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Hospital nursing leadership-led interventions increased genomic awareness and educational intent in Magnet settings

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ABSTRACT

Background: The Precision Medicine Initiative will accelerate genomic discoveries that improve health care, necessitating a genomic competent workforce.
Purpose: This study assessed leadership team (administrator/educator) year-long interventions to improve registered nurses' (RNs) capacity to integrate genomics into practice.
Methods: We examined genomic competency outcomes in 8,150 RNs.
Findings: Awareness and intention to learn more increased compared with controls. Findings suggest achieving genomic competency requires a longer intervention and support strategies such as infrastructure and policies. Leadership played a role in mobilizing staff, resources, and supporting infrastructure to sustain a large-scale competency effort on an institutional basis.
Discussion: Results demonstrate genomic workforce competency can be attained with leadership support and sufficient time. Our study provides evidence of the critical role health-care leaders play in facilitating genomic integration into health care to improve patient outcomes. Genomics' impact on quality, safety, and cost indicate a leader-initiated national competency effort is achievable and warranted.

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A challenge associated with the clinical application of genomic discoveries is an adequately prepared health-care workforce capable of effective practice integration. Genetics, the study of one single gene is encompassed by genomics which is defined as the study all genome variation (Green & Guyer, 2011). The speed in which genomic information and discovery are transitioning to the clinical setting is only going to continue to

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accelerate fueled by large-scale evidence generation such as the All of Us Research Program previously known as the Precision Medicine Initiative (Health NIo, 2017).

Background

The primary aim of genomic clinical applications is improved health outcomes (Rehm, 2017). Evidence of potential cost savings associated with the appropriate use of genomic information and technology is emerging, a priority in the current fiscal climate (Anderson et al., 2006; Bock et al., 2014; Gallego et al., 2015; Plevritis et al., 2006). Advances having significant ethical and safety challenges motivate nursing schools to integrate genomic content into curricula. However, the ability to influence the practicing registered nurse (RN) workforce continues to be a major gap. Currently there are over 3,880,000 RNs in the United States, most of whom have had no genomic education (Calzone, Jenkins, Culp, Bonham, & Badzek, 2013; National Council of State Boards of Nursing, 2016, 2017). Most (54%) are working in a hospital setting, a target for a broad genomic integration initiative (National Council of State Boards of Nursing, 2016). In 2013, an interprofessional Advisory Panel established a Genomic Nursing Science Blueprint, providing a framework and recommendations to further genomic nursing science (Genomic Nursing State of the Science Advisory Panel et al., 2013). Capacity building consisting of educating the current and future nursing workforce in genomics was identified as a priority in the Blueprint.

Existing nursing scope and standards of practice have little genomic integration. Genomic nursing competencies specify required genomic knowledge skills, and abilities for the nursing profession. These competencies established in 2006 for all RNs were revised in 2009 to incorporate outcome indicators, and subsequently were leveled for graduate nurses in 2011 (Calzone, Jenkins, Prows, & Masny, 2011; Consensus Panel on Genetic/Genomic Nursing Competencies, 2009; Greco, Tinley, & Seibert, 2012; Jenkins & Calzone, 2007). These competencies apply to all RNs irrespective of academic preparation, clinical role, or specialty.

Health-care provider genomic knowledge and competency is a global issue, with surveys world-wide revealing limited knowledge (Baars, Henneman, & Ten Kate, 2005; Escher & Sappino, 2000; Finn et al., 2005; Harvey et al., 2007; Skirton, O'Connor, & Humphreys, 2012; Wonkam, Njamnshi, & Angwafo, 2006). The first national assessment of nursing competency in genetics was conducted in 1993, at which time 68% of nurse participants reported being not too or not at all knowledgeable about genetics (Scanlon & Fibison, 1995). In over 20 years, little has changed despite the existence and endorsement of essential genetic/genomic nursing competencies (Calzone, Jenkins, Culp, Caskey, & Badzek, 2014; Consensus Panel on Genetic/Genomic Nursing Competencies, 2009; Greco et al., 2012). Integration of genomics into nursing curriculum was mandated by the American Association of Colleges of Nursing Essentials in 2010 for graduates from baccalaureate nursing programs and then a year later for master's programs. This mandate does not impact nurses already in the workforce who have had limited or no academic preparation in genomics. Most (60%) report they have never had genetics as a major content segment in a course since initial licensure (Calzone et al., 2014). Genomic knowledge gaps can decrease effective utilization of genomic information in health-care decisions impacting safety, outcomes of care, and public protection (e.g., policies on confidentiality) (Calzone et al., 2013; Katsanis et al., 2015; Selkirk, Weissman, Anderson, & Hulick, 2013). In studies assessing nursing genomic competency, all nurses were found to have knowledge gaps irrespective of education level (diploma through doctorate), indicating an expansive education intervention would benefit nurses (Calzone et al., 2013; Coleman et al., 2014; Read & Ward, 2016).

