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Genetic and genomic nursing competency among nurses in tertiary general hospitals and cancer hospitals in mainland China: a nationwide survey

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ABSTRACT

Objectives To explore genetic/genomic nursing competency and associated factors among nurses from tertiary general and specialist cancer hospitals in mainland China and compare the competencies of nurses from the two types of hospitals.

Design and setting A cross-sectional survey was conducted from November 2019 to January 2020, wherein 2118 nurses were recruited from 8 tertiary general hospitals and 4 cancer hospitals in mainland China. We distributed electronic questionnaires to collect data on nurses' demographics, work-related variables and genomic nursing competency.

Participants 2118 nurses were recruited via a three-stage stratified cluster sampling method.

Results More than half (59.1%, 1252/2118) of the participants reported that their curriculum included genetics/genomics content. The mean nurses' genomic knowledge score was 8.30/12 (95% CI=8.21 to 8.39). Only 5.4% had always collected a complete family history in the past 3 months. Compared with general hospital nurses, slightly more cancer hospital nurses (75.6% vs 70.6%, p=0.010) recognised the importance of genomics, while there was no significant difference in the knowledge scores (8.38 vs 8.21, p>0.05). Gender (β=0.06, p=0.005), years of clinical nursing (β=−0.07, p=0.002), initial level of nursing education (β=0.10, p<0.001), membership of the Chinese Nursing Association (β=0.06, p=0.004), whether their curriculum included genetics/genomics content (β=0.08, p=0.001) and attitude towards becoming more educated in genetics/genomics (β=0.25, p<0.001) were significantly associated with the nurses' genomic knowledge score.

Conclusion The levels of genomic knowledge among mainland Chinese nurses in tertiary hospitals were moderate. The overall genomic competency of cancer hospital nurses was comparable to that of general hospital nurses. Further genomic training is needed for nurses in China to increase their genomic competency and accelerate the integration of genomics into nursing practice.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The Genetics and Genomics in Nursing Practice Survey (GGNPS) was used after a cross-cultural adaptation, making the instrument more appropriate for Chinese nurses.
⇒ A large sample of nurses was obtained from 12 tertiary hospitals from across China.
⇒ The tertiary hospitals included in the study were not randomly selected, potentially limiting the generalisability of the findings.
⇒ The electronic data collection used for the survey will have limited the participants to only those having internet access.
⇒ Due to differences in language and culture, the adequacy of the GGNPS translation and adaptation for local contexts may be potential limitations.

INTRODUCTION

With the completion of the Human Genome Project in 2003 and the introduction of the Precision Medicine Initiative in 2015, genomic knowledge and technology have profoundly impacted medical practice, providing new diagnoses and treatment methods for certain diseases. Like all healthcare professionals, nurses should have essential genomic competence to practice effectively in the genomic era. As the primary contact for patients, nurses play a vital role in the clinical application of genomic knowledge, such as health assessors and health educators. Nurses may identify at-risk individuals by completing a three-generation family history (FH) assessment, as well as directing these individuals for genetic consultation to further manage the diseases' risk, which includes providing health education on risk management and, when applicable, the purpose, benefit and risks of genetic testing to the patients.[1 2]

Essential genomic nursing competencies specify what knowledge, skills and attitudes a nurse needs to apply to conduct nursing assessments of clients; identify potential clients who would benefit from genomics, as well as available resources; recommend

professional genetic and genomic referral services and provide professional education, care and support to clients.[3] The Consensus Panel on Genetic/Genomic Nursing Competencies proposed that all registered nurses should have such competencies, and the Global Genomics Nursing Alliance (G2NA) advocated for the integration of genomics into all levels of nursing practice.[4] Among the 18 original member countries of the G2NA, only 3 countries and 1 region (UK, USA, Japan and Europe) have developed competency frameworks or curriculum guidelines for all nurses.[4]

The following existing studies have explored nurses' genomic nursing competency levels and related factors in different countries or regions. However, there is little understanding about genomic nursing competency in many countries globally. In the USA, Israel, Italy, Australia and Turkey, previous studies have found that although most nurses believe that genomics is important to their nursing practice, they lack confidence and competency to use it in practice.[5–9] Moreover, most nurses believe that their genomic knowledge and skills are too poor to be integrated effectively into nursing practice.[5 6 8] An integrated review published in 2018 showed that nurses had made minimal progress towards achieving core genomic competency in the previous 5 years.[10] The lack of understanding of the competency of nurses directly affects the quality of care delivered to patients.

