevance of family history in patient care and their personal practice. This included a question about the use of family history within the past 3 months in their personal practice. A skip pattern was included in the survey to account for those participants not actively seeing patients and in whom this line of questioning would not apply.

Additional questions were created for the nursing survey to further assess nursing adoption related to the Essential Genetic/Genomic Nursing Competencies, level of prior genetic education, preferred method of education, nursing leadership support for genomics, and institutional financial support for continuing education. Competency-specific assessments of frequency of use, confidence, and perceived level of importance were evaluated utilizing the United Kingdom nursing survey design with permission from the developer (Kirk, Tonkin, & Birmingham, 2007).

Survey feasibility—Questions assessed length of time to complete the survey, difficulty using the online methodology, confusing questions or terminology, and recommendations for instrument modifications.

Lastly, demographic questions modified for nursing from the FP survey instrument and usability assessment were incorporated.

Sociodemographics—Gender, year of birth, ethnic background, entry level and highest level of nursing education, highest level of non-nursing education, years in practice, clinical role, and practice setting were collected.

Design

This is a cross-sectional study of a representative subset of the practicing nurse community. The study was reviewed and approved by the National Institutes of Health (NIH) Office of Human Subjects Research and determined to be Code of Federal Regulations (45 CFR 46) exempt because the information collected in the survey was recorded so that individual respondents could not be identified (indirectly or directly) and there were no other participant risks.

Sample and Participants

Eligible participants consisted of a convenience sample of registered nurses employed at the NIH. Inclusion criteria were age 18 years and older; licensed registered nurse currently employed at the NIH Clinical Center or National Cancer Institute; and computer access.

An email was distributed to all 839 eligible nurses informing them of the survey. The invitation included the survey website link, log-in information, estimated completion time, and a 4-week deadline for survey responses. A reminder email was sent 2 weeks following the initial notification and again 7 days and 2 days prior to the survey deadline. An incentive for the first 100 participants consisted of a printed copy of the Essentials of Genetic and Genomic Nursing: Competencies, Curricula Guidelines, and Outcome Indicators, 2nd edition (Consensus Panel on Genetic/Genomic Nursing Competencies, 2009). Participants were instructed where they could go to collect their copy at the completion of the survey.

This was a minimal risk study not expected to result in any significant adverse events or harms to participants. All respondents had to initiate contact themselves in order to participate and could complete the survey anonymously. Therefore, consent was obtained on the log-in page of the survey, which specified that their participation was voluntary, participation would not affect their employment at the NIH, and they could skip any question or stop completing the survey at any time. In the emails notifying nurses of the survey, participants were provided with the phone number of the principal investigator for questions or concerns.

Data Collection

Data were prospectively collected and stored using unique subject identifiers in a password-protected file only accessible to study personnel. At the conclusion of the data collection period, all data were extracted into an Excel database for analysis.

The survey was programmed for web-based administration using Survey Monkey. Estimates based on expert reviewers' (nurse educator, administrator, nurse researchers, nurse genetic experts, and clinical nurse specialist) validation assessments indicated the survey would take about 20 min to complete.

Data Analysis

All survey results were tabulated and analyzed using descriptive statistical techniques. The innovativeness scale was converted into an index variable to reflect the degree of innovation. Data for questions that demonstrated innovativeness were scored as is, while data for questions that demonstrated no innovativeness were reverse scored to create the index. The index variable was then created by summing the transformed data for each participant from the total 11 innovativeness questions, resulting in one continuous variable.

Statistical tests performed depended on the nature of the parameters being evaluated. To account for ordering in the effects, we tested for trends between two groups with order categorical data using an exact Cochran-Armitage trend test and used an exact Jonckheere-Terpstra trend test to evaluate associations in doubly ordered tables with varying numbers of rows and columns. We also tested for general associations between two dichotomous variables using Fisher's exact test. For continuous data correlations, we used Spearman's correlation coefficient (interpretation of r : strong association, $r > 0.7$; moderate association, $0.5 < r < 0.7$; moderate to weak association, $0.3 < r < 0.5$; and weak association, $r < 0.3$). For comparisons of continuous data between two groups, we used the Wilcoxon rank sum test. For comparing continuous data among three or more groups, we used the Kruskal-Wallis test. Since this was planned as an exploratory study, analyses performed were intended to lead to hypotheses that could be addressed more fully through a subsequent national study if indicated. In view of the large number of exploratory analyses performed, $p < .01$ would be interpreted as being associated with a statistically significant test, while $.01 < p < .05$ would be considered a strong trend. All p values are two-tailed and presented without adjustment for multiple comparisons.