Diffusion of Innovations (DOI) serves as a conceptual framework for constructing pathways likely to influence adoption of innovations (e.g., genomics) into practice. The DOI was used to construct "pathways" which may influence whether nurses learn about and implement genomics into practice (Rogers, 2003). Adoption of new ideas can be accelerated using change agents and opinion leaders who are influential (Valente & Davis, 1999; Valente & Pumpuang, 2007). Opinion leaders may be identified and used to create efficient "learning communities" (Valente, Hoffman, Ritt-Olson, Lichtman, & Johnson, 2003). Institutional leadership support of nursing faculty was found to accelerate capacity building for genomic curriculum integration (Jenkins & Calzone, 2014).

Little is known about optimal mechanisms for genomic translation to the bedside. Results of a year-long genomic education intervention to train, support, and supervise hospital administrator and educator opinion leader pairs (dyads) who implemented strategies to increase nursing ability to integrate genomics into practice are presented.

Methods

Study Design and Sample

This was a 1-year longitudinal study of RNs employed at 23 American Nurses Credentialing Center-designated Magnet hospitals conducted from 2012 to 2013. Two groups were assessed pre and post interventions; group one consisted of 21 intervention Magnet hospitals and group two consisted of 2 Magnet hospitals serving as control. Intervention hospitals underwent a competitive application to participate whereas the control hospitals were recruited by the study team from a pool of institutions that did not apply. Control hospitals agreed to continue usual education interventions. This study was approved by the West Virginia University (WVU) Institutional Review Board with a reliance agreement from National Institutes of Health (NIH).

Intervention

The intervention consisted of an educator and a nursing administrator dyad who began with initial training in genomics, genomic resources, and educational strategies followed by monthly supplemental education and peer support. Dyads developed institutional action plans informed by their hospital-specific baseline Genetics and Genomics Nursing Practice Survey data. Progress was accessed using quarterly reports and site visits followed by a Realization meeting held at the conclusion of the intervention and offered to both intervention and control group dyads (Jenkins et al., 2015).

Dyads

Leadership dyad teams designed interventions to enhance genomic education and policies at their hospitals. The selection of administrator/educator dyads was strategic as they were expected to be uniquely positioned to engage leadership stakeholders (e.g., Board of Directors, Medicine, Pharmacy) and identify innovative solutions at the institutional level (e.g., provision of resources for nursing education, modifications to Electronic Health Record), for addressing current competency workforce issues around genomics within their specific institutional environment.

Outcome Measures

The Genetics and Genomics Nursing Practice Survey (GGNPS) was utilized to assess the nursing workforce at both the intervention and control institutions (Calzone et al., 2016). The current version of the GGNPS is open access and available at https://www.genome.gov/27527636/new-horizons-and-research-activities/ under research tools. The constructs of the survey, originally developed for practicing physicians then leveled and refined for nurses, assess domains derived from the DOI theory: attitudes, confidence, knowledge, persuasion, receiver characteristics, as well as the decision to utilize family history for competency assessment and evidence of adoption (Calzone et al., 2012, 2016; Jenkins, Woolford, Stevens, Kahn, & McBride, 2010). Structural equation modeling was used to assess item alignment with the domains of Rogers' DOI, all of which supported that the items fit the DOI model (Jenkins et al., 2010). Items were leveled for nursing practice by genetic nurses followed by content validity by nursing practice and genomic experts, a small usability pilot representative of the target population ($n = 5$), and then a larger target population pilot study $n = 239$ (Calzone et al., 2012). Questions in each domain are intended to be used inform the development of interventions to optimize genomic nursing competency and integration into practice. Instrument items are therefore constructed in varying formats to maximize the information gathered. The GGNPS version used in this study consisted of 46 items, including select all that apply, multiple-choice, dichotomous yes/no, and Likert-scale questions on the genomics of common diseases and family history.