Though genomic nursing competencies are an emergent need for nurses, especially those in oncology settings who should have in-depth genomic knowledge and skills,[11] this topic has been rarely investigated. Studies include both quantitative and qualitative data. Combining the results of these studies, we found that oncology nurses have moderate or even poor genetic and genomic knowledge.[11–13] For example, Seven showed that 'Turkish oncology nurses have a moderate level of knowledge in cancer genetics',[11] and Wright showed that 'most participants reported their genomic knowledge as poor or average'.[13] Moreover, few studies have compared the genomic competence of oncology nurses with other nurses in different specialist fields. To the best of our knowledge, one study has compared the differences in genomic knowledge among obstetric, internal and paediatric nurses,[6] but no studies have addressed how this competency varies among oncology and general nurses. This hinders the development of field-targeted training programmes for nurses from various clinical departments, which in turn influences the quality of care.

The Rogers' Diffusion of Innovations (DOI) theory[14] provides a comprehensive insight into understanding genomic nursing competency. According to this theory, integrating genomics into nursing practice is consistent with the DOI as it is a new and complex competency for nurses to achieve. Rogers suggested that an innovation-decision process always begins with the knowledge of the innovation, highlighting the importance of understanding the fundamentals of genomics. More education, higher social status, more exposure to mass media channels of communication and interpersonal channels were the characteristics of earlier adopters of innovation. According to the five main steps (knowledge, persuasion, decision, implementation and confirmation) of the innovation-decision process proposed in the DOI theory and two other existing genomic nursing competency frameworks,[15 16] the Genetics and Genomics in Nursing Practice Survey (GGNPS)[17] was developed. The GGNPS was derived from a well-validated instrument assessing the adoption of genomics by family physicians[18] and is a nursing-specific instrument designed to evaluate genomic nursing competency. This instrument is internationally relevant and can be used in various countries and areas with variable resources,[4 9 19] because it adopts FH as the basis for competency assessment.[17] In China, taking FH is routine for nurses; however, genomics requires more in-depth FHs and the creation of a pedigree.

As the only developing country that has participated in the Human Genome Project, China launched its Precision Medicine Initiative in 2016. However, to the best of our knowledge, there is a lack of understanding on the current status of nurses' genomic competency in mainland China. The total number of registered nurses reached about 4.709 million by the end of 2020 in mainland China.[20] Hospitals in mainland China are divided into 3 grades according to their function and scale: primary hospitals, which are generally township hospitals with less than 100 beds; secondary hospitals, which contain 100–500 beds and tertiary hospitals, which are provincial or national, with bed capacity exceeding 500.[21] Tertiary hospitals include general and specialised hospitals. As China has many new cancer cases every year,[22] each province has a tertiary provincial cancer hospital. Generally, nurses in tertiary hospitals have more opportunities to access and use genomic knowledge and skills.

Therefore, based on the DOI theory and adopting the GGNPS, the present study aims to understand genomic competency and associated factors through the perspective of nurses at tertiary general and cancer hospitals. This study will provide an evidence base for formulating a training programme on genomic integration into nursing practice and will lay the foundation for driving the overall development of genomic nursing competency in mainland China and similar settings.

METHODS

Study design

The study was a cross-sectional electronic survey conducted from November 2019 to January 2020. It aimed at understanding the current status and specific factors influencing genomic nursing competency in tertiary hospitals in mainland China and comparing the differences between nurses in general hospitals and cancer hospitals. Both the STrengthening the Reporting of OBservational studies in Epidemiology checklist and the Checklist for Reporting Of Survey Studies were used to guide reporting of this study.[23 24]