To further assess survey performance, we analyzed the survey data to identify if there were differences in characteristics of participants who responded or did not respond to selected questions. Four questions were identified as being representative of characteristics that could be associated with per-question response rates, including number of years in nursing; total innovation score; ever having heard of the Essential Competencies; and self-rating of understanding of genetics. Five questions were selected throughout the survey to compare with the four questions pertaining to the characteristics of respondents. These questions assessed confidence in the extent of family history needed to determine a patient's genetic susceptibility to common diseases; frequency of the use of family history; disadvantages of integrating genetics into practice; knowledge question about genetics of common disease; and the importance placed on the advocacy nursing competency.

Results

Study Population

Survey data were obtained on 239 of 839 nurses, for an overall response rate of 28%, with varying individual question response rates. Table 2 provides an overview of the characteristics of the participant population, who ranged in age from 22 to 72 years, were mostly female (92%), and White (83%). The majority (68%) had their initial nursing education at the baccalaureate level, 56% reported their highest level of nursing education was also at the baccalaureate level, 26% had a master's degree in nursing, and 3% were prepared at the doctoral level. Nursing roles varied: 41% were staff nurses; 22% were researchers, reflecting the research mission of the NIH; 8% were case managers; and 7% were nurse practitioners. Nearly 90% of respondents reported some proportion of their time was spent seeing patients in some capacity.

Attitudes and Receptivity

Thirty-four percent ($n = 45/133$) of respondents had heard or read the Essential Nursing Competencies and Curricula Guidelines in Genomics. There was a trend ($p = .022$) that nurses who were more innovative were more likely to have heard or read the Essential Competencies. In addition, there was a trend that the more innovative nurses favored the Essential Competencies requirement of a three-generation family history constructed in the form of a pedigree ($p = .030$) and felt the recommendations were an improvement over family history assessments currently used in their practice setting ($p = .017$). Statistically significant differences were also found in those who reported prior education in genetics. Specifically, genetics education was associated with having heard or read about the Essential Competencies ($p = .003$) and favorable views about the Essential Competency recommendations for family history ($p = .001$). The perceived value of family history was not found to be associated with basic nursing education or current nursing role.

Confidence

Only 24% ($n = 38/159$) reported being very or somewhat confident in deciding what family history information is needed to assess a patient's genetic susceptibility to common diseases such as cancer, heart disease, and diabetes. Even fewer reported being very or somewhat confident in discussing information about the availability (16%, $n = 26/158$), risks (13%, $n = 21/158$), benefits (15%, $n = 24/159$), and limitations (13%, $n = 20/158$) of genetic testing for common diseases. Furthermore, only 6% ($n = 9/158$) felt very confident in facilitating referrals for genetic services.

In individual competency queries regarding the frequency, confidence, and importance the respondent placed on each competency, only 16% ($n = 14/90$) felt confident in eliciting a minimum of a three-generation family history; however, 42% ($n = 39/92$) felt it was an essential competency. Similarly, only 11% ($n = 10/91$) felt confident in the ability to construct a pedigree, while 32% ($n = 29/92$) felt it was essential.

Competency and Knowledge

Outcomes from the knowledge measures are depicted in Table 3. No one reported an excellent understanding of the genomics of common diseases, only 2% reported their understanding was good, and the majority reported their understanding was fair (56%) or poor (25%). Most (60%) had never had a course that included genetics as a major component since they received their nursing license. Knowledge about the extent of family history that should be collected showed more experienced nurses tended to feel more strongly that only first-degree relatives were important when collecting family history information ($p = .044$). Nursing role and level of basic nursing education showed no relationship to the extent of family history respondents thought should be collected.

Social System

In terms of the social system, 35% ($n = 38/108$) of survey respondents reported that senior staff members saw genetics as an important part of their nursing role, while 43% ($n = 46/108$) felt senior staff did not view this as important, and the remainder (22%, $n = 24/108$) were uncertain. Thirty-nine percent ($n = 42/108$) of respondents reported that the senior staff considered genetics an important role for senior staff, while 34% ($n = 37/108$) reported that genetics was not important to the senior staff role, and 27% ($n = 29/108$) were uncertain.