The GGNPS was completed by RNs at baseline (2012) and at the conclusion of the intervention period (2013). Survey eligibility consisted of employment as an RN at a participating institution inclusive of all levels of academic preparation, roles, and clinical specialties. An administrator impact survey was administered at the conclusion of the intervention which assessed dyad personal development time as well as direct and indirect expenses.

Data Analysis

Data analysis comparing the baseline and post-intervention data was performed using IBM Statistical Packages for the Social Sciences Statistics (SPSS) for Windows, Version 21.0. Frequencies for all items were calculated. Comparison between categorical variables was analyzed using chi-squared tests. A knowledge score was derived from 12 items of the GGNPS which were converted into dichotomous correct or incorrect responses prior to analysis, with 1 point awarded for each correct response for a maximum score of 12. Knowledge scores were calculated only for individuals responding to all 12 items. To assess differences in mean knowledge scores by different levels of education, a one-way analysis of variance (ANOVA) followed by Tukey's *post hoc* test was used. All statistical tests of significance were two-tailed and $\alpha = .05$ was used as the level of significance.

To establish an adequate sample size, G*Power 3 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) was used to conduct a power analysis for one-way ANOVA, the most complex statistical test used in this analysis. To identify a medium effect with 80% power at $\alpha = .05$ level of significance for a one-way ANOVA with four groups, a minimum of 180 participants was required. We oversampled to control for multiple testing (Faul, Erdfelder, Lang, & Buchner, 2007).

Findings

Enrollment

Of the 21 intervention hospitals, one institution withdrew from the study, citing competing demands and inability to adhere to an institution-wide initiative. Their data are not included in this analysis. A second institution had a participation gap of 4 months due to staffing challenges, resulting in the inability to meet the study demands during this period. That facility's survey data were included in the analysis.

Table 1 – Sample Demographics

Demographic Variables	Baseline		Follow-Up	
	Controls (*N* = 492) *N* (%)	Intervention (*N* = 7,196) *N* (%)	Controls (*N* = 337) *N* (%)	Intervention (*N* = 7,813) *N* (%)
Gender				
Male	14 (6.3%)	311 (6.4%)	17 (8.1%)	411 (7.4%)
Female	207 (93.7%)	4578 (93.6%)	193 (92.6%)	5159 (92.6%)
Race				
White	216 (99.1%)	3976 (83.8%)	199 (97.5%)	4495 (82.7%)
Asian	0 (0.0%)	380 (8.0%)	1 (0.5%)	485 (9.0%)
Black/African American	2 (0.9%)	327 (6.9%)	2 (1.0%)	366 (6.8%)
American Indian/Alaska Native	0 (0.0%)	26 (0.5%)	2 (1.0%)	49 (0.9%)
Native Hawaiian/Pacific Island	0 (0.0%)	33 (0.7%)	0 (0.0%)	35 (0.6%)
Consider themselves Hispanic or Latino				
Yes	0 (0.0%)	229 (4.7%)	0 (0.0%)	283 (5.1%)
No	221 (100.0%)	4639 (95.3%)	205 (100.0%)	5267 (94.9%)
Highest level of nursing education				
Diploma	13 (5.8%)	302 (6.2%)	9 (4.3%)	264 (4.7%)
Associate degree	56 (24.9%)	995 (20.3%)	49 (23.3%)	1086 (19.4%)
Baccalaureate degree	131 (58.2%)	2875 (58.7%)	128 (61.0%)	3417 (60.9%)
Master's degree	23 (10.2%)	695 (14.2%)	19 (9.0%)	795 (14.2%)
Doctorate degree	2 (0.9%)	31 (0.6%)	5 (2.4%)	48 (0.9%)
Primary role				
Staff nurse	141 (67.1%)	3440 (73.6%)	135 (69.6%)	3928 (73.6%)
Head nurse	13 (6.2%)	268 (5.7%)	9 (4.6%)	322 (6.0%)
Education	14 (6.7%)	210 (4.5%)	9 (4.6%)	257 (4.8%)
Supervisor	16 (7.6%)	213 (4.6%)	12 (6.2%)	249 (4.7%)
Nurse practitioner	2 (1.0%)	182 (3.9%)	5 (2.6%)	181 (3.4%)
Clinical nurse specialist	9 (4.3%)	95 (2.0%)	10 (5.2%)	107 (2.0%)
Director/assistant director	9 (4.3%)	95 (2.0%)	6 (3.1%)	135 (2.5%)
Case manager	2 (1.0%)	94 (2.0%)	5 (2.6%)	83 (1.6%)
Consultant	3 (1.4%)	42 (0.9%)	0 (0.0%)	41 (0.8%)
Researcher	1 (0.5%)	35 (0.7%)	3 (1.5%)	34 (0.6%)
Did nursing curriculum include genetics content?				
Yes	119 (51.1%)	2587 (52.1%)	108 (52.2%)	2700 (47.7%)
No	114 (48.9%)	2376 (47.9%)	99 (47.8%)	2961 (52.3%)
Genetics course since licensure				
Yes	29 (12.4%)	653 (13.2%)	26 (12.4%)	1098 (19.5%)
No	205 (87.6%)	4311 (86.8%)	183 (87.6%)	4541 (80.5%)