Study settings and sample

The target participants were nurses from tertiary general hospitals and cancer hospitals in mainland China. In this research, oncology nurses were operationally defined as nurses from the oncology departments of cancer hospitals, and general nurses were operationally defined as nurses from the non-oncology departments of tertiary general hospitals. We adopted a three-stage stratified cluster sampling method. In the first stage, we selected five provinces (Beijing, Shandong, Hunan, Guangxi Zhuang autonomous region and Xinjiang Uygur autonomous region) from different geographical regions of China (north, east, central, south and northwest), with 0.967 million registered nurses by the end of 2020. In the second stage, we selected one cancer hospital and two tertiary general hospitals from each province. We then contacted the nursing directors of these hospitals for permission for the study. In total, four cancer hospitals (except for the Xinjiang Uygur autonomous region) and eight tertiary general hospitals (except for the Guangxi Zhuang autonomous region) agreed to participate in the investigation. In the third stage, we selected the clinical departments taking care of patients and randomly selected 10 non-oncology departments from each general hospital and 20 oncology departments from each cancer hospital. All 2673 nurses from the selected departments were potential participants. The inclusion criteria were nurses who were (1) registered nurses and (2) full-time employees. The exclusion criteria were being temporarily away from nursing posts for maternity leave, sick leave or other reasons during the data collection period.

The sample size was calculated using PASS V.15.0 software (NCSS, Kaysville, Utah, USA). The knowledge score of the GGNPS was used as the primary outcome for the sample size estimation. We used the results of a large-scale survey in the USA, which reported an average knowledge score of 8.08 (SD: 1.62).[5] Assuming a type I error of 5% (two-tail), an allowable error of 0.1, a total SD of 1.62 and a design effect of 1.5, the sample size was estimated as 1514. Given an invalid response rate of 20%, we would have had to collect at least 1817 nurses. Finally, 1166 cancer hospital nurses and 952 general hospital nurses completed the survey, and the final sample size was 2118, achieving the prior hypothesised calculation.

Measures

We adopted several questionnaires to measure genomic nursing competency, social demographics and work-related variables (online supplemental file 1).

We used the GGNPS to assess nurses' genomic nursing competency. This instrument measures five domains: knowledge, attitudes/receptivity, confidence, decision/adoption and the social system. The knowledge domain measures knowledge of the genomics of common diseases and the FH information required to evaluate patients' genetic susceptibility. The attitudes/receptivity domain assesses the perceived importance, advantages and disadvantages of integrating genomics into practice. The confidence domain measures confidence in (1) discussing genetics with patients; (2) deciding what FH information is relevant to assessing genetic susceptibility; (3) determining the availability, risks, benefits and limitations of genetic testing; and (4) facilitating referrals for genetic services. The decision/adoption domain involves self-reported collection and assessment of FH within the past 3 months, as well as self-reported facilitation of referrals to genetic services. The social system domain measures supervisory support for nurses using genomics and institutional financial support for genomic continuing education. The GGNPS contains 47 items comprising multiple-choice, dichotomous (yes/no, true/false) and Likert-scale questions. Items corresponding to the attitudes/receptivity, confidence, social system and adoption domains were analysed individually and not combined to form scores. The responses to 12 items measuring genomic knowledge were combined to form a knowledge score, ranging from 0 to 12; a higher score indicated better knowledge.

After receiving permission from the original author of the questionnaire, we conducted a cross-cultural adaptation of the GGNPS to develop a Chinese version (GGNPS-CV) according to the guidelines of the American Academy of Orthopaedic Surgeons, including the initial translation, synthesis, back-translation, expert committee review and test of the prefinal version.[25] The GGNPS-CV was subjected to content validity testing by five experts (two college nursing professors and three clinical oncology care specialists). Minor amendments were made to the GGNPS-CV to be tailored to the Chinese context. The scale-level content validity index (S-CVI) of the GGNPS-CV was 0.94. We conducted a pilot study among 30 nurses from a nurses' training meeting to ascertain whether the instrument was understandable and whether the test was reliable. The internal consistency Cronbach's alpha of the GGNPS-CV was 0.867.

A series of self-made questions were used to assess sociodemographics and work-related variables, including age, gender, marital status, work experience, educational background, professional title, monthly income and genetics/genomics training experience. We also asked whether they were working in a cancer hospital or a general hospital.