Decision and Adoption

In the 3 months prior to taking the survey, only 3% ($n = 4/148$) of nurses reported always taking a family history, while 77% ($n = 114/148$) had rarely or never assessed a family

history. Only 1% had updated a family history in the prior 3 months, while 79% ($n = 114/145$) rarely or never updating a family history within that time period. Yet, when a patient indicated a disorder in the family, 61% ($n = 82/135$) always collected the age of diagnosis, the relationship to the patient (82%, $n = 111/136$), race or ethnic background (55%, $n = 72/131$), and age at death from the condition (64%, $n = 86/134$). There were widely varying responses to whether family history was considered to have any clinical relevance to a wide range of common health conditions. However, 67% ($n = 105/156$) agreed or strongly agreed that family history should be a key component of nursing care. No differences were found in attitudes, competency, or utilization of family history based on initial nursing education, highest level of nursing education, year of graduation, or clinical role. However, the most experienced nurses tended to feel only first-degree relatives were needed in the collection of family history ($p = .04$). Nurses with higher levels of innovativeness were more likely to value family history ($p = .006$) and tended to report a family history should include second- and third-degree relatives ($p = .029$).

Nurses who had prior genetic education tended to feel that family history made a difference in patient care (health outcomes; $p = .013$) and were favorable about the family history recommendations ($p = .001$). Sixty-seven percent ($n = 105/156$) of nurses agreed or strongly agreed that family history should be a key component of nursing care, and 79% ($n = 121/153$) agreed or strongly agreed that there is a role for nurses in counseling patients about genetic risks. Seventy-six percent ($n = 83/109$) of nurses reported that they intended to learn more about genetics, and 51% ($n = 55/108$) were willing to attend a course on their own time. However, only 46% ($n = 50/108$) were aware of any available courses in genomics for nurses.

Survey Feasibility

Many respondents commented that the survey was too long. Eighty-four percent ($n = 98/116$) of respondents agreed or totally agreed that the directions provided the information needed to complete the survey and that the survey was organized and easy to navigate. Eighty-nine percent ($n = 105/117$) felt the screens were easy to read, with sharp, legible characters. Seventy-three percent ($n = 85/117$) agreed, or totally agreed, that the screens were clear and predictable and the terminology was consistent and appropriate. Sixty-seven percent agreed, or totally agreed, that the organization of the survey was clear. Overall, 81% ($n = 95/117$) of respondents agreed, or totally agreed, that the survey was technically easy to complete. No one required additional technical assistance to complete the survey. However, 39% ($n = 43/109$) indicated that some of the survey questions were unclear. Expert reviewers assessed unclear survey questions and eliminated those questions in the final instrument, which consists of seven parts and 31 primary questions. A copy of the final instrument is included as supplemental material to this manuscript.

Response Rates

The overall response rate to the survey was low (28%, $n = 239/839$), and the per-question response rate varied throughout. We found that 29% ($n = 71/239$) of the nurses did not answer any questions in Part 1 (demographics), 41% ($n = 99/239$) did not answer any questions in Part 4 (value of family history), and 50% ($n = 117/239$) did not answer any questions in Part 8 (survey usability). Thus, many nurses did not answer any questions in Part 1, and nurses answered fewer questions as the survey progressed to Part 8. A likely explanation is that almost 30% ($n = 71/239$) of the nurses logged on to take the survey and thus were counted but never actually answered any questions. As described in the analysis section earlier in this article, we further analyzed the survey data in order to determine if there were any differences in characteristics of participants who responded or did not respond to selected questions. The actual response was not of interest, but rather, whether

the question received a response. Unfortunately, the findings showed that many participants did not respond to either a given question of the five scattered throughout the survey or the four that were related to characteristics. As a consequence, the data were too sparse for a reliable analysis of differences in characteristics of participants who responded or did not respond to selected questions.

Discussion

This was a small exploratory study; however, analysis of the question-specific data revealed some important early trends indicating that respondents felt inadequately prepared to use genomics in their practice, self-rated their knowledge as poor or fair, but indicated interest in pursuing education to improve genomic competency. The majority of respondents indicated that family history was not collected, documented, or used routinely in care delivery, and the adequacy of family history varied widely, with the most experienced nurses having the least amount of competency in the scope of family history required to assess for disease risks.

Critical to successful diffusion of an innovation is a sufficiently knowledgeable and skillful workforce (Rogers, 2003). Seventy-one percent felt genomics was important to nursing practice. This provides some preliminary indication of attributes that contribute to adoption of genomics, such as perceived relative advantage and compatibility of the innovation with existing values, and the relevance of the innovation to nursing practice. If confirmed in a larger national workforce study, these attributes may decrease the time to adoption if the knowledge deficits are addressed. Expanding opportunities for genomic nursing education emerged as a critical need.

Descriptive analysis found that the respondents perceived the value senior staff members place on genetics was low or respondents were uncertain of the senior staff's views on genomics. Rogers DOI theory states that the social system (in this case the healthcare system) in which an innovation (genomics) is being introduced can influence the rate of adoption (Rogers, 2003). Therefore, senior staff can hinder or facilitate adoption of an innovation. While these data are only exploratory in nature, this finding, if confirmed in a broader national workforce study, could point to the need for institutional policy changes that promote successful integration of genomic competencies or for an emphasis on training leadership in the healthcare system early in any intervention initiative.