Participants

The 20 intervention hospitals that completed the study represented 14 states and were all nonprofit. Most were academic or community hospitals; however, rural (1), Veteran's Administration (1), cancer center (1), psychiatric (1), and children's hospitals (3) were represented. Hospital size was mixed with bed numbers between 100 and 1,061 and daily census averages of 62 to 870. The study sample demographics consisted mostly of experienced staff nurses with baccalaureate preparation, who spent most of their time with patients (Tables 1 and 2). There were no significant differences in demographics between intervention and control at either time point.

Table 2 – Sample Demographics, Continuous Variables

Continuous Demographic Variables	Baseline		Follow-Up	
	Controls	Intervention	Controls	Intervention
Number of years worked in nursing				
Mean	16.3 years	17.7 years	17.3 years	16.9 years
Standard deviation	12.1	12.1	12.4	12.3
Range	1–46 years	1–50	0–47	1–50
Percent time seeing patients				
Mean	69.7%	74.3%	71.4%	74.2%
Standard deviation	36.6	33.9	37.7	34.6
Range	0%–100%	0%–100%	0%–100%	0%–100%

Table 3 – Attitudes About Genomic Integration

Attitudes	Control	Intervention	p Value
	Follow-Up	Follow-Up	
Advantages			
Better treatment decisions	65.3% (220/337)	68.7% (5,366/7,813)	$p = .106$
Improved services to patients	60.5% (204–337)	66.9% (5,227/7,813)	$p = .010$
Disadvantages			
Increase patient anxiety about risk	40.9% (138/337)	40.6% (3,172/7,813)	$p = .470$
Would increase insurance discrimination	40.9% (138/337)	39.4% (3,078/7,813)	$p = .303$
Greater burden of responsibility on nurses	28.8% (97/337)	26.5% (2,073/7,813)	$p = .196$
Need to educate nurses on genetics	46.0% (155/337)	46.0% (3,595/7,813)	$p = .520$

Interventions

All intervention hospitals undertook genomic awareness campaigns followed by educational activities. Specific details about the strategies utilized by the dyads are reported elsewhere (Jenkins et al., 2015). Dyads initially focused on personal genomic competency and institutional leadership endorsement which delayed the onset of awareness initiatives (mean 4, range 1 to 9 months). Institutional education initiatives followed (mean 7, range 4 to 11 months). Most intervention dyads (98%) reported plans following study completion to continue integration of genomic competencies into nursing practice in their institution (Jenkins et al., 2015).

Attitudes and Receptivity

Intervention Group—Baseline Compared With Follow-Up
At follow-up, intervention nurses were more likely to consider decisions about recommendations for preventative services and adherence to better clinical recommendations as advantages to the integration of genomics into nursing practice ($p < .001$). There was a statistically significant improvement at follow-up in the proportion of nurses who agreed or strongly agreed that there is a role for nurses in counseling patients about genetic risks ($p < .001$). Otherwise, the remaining advantages and disadvantages were largely unchanged from baseline to follow-up.

Intervention Versus Control Group
The majority of nurses (71% intervention, 66% controls) agreed or strongly agreed that family history taking should be a key component of nursing care, which did not change over the course of the study in either group. When compared with controls, more intervention nurses considered better decisions about recommendations for preventative services ($p < .001$), and adherence to clinical recommendations ($p < .001$) were advantages to practice integration. Additional data on attitudes are provided in Table 3.