Data collection

Data were collected from the Chinese professional survey website Wenjuanxing (www.sojump.com). First, we sent the questionnaire QR code and unified instructions to the director of the nursing department of each hospital, who forwarded the questionnaire link to the head nurses of the selected departments. The head nurses then sent the QR code to their individual WeChat working groups to ensure that the questionnaire was accessible to each potential nurse in the department. Along with the code, a message with a brief introduction to this study and the principles of anonymity and voluntariness was forwarded. Any voluntary and interested nurses were screened

through the link, able to provide informed consent and complete the survey. Participants can only answer the questionnaire through WeChat, and one WeChat ID can only participate once. Only after answering all of the required items can the questionnaire be submitted. All 2673 nurses from the selected departments of the 12 hospitals had access to this online survey, and 2168 nurses completed the survey with a response rate of 81.1%. After the survey, each participant received ¥10 (~ US$1.5) as a compensation for their participation. A total of 50 responses were considered invalid due to their low quality (eg, the selected options for each item were the same) and logic errors (such as if a respondent's reported practice duration exceeded their age, or if someone started work at the age of less than 18). Finally, 2118 respondents were selected for the analysis.

Data analysis

Data were analysed using the IBM SPSS V.23.0 software package. Frequencies, percentages, means and SD were used to describe the participants' demographic and work-related variables and genomic nursing competency. A χ^2 test and an independent samples t-test were conducted to compare the differences in the genomic nursing competency of the nurses in the two types of hospitals.

The content validity of the instrument was determined by calculating the S-CVI based on experts' ratings of item relevance (1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=highly relevant). The S-CVI/Ave was computed as follows: The total number of items with a rating of 3 or 4 by all experts combined was determined and then divided by the total number of ratings.[26]

Multivariable linear regression models were used to identify the salient variables associated with genomic knowledge scores. The basic hypotheses of autocorrelation and multicollinearity were tested before performing the regression analysis. The Durbin-Watson value was 1.99, which indicated no autocorrelation. Multicollinearity was not found within the tolerance value, which ranged from 0.20 to 0.99, and the variance inflation factors ranged from 1.02 to 5.14. We conducted a three-block hierarchical regression analysis to analyse the impact of the hospital types, the genetics/genomics training experiences and attitudes towards genomic integration on nurses' genomic knowledge. First, personal and work-related characteristics were entered using the stepwise method, and four statistically significant variables were identified. These four variables were entered as a block into model 1. Then, we added the type of hospital in the second block of model 2. In model 3, genetics/genomics-related training experiences (whether the nursing curriculum included genetics/genomics content and attendance at genetics/genomics training since licensure) and attitudes towards genomic integration (importance of becoming more educated in genetics and genomics of common diseases) were included as the third block. Next, the R^2 changes and p values were calculated, and a value with $p<0.05$ was considered statistically significant (two-tailed test).

Patient and public involvement

There was no patient or public involvement in the study. Five experts and thirty nurses contributed their professional opinions to the cross-cultural adaptation of the research instrument.

RESULTS

Sample characteristics

Table 1 compares demographic and work-related characteristics of the participants, as well as their genomic training information. Among the 2118 participants, 44.9% came from general hospitals (952/2118), while 55.1% (1166) came from cancer hospitals. The age of the participants ranged from 19 to 60 years (mean=31.44 years, SD=6.43), with an average work experience of 9.59 years (SD=7.00, range: 1–37 years). Most of the respondents were female (97.7%), Han (86.4%) and married (69.5%). A majority had bachelor's degrees (80.1%), and 67.5% of the nurses had junior professional titles. Most nurses (75.7%) spent more than 50% of their working time taking care of patients. More than half (N=1252, 59.1%) reported that their curriculum had included genetic and genomic content, but only 504 nurses (23.8%) had attended genetic and genomic training since licensure. In addition to ethnicity and whether their nursing curriculum included genetic/genomic content, there were statistical differences in the demographic and work-related characteristics among the nurses from the two hospital types ($p<0.05$). Nurses over age 35 years were significantly less likely to report genetic/genomic curriculum content in their prequalification curriculum compared with those aged equal to or younger than 35 years (53.7% vs 60.5%, $\chi^2=6.57$, $p=0.010$). Nurses with more than 20 years of practice were significantly less likely to have genetic/genomic curriculum content in the pre-qualification curriculum than those with equal to or less than 20 years of practice (43.3% vs 60.6%, $\chi^2=20.26$, $p<0.001$).