The overall survey response rate was limited (28%, $n = 239/839$), and the per-question response rate varied widely. The length of the survey was deemed to be too burdensome, since the per-question response rate declined as nurses progressed through the survey. To address this for future use of the instrument, questions assessing the same constructs were assessed for consistency in response. Questions having consistent results for the same construct were then considered for elimination by the research team for a revised survey instrument.

These results should be interpreted cautiously. While the survey participants were representative of the nurses at the NIH Clinical Center and the National Cancer Institute, they may not be representative of the general population of nurses. Our sample of respondents included fewer under-represented minorities and men, as well as a higher proportion of nurses prepared at the bachelor's and master's or doctorate level than the general nursing population (U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions, 2010). Further assessment is needed in under-represented minority nursing populations. In addition, this survey is specific to those actively seeing patients in practice and does not adequately capture data from nurses in non-patient care roles such as nurse educators. Lastly, the

instrument did not assess competing demands nurses face for continuing education. In addition, prioritizing genomics in relation to other clinical learning needs was not assessed, although this could be the focus of a future study.

Conclusions

This study evaluated nurses' competencies in genomics, which remains limited. These findings can be used to justify resource allocation specific to expanding genomic nursing competency. Assessments of the nursing workforce, such as this survey, are essential if we are to characterize progress or lack thereof in building nursing genomic competency. Findings from this study guided further refinement of the survey instrument. Next steps include utilizing the finalized instrument in a U.S. national nursing workforce study as well as in assessment targeting minority nurses to benchmark nursing competency in genomics to inform educational nursing interventions nationally.

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Table 1**Conceptual and Operational Domain Definitions and Related Survey Items**

Domain	Conceptual definition	Operational definition	Survey instrument items
Attitudes/receptivity	The relative advantage offered by the innovation. Perceived attributes of the innovation including the recognized need for the innovation, as well as contextual factors such as identification of communication channels that facilitate or hamper adoption and sustained implementation.	Perceived importance, advantages, and disadvantages of integrating genomics into practice. The complexity of integrating family history into practice. Perception of the value of family history in patient care and their personal practice.	Part 1: Questions 1, 2, 3 Part 2: Question 2, 3c Part 3: Question 6
Confidence	Level of certainty that knowledge about the innovation is accurate.	Confidence in: discussing genetics with patients; deciding what family history information is relevant to assessing genetic susceptibility; availability, risks, benefits and limitations of genetic testing; facilitating referral for genetic services.	Part 2: Question 1
Competency/knowledge	Recognition of the innovation and evidence of understanding the innovation and its function.	Knowledge of the genomics of common disease, and the family history information needed to evaluate patients' genetic susceptibility.	Part 2: Question 3 Part 4: Questions 1, 2, 4 Part 5: Questions 1, 2
Social system	The environment in which the innovation is being introduced, the interconnected entities involved in shared problem solving.	Supervisory support for nurses using genomics, and institutional financial support for genomic continuing education.	Part 6: Question 1
Decision/adoption	Observation of use of the innovation.	Utilization of family history within the past three months.	Part 3: Questions 1, 2, 3, 4, 5

Note. Data from Rogers (2003).

Table 2

Demographics of Participant Population

Demographics	Findings
Sex (<i>n</i> = 168)	
Male	8%
Female	92%
Years in nursing (<i>n</i> = 167)	
Median (range)	20.01 (0.5–50)
Age (<i>n</i> = 163)	
Median years (range)	48 (22–72)
Race (<i>n</i> = 166)	
White	83%
Asian	7%
Black/African American	8%
Other	2%
Highest level of nursing education (<i>n</i> = 152)	
Diploma	5%
Associate degree	11%
Baccalaureate degree	56%
Master's degree	26%
Doctorate degree	3%
Primary area of practice (<i>n</i> = 167)	
Staff nurse	41%
Head nurse	2%
Nurse practitioner	7%
Clinical nurse specialist	4%
Educator	4%
Supervisor	2%
Researcher	22%
Director/assistant director	1%
Consultant	5%
Case manager	8%
Other	6%
Proportion of time spent seeing patients (<i>n</i> = 169)	
Median (range)	50% (0–100%)

Table 3

Knowledge Measures

Measure	%
Understanding of genetics of common diseases (<i>n</i> = 126)	
Excellent	0
Very good	2
Good	17
Fair	56
Poor	25
Heard or read the essential nursing competencies (<i>n</i> = 133)	
Yes	34
No	66
Prior genetics course since licensure (<i>n</i> = 108)	
Yes	40
No	60