Most intervention and control nurses felt it was somewhat or very important to become educated in genetics of common disease, which did not change over the course of the study. There was a statistically significant increase in intervention nurses' intent to learn more about genetics when compared with controls ($p < .001$). Plus, nurses in the intervention group (72%) expressed greater intent to attend a course on their own time when compared with the control group (57%) at the follow-up assessment ($p < .001$).

Social System

Intervention Group—Baseline Compared With Follow-Up
The proportion of intervention nurses indicating that senior staff considered genetics an important part of the nurses' personal role increased from baseline (25%) to follow-up (36%).

Intervention Versus Control Group
More intervention nurses felt senior staff considered genetics an important part of the nurses' role ($p < .001$) and senior staff role ($p < .001$). Nurses in the control group reported no change in their views of senior staff importance of genetics from baseline to follow-up. There was no significant difference in the proportion of nurses who indicated they would be able to attend a course during work hours, which was greater than 50% in both the groups.

Confidence

Intervention Group—Baseline Compared With Follow-Up
Small improvements in confidence were detected in deciding what family history information is needed to tell something about a patient's genetic susceptibility to common diseases ($p = .003$); deciding which patients

would benefit from a referral for genetic counseling and possible testing for susceptibility to common diseases ($p < .001$); facilitating referrals for genetic services ($p < .001$); as well as accessing reliable and current information about genetics and common diseases ($p < .001$). Higher levels of academic preparation, reporting genomics content in the curriculum, and post-licensure continuing education also increased the above confidence variables.

Intervention Versus Control Group
At follow-up, no difference was detected in confidence in any of the questions. Eliciting no difference includes counseling patients about inherited risk for common diseases; deciding which patients would benefit from a referral for genetic counseling and possible testing for susceptibility to common diseases; accessing reliable and current information about genetics and genomics of common diseases; and providing information about the availability of genetic testing for common diseases.

Competency/Knowledge

Intervention Group—Baseline Compared With Follow-Up
The intervention group improved slightly in nurses agreeing that a family history including second- and third-degree relatives should be taken on every new patient. Additionally, for nurses taking family history, the proportion reporting always collecting age at diagnosis of condition ($p < .001$), race or ethnic background ($p < .001$), and age at death ($p < .001$) all increased. This group also reported increased confidence in deciding what family history information is needed to tell something about a patient's genetic susceptibility to common diseases ($p = .003$). The higher the level of academic preparation, the greater the likelihood nurses rated their understanding of the genetics of common diseases as higher ($p < .001$), reported having heard or read about the competencies ($p < .001$), and described their genetic/genomic knowledge as greater ($p < .001$). Similar findings were found in individuals reporting genomics content in the curriculum or reporting post-licensure continuing education. An objective true/false/don't know knowledge question on whether most common diseases such as diabetes and heart disease are caused by a single gene variant [correct answer false] increased at follow-up the number of correct responses for those nurses with high levels of education ($p < .001$), genomics in their curriculum ($p < .001$), or post-licensure continuing education in genomics ($p < .001$).

Intervention Versus Control Group
Having heard or read about the genetic/genomic nursing competencies was higher in the intervention cohort ($p = .001$). There was no statistical difference between the intervention and control groups on the remainder of the knowledge items.

Decision/Adoption

Intervention Group—Baseline Compared With Follow-Up
The intervention group improved their thinking that family history was important in supporting clinical decisions such as administering drugs prescribed ($p < .001$).

However, nurses who incorrectly believed genetics information about common disease would increase insurance discrimination were less likely to have facilitated a genetics referral ($p < .001$). Additionally, those with higher levels of confidence in deciding what family history information was needed to tell something about a person's genetic susceptibility to common diseases were more likely to complete a family history ($p < .001$). Academic education level, reporting genetics in the nursing curriculum, and attending a course since licensure that included genetics as a major component all significantly increased whether nurses reported completing a family history in the past 3 months ($p < .001$, $p < .001$, and $p < .001$).

Intervention Versus Control Group
There was no statistical difference for importance of family history at follow-up ($p = .084$). The intervention group reported a higher frequency over controls for family history completion that included three generations, information on the health disorders, age of diagnosis and death for each affected family member ($p = .004$). No difference was detected in the use of family history information to inform clinical decision making or recommendations. There was also no difference in facilitation of referrals to genetic services.