Descriptive analysis and comparison of genomic competency among nurses from cancer hospitals and general hospitals

Domain 1: knowledge

The data on self-reported genetic/genomic knowledge are presented in table 2. Approximately 83% (N=1753/2118) of the participants, comprising 996 nurses from cancer hospitals and 757 from general hospitals ($\chi^2=13.11$, $p=0.001$), reported that genetic test results were essential to support clinical decisions. Less than 60% of nurses reported that they understood the genetics of common diseases (57.3%, N=1214) and that their overall genomic knowledge was poor (61.9%, N=1312). Furthermore, when a patient indicated a disorder in the family,

Table 1 Comparison of demographic and work-related characteristics of the participants from the two hospital types

Variable	Total (N=2118)	Cancer hospital nurses (N=1166)	General hospital nurses (N=952)	χ^2	P value
Gender				14.32	<0.001
Male	49 (2.3)	40 (3.4)	9 (0.9)		
Female	2069 (97.7)	1126 (96.6)	943 (99.1)		
Age (years)				28.24	<0.001
≤25	334 (15.8)	217 (18.6)	117 (12.3)		
26–30	782 (36.9)	446 (38.3)	336 (35.3)		
31–35	570 (26.9)	272 (23.3)	298 (31.3)		
36–40	234 (11.0)	130 (11.1)	104 (10.9)		
>40	198 (9.3)	101 (8.7)	97 (10.2)		
Ethnicity				0.02	0.899
Han	1831 (0.9)	1009 (86.5)	822 (86.3)		
Other	287 (0.1)	157 (13.5)	130 (13.7)		
Marital status				17.40	<0.001
Not married	611 (28.8)	378 (32.4)	233 (24.5)		
Married	1472 (69.5)	773 (66.3)	699 (73.4)		
Other	35 (1.7)	15 (1.3)	20 (2.1)		
Years of clinical nursing				26.52	<0.001
<3	329 (15.5)	222 (19.0)	107 (11.2)		
3–10	1157 (54.6)	625 (53.6)	532 (55.9)		
11–20	452 (21.3)	226 (19.4)	226 (23.7)		
>20	180 (8.5)	93 (8.0)	87 (9.1)		
Initial level of nursing education				6.63	0.036
Associate degree or diploma	1484 (70.1)	790 (67.8)	694 (72.9)		
Bachelor's degree	615 (29.0)	365 (31.3)	250 (26.3)		
Master's degree or above	19 (0.9)	11 (0.9)	8 (0.8)		
Highest level of nursing education				104.32	<0.001
Associate degree or diploma	340 (16.1)	102 (8.7)	238 (25.0)		
Bachelor's degree	1697 (80.1)	1010 (86.6)	687 (72.2)		
Master's degree or above	81 (3.8)	54 (4.6)	27 (2.8)		
Professional title*				18.00	<0.001
Junior professional title	1429 (67.5)	816 (70.0)	613 (64.4)		
Intermediate professional title	623 (29.4)	304 (26.1)	319 (33.5)		
Senior professional title	66 (3.1)	46 (3.9)	20 (2.1)		
Average monthly income				96.47	<0.001
≤ ¥5000 (approximately US$776)	400 (18.9)	172 (14.8)	228 (23.9)		
¥5001–10 000 (approximately US$776–1552)	1293 (61.0)	675 (57.9)	618 (64.9)		
> ¥10 000 (approximately US$1552)	425 (20.1)	319 (27.4)	106 (11.1)		
Member of Chinese Nursing Association				19.47	<0.001
Yes	623 (29.4)	389 (33.4)	234 (24.6)		
No	1495 (70.6)	777 (66.6)	718 (75.4)		
Nursing researcher				10.93	0.001
Yes	53 (2.5)	41 (3.5)	12 (1.3)		
No	2065 (97.5)	1125 (96.5)	940 (98.7)		

Continued

Table 1 Continued

Variable	Total (N=2118)	Cancer hospital nurses (N=1166)	General hospital nurses (N=952)	χ^2	P value
Percentage of worktime spent caring for patients				9.29	0.026
≤25%	142 (6.7)	69 (5.9)	73 (7.7)		
26%–50%	371 (17.5)	188 (16.1)	183 (19.2)		
51%–75%	721 (34.0)	393 (33.7)	328 (34.5)		
>76%	884 (41.7)	516 (44.3)	368 (38.7)		
Nursing curriculum included genetic/genomic content				0.06	0.807
Yes	1252 (59.1)	692 (59.3)	560 (58.8)		
No	866 (40.9)	474 (40.7)	392 (41.2)		
Genetic/genomic training since licensure				0.127	0.007
Yes	504 (23.8)	274 (23.5)	230 (24.2)		
No	1614 (76.2)	892 (76.5)	722 (75.8)		

Data in the table are N (%).
*Professional title is a sign reflecting the technical level and working ability of clinical nurses in China. Junior professional title is the lowest level, intermediate title is the medium level and senior title is the highest level.

some of the nurses reported that they always collected the age of diagnosis (31.9%, N=675), the relationship to the patient (46.3%, N=981), race or ethnic background (29.4%, N=623), age at death from the condition (30.1%, N=637) and maternal and paternal lineages (41.6%, N=882).

The mean total knowledge score was 8.30/12 (95% CI=8.21 to 8.39) with an SD of 2.07, reaching a correct response rate of 69.1%, which was not significantly different among the cancer and general hospital nurses' scores (8.38 vs 8.21, p>0.05). From the perspective of knowledge items, the majority correctly responded to questions about whether genomic risk (as indicated by FH) has clinical relevance for diabetes (92.2%, N=1953) and breast cancer (90.2%, N=1911). However, only 23.3% of participants correctly answered the true/false question that 'the DNA of sequences of two randomly selected healthy individuals of the same sex are not 90%–95% identical' and only 28.4% of participants knew that 'diabetes and heart disease are not caused by a single gene variant'. A significantly higher proportion of cancer hospital nurses correctly answered that 'a FH that includes

Table 2 Knowledge of genomics among nurses in the two hospital types

Measure	Total (N=2118)	Cancer hospital nurses (N=1166)	General hospital nurses (N=952)	T-test/χ^2 test	P value
Genomic knowledge score, mean (SD)				1.83*	0.068
	8.30 (2.07)	8.38 (2.08)	8.21 (2.06)		
Understanding of the genetics of common diseases				1.38†	0.503
Excellent	188 (8.9)	103 (8.8)	85 (8.9)		
Good	716 (33.8)	382 (32.8)	334 (35.1)		
Poor	1214 (57.3)	681 (58.4)	533 (56.0)		
Self-assessment of overall genomic knowledge				3.44†	0.179
Excellent	175 (8.3)	98 (8.4)	77 (8.1)		
Good	631 (29.8)	328 (28.1)	303 (31.8)		
Poor	1312 (61.9)	740 (63.5)	572 (60.1)		
Whether genetic test result is essential to support clinical decisions				13.11†	0.001
Not at all	77 (3.6)	38 (3.3)	39 (4.1)		
Essential	1753 (82.8)	996 (85.4)	757 (79.5)		
Don't know	288 (13.6)	132 (11.3)	156 (16.4)		

Data in the table are N (%), except where noted as mean (SD).
*Independent samples t-test.
†χ^2 test.

Table 3 Attitudes towards genomic integration

Item	Total (N=2118)	Cancer hospital nurses (N=1166)	General hospital nurses (N=952)	χ^2	P value
Become more educated in genetics and genomics of common diseases for nurses				14.48	0.002
Not at all important/not very important	44 (2.1)	18 (1.5)	26 (2.7)		
Neutral/not sure/don't know	521 (24.6)	267 (22.9)	254 (26.7)		
Somewhat important	700 (33.1)	373 (32.0)	327 (34.3)		
Very important	853 (40.3)	508 (43.6)	345 (36.2)		
Advantages					
Better treatment decisions	1968 (92.9)	1096 (94.0)	872 (91.6)	4.59	0.032
Improved services to the patients	1860 (87.8)	1027 (88.1)	833 (87.5)	0.16	0.685
Better adherence to clinical recommendations among patients	1965 (92.8)	1097 (94.1)	868 (91.2)	6.60	0.010
Disadvantages					
Would take too much time working and studying	1478 (69.8)	810 (69.5)	668 (70.2)	0.12	0.727
Can't be reimbursed/cost too much	1452 (68.6)	781 (67.0)	671 (70.5)	2.98	0.084
Need to 're-tool' professionally	1495 (70.6)	803 (68.9)	692 (72.7)	3.69	0.055
Increase patient anxiety about risk	1106 (52.2)	602 (51.6)	504 (52.9)	0.36	0.548
Would increase insurance discrimination	1119 (52.8)	595 (51.0)	524 (55.0)	3.39	0.066