Administrator Impact Survey

Fifty-two percent of administrator dyad members completed the post-Genomic Administration Survey measuring impact domains. Forty-six percent of administrators financially invested in supplemental genomic personal development activities. Additional direct and indirect costs were incurred for the following:

- Other staff assigned to work on the initiative, 67%
- Providing replacement staff, 14%
- Marketing activities undertaken to raise awareness about the genomic initiative, 71%
- Continuing Education Units (CEU) for genomic education, 100%
- Supplies (e.g., folders) used to support initiatives, 80%
- Survey participation incentives, 71%

Limitations

Limitations to this study exist. Survey data were collected anonymously at the workforce level; therefore, data are not paired between baseline and follow-up. These data were generated from self-reported surveys and not actual clinical performance measures. There were varying institutional response rates, and control survey participation diminished at the post-intervention data collection point. Additionally, all participating institutions were Magnet Hospitals, which are considered facilities with a common core infrastructure focused on nursing strength and quality (Abraham, Jerome-D'Emilia, & Begun, 2011). Nurses completing the survey were largely baccalaureate prepared, reflective of Magnet Hospitals but not the national nursing workforce (National Council of State Boards of Nursing, 2016). All dyads were self-selected and utilized institution-specific strategies to build genomic capacity tailored to their setting and workforce.

Discussion and Recommendations

Complex Competency

Despite awareness changes resulting from the year-long intervention, competency deficits persisted with minimal changes in knowledge and adoption domains. This was influenced by the dyads time required for achieving personal genomic competency and institutional leadership endorsement. This finding is not surprising given genomics is a science that many health-care providers, including nurses, have limited foundational knowledge from which to build upon. This differs considerably from other reported change initiatives such as End of Life Nursing Education Consortium and Quality and Safety Education for Nurses which focused on health-care applications from which there were foundational underpinnings. This delayed onset of awareness and education initiatives demonstrates sustained efforts are required to expand the competency and capacity of the nursing workforce.

Genomics represents a complex competency. Innovation attributes such as observability have been shown to impact rates of adoption (Hayes, Eljiz, Dadich, Fitzgerald, & Sloan, 2015; Knudsen & Roman, 2015). Most genomic outcomes are not observable because competent genomic integration optimizes therapeutic interventions or reduces negative outcomes (e.g., drug adverse events, disease risk). This complexity affects observability and slows adoption rates (Rogers, 2003). A high level of interest including favorable perceptions about the need for genomic competency and intent to learn more genomics were not sufficient to overcome the lack of adequate knowledge about genomics and organizational infrastructure needs. Dyads self-defined personal knowledge development was a foundational necessity, unlike more familiar areas to nurses such as pain management or end-of-life care. Study leaders and champion dyads underestimated the time required to obtain knowledge and gain clarity about genomics and genomic competency for nurses. Neither the relative advantages of genomics as an innovation nor its compatibility with nursing practice including clinical utility to impact patient care were familiar to the nursing dyads. Given this study's findings, more effort, time, and expansion of the intervention are recommended.

Institutional Competency

This study documented substantial baseline genomic deficits in attitudes, confidence, and knowledge. However, receptivity was high, with most nurses thinking this was important. All institutional dyads opted to begin with awareness campaigns followed by education interventions. Consequently, educational endeavors began shortly before the outcome assessment.

Thus, adoption domains remained largely unchanged although significant changes were observed in increased awareness that leadership considered genomic competency an institutional priority. Social system is a vital DOI domain and an essential component of achieving competency and adoption. Capacity to learn more about genomics was improved for nurses reporting: higher academic degrees; genomic content in their curriculum; and/or post-licensure genomic continuing education. This supports the need for genomic integration into academic curricula at all degree levels as well as increased post-licensure genomic continuing education opportunities. Consideration could be given to genomic continuing education supported at the hospital level which enables interdisciplinary team participation. Furthermore, this provides the nurse with evidence that genomics is considered a competency priority by nursing leadership.

Correcting misconceptions proved important to adoption. Those who thought use of genomics would increase insurance discrimination were not likely to refer a patient to genetic services. Confidence also influenced adoption, an indicator of increased competency. Lower levels of nurse confidence in deciding what family history information was indicative of a genetic susceptibility to common disease correlated with lower use of family history.