Data in the table are N (%).

only first-degree relatives should be taken for every new patient' compared with general hospital nurses (43.8% vs 36.0%, p<0.001).

Domain 2: attitudes/receptivity

Most respondents felt it was very important (40.3%, N=853) or somewhat important (33.1%, N=700) for nurses to become more educated on the genetics and genomics of common diseases. Compared with general hospitals (36.2%), more cancer hospital nurses (43.6%) felt it was very important (p<0.001). Overall, 92.9% nurses considered 'better treatment decisions' to be one of the potential advantages of integrating genomics into practice, while more cancer hospital nurses agreed with it (p=0.032). Most of the nurses (70.6%, N=1495) selected 'need to 're-tool' professional knowledge and skills' as a potential advantage. Additional data on attitudes are provided in table 3.

Domain 3: confidence

A total of 70.6% (N=1495/2118) nurses had confidence in collecting FH information about a patient's genetic susceptibility to common diseases, with the most reported being confident in discussing information about the risks (71.9%, N=1522), benefits (74.4%, N=1576) and limitations (67.8%, N=1435) of genetic testing for common diseases. More nurses in cancer hospitals reported being confident in discussing risks (68.7% vs 74.4%, p=0.003), benefits (72.0% vs 76.4%, p=0.019) and limitations (64.8% vs 70.2%, p=0.009) of genetic testing than nurses in general hospitals.

In addition, the majority reported having confidence in facilitating referrals for genetic services (69.0%, N=1462), accessing reliable and current information about the genetics and genomics of common diseases (66.1%, N=1400), discussing how FH affects recommended screening intervals (64.4%, N=1365) and deciding which patients would benefit from a referral for genetic counselling and possible testing for susceptibility to common diseases (60.6%, N=1284). No difference was found in these variables between nurses from the two types of hospitals.

Domain 4: decision/adoption

A total of 2061 (97.3%) nurses, including 926 general hospital nurses and 1135 cancer hospital nurses, reported that they were actively taking care of patients. Of these, only 5.4% (N=111) indicated that they had always collected a complete FH in the previous 3 months, compared with 5.5% (N=51/926) nurses in general hospitals and 5.3% (N=60/1135) nurses in cancer hospitals. Furthermore, 81.3% (N=1675/2061) reported that they had never or rarely facilitated referrals to genetic services in the past 3 months. The majority (69.0%, N=1421/2061) indicated that they had never or rarely used FH information when facilitating clinical decisions or recommendations for their patients in the past 3 months. A total of 22.5% (N=464/2061) nurses reported that some patients had initiated a discussion with them about genetics in the previous 3 months; this was reported more by cancer hospital nurses (26.3%) than general hospital nurses (17.8%).

Table 4 Hierarchical linear regression analyses of factors associated with the nurses' genomic knowledge total score (N=2118)