An outcome from this study was resource development (Jenkins et al., 2015). Participants continue their networking and collaborative efforts by developing a resource toolkit, including proven strategies and management best practices to facilitate genomic adoption in an institutional setting. A toolkit website, http://genomicsintegration.net, launched in August 2017, provides access to resources Method for Integrating a New Competency (MINC) dyads developed and their recommended strategies and best practices.

Policy Implications

Studies have documented that nurses feel it is important to become more knowledgeable about the genetics of common diseases (Calzone et al., 2012, 2013). Despite these findings, genomic integration at the bedside continues to lag. Introducing genomics as a leadership led health-care improvement changed nurses' intent to learn about genetics. Leadership involvement made it more likely that nurses would engage in learning and apply genomic information at the point of practice.

However, even with an increase in nurses' views that senior staff considered genetics an important part of the nurses' personal role, most nurses (64%) at follow-up viewed their senior staff as not valuing genetics. Several dyads were surprised at their data on this item at baseline and explored this further with focus groups. Participants in these forums reported that they considered senior staff as their direct nursing supervisor and not the Chief Nursing Officer or other higher level nursing leaders. This highlights the importance of engaging all levels of nursing leadership in any genetic competency initiative.

This study documented the critical role nursing administrators play in change efforts such as Electronic Health Record modifications, providing staffing, release time, and funding for a competency effort of this magnitude. Most Chief Nursing Officers had to defend the return on investment for this initiative at the highest levels of institutional leadership such as the Board of Directors and Medical Director. This supports the premise that all individuals in the health-care system need some genomic competency to support point of care integration efforts. Effective leadership can establish policies and build genomic capacity. This facilitates the application of genomic information proven to increase quality and safety as well as contain health-care costs.

Across the health-care community, we already see those in specialized areas where genomic information is sporadically reaching the bedside, such as cancer care, making a difference in treatment and quality of life (McDermott, Downing, & Stratton, 2011; Subbiah & Kurzrock, 2016). Studies across the interprofessional health community document that inadequate genomic competency impacts the capacity to integrate genomics appropriately into practice (Calzone & Jenkins, 2012; Calzone et al., 2013; Korf et al., 2014). This lack of competency extends to health providers in all disciplines and all roles including administrators, educators, researchers, and practitioners. The MINC study targeted nursing; however, most dyads engaged interprofessionally. Although the outcome measurements were only administered to nurses, genomic competency is an interprofessional challenge (Institute of Medicine [IOM], 2015). Therefore, genomic competency efforts align perfectly with the interprofessional competency model (Interprofessional Education Collaborative Expert Panel, 2011).

Next Steps

Quality and safety are essential outcome measures. The convention in nursing has been to measure nursing quality through safety outcomes such as Nursing Hours per Patient Day (structure), Falls or Falls with Injury (process and outcome), Pressure Ulcer Prevalence (process and outcome), and Nosocomial Infections (outcome) (Izumi, 2012; Montalvo, 2007). The *Essentials* define what the nurse is required to know about genomics to achieve competency (Consensus Panel on Genetic/Genomic Nursing Competencies, 2009). Nursing-sensitive genomic quality measures should evaluate RNs' use of professional judgment, clinical reasoning, and patient outcomes, but no nursing-sensitive quality measures in genomics currently exist. An advisory panel was convened in 2016 by members of the MINC leadership with support from the National Human Genome Research Institute to start the process for developing interprofessional genomic quality measures so nursing-sensitive outcomes can be evaluated.

Conclusions

The nursing profession is a cornerstone of health-care delivery and an essential bridge between genomic discoveries with clinical utility and their adoption into practice to advance health (Calzone et al., 2010). Genomics is a central science for health-care practitioners, including nurses. The Precision Medicine Initiative is poised to accelerate genomic discoveries relevant to practice (Collins & Varmus, 2015). Assuring the genomic awareness of nurses in the workforce is an essential step to realizing the benefits of genomic discoveries on the public's health. Longer term interventions are required for successful practice integration. This necessitates an ongoing investment in leadership education, infrastructure, and policy development to enable genomic adoption enhancing health-care safety and quality while reducing costs. Results provide policy makers and health-care leaders a mechanism applicable to the interprofessional health-care community for capacity building and integration of genomics to improve health outcomes.

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