	Model 1		Model 2		Model 3	
Variable	β (95% CI)	P value	β (95% CI)	P value	β (95% CI)	P value
Gender						
Male	Ref		Ref		Ref	
Female	0.06 (0.02 to 0.10)	0.006	0.06 (0.02 to 0.11)	0.004	0.06 (0.02 to 0.10)	0.005
Years of clinical nursing	−0.09 (−0.14 to 0.05)	<0.001	−0.09 (−0.14 to 0.04)	<0.001	−0.07 (−0.11 to 0.03)	0.002
Initial level of nursing education	0.09 (0.04 to 0.13)	<0.001	0.09 (0.04 to 0.13)	<0.001	0.10 (0.06 to 0.14)	<0.001
Member of Chinese Nursing Association	0.07 (0.02 to 0.11)	0.003	0.06 (0.02 to 0.11)	0.005	0.06 (0.02 to 0.10)	0.004
Type of hospital						
General hospital			Ref		Ref	
Cancer hospital			0.03 (−0.02 to 0.07)	0.231	0.01 (−0.03 to 0.05)	0.744
Did nursing curriculum include genetics and genomics content?					0.08 (0.03 to 0.12)	0.001
Genetics/genomics course since licensure					−0.02 (−0.07 to 0.02)	0.286
Attitude towards becoming more educated in genetics and genomics of common diseases					0.25 (0.20 to 0.29)	<0.001
F	12.90	<0.001	10.61	<0.001	26.78	<0.001
$\triangle R^2$	0.02		<0.01		0.07	
$\triangle F$			1.44	0.231	52.44	<0.001

β stands for standard regression coefficient; $\triangle R^2$ stands for change in explained variance.

Domain 5: social system

Most participants reported that they intended to learn more about genetics and genomics (57.3%, N=1213/2118); 42.4% (N=899) indicated they would attend a genetic and genomic course during work hours, and 47.4% (N=1003) indicated that they would attend such a course on their own time. More nurses in the cancer hospitals intended to learn more about genetics and genomics than the general hospital group (60.6% vs 53.2%, p=0.001). Additionally, almost the same percentage of respondents thought that their senior staff saw genetics/genomics as important for nurses (36.4%, N=770) and senior nurses (36.4%, N=771).

Multivariable analyses of factors associated with nurses' genomic knowledge

Table 4 shows the results obtained for a multivariable linear hierarchical regression analysis conducted to identify the factors associated with nurses' genomic knowledge. Four variables were significantly associated with the total score of nurses' genomic knowledge in model 1 (F=12.90, p<0.001): gender, years of clinical nursing, initial level of nursing education and membership of the Chinese Nursing Association. The second model showed that hospital type was not a significant factor (β=0.03, p=0.231). In the final model, whether the nursing curriculum included genetic/genomic content (β=0.08, p=0.001) and attitude towards genomic integration (β=0.25, p<0.001) was significantly related to genomic knowledge. In particular, nurses who were female, had fewer working years, had a higher initial level of nursing education, were members of the Chinese Nursing Association, had genetic/genomic content as part of their nursing curriculum or who regarded genetics and genomics were important for practice, had higher knowledge scores.

DISCUSSION

This study is the first cross-China survey that assessed the genomic nursing competency of mainland Chinese registered nurses. The findings revealed some interesting trends concerning genomic nursing competency among Chinese nursing professionals and can provide clues for suitable and targeted training for developing nurses' genomic nursing competency.

The knowledge of genomics among these samples was at a moderate level, with a 69.1% (8.30/12) correct response rate. The result was very close to the score of a large national-scale survey in the USA (8.08/12) conducted as early as 2012[5] but much lower than the score of Turkish nurses in 2020 (9.36/12).[9] In contrast, the knowledge of nurses in our country is far from adequate, as mainland Chinese nurses' genomic knowledge is similar to that of the nurses 7 years prior in the USA despite the elapsed

time and the rapid development of genomics. Meanwhile, approximately 62% of our participants considered their overall genomic knowledge to be poor. The gap between the subjective perception of knowledge and the objective score is an interesting phenomenon, potentially because the 12 knowledge questions of the GGNPS cover only basic genomic knowledge. In our study, 59.1% of the participants reported that their curriculum included genetic and genomic content, but only 23.8% of nurses had had genetic and genomic training since licensure. This proportion is very low; thus, it is necessary to strengthen nurses' genomic knowledge and skills.

Furthermore, our study indicated that nurses in mainland China had positive attitudes towards genomic nursing and confidence in adopting this knowledge. Most nurses believed that genomics was important to their practice, which is in line with the results reported by studies conducted in other countries.[5 8 19] Most nurses recognised the potential advantages of genomics. The findings of this study showed that 60.6%–74.4% of Chinese nurses were confident in genomic integration and adoption, such as collecting FH information, informing the benefits of genetic testing and providing referral services, which was slightly better than the confidence of American nurses in 2012 and nurse faculty in 2014 (less than 50%).[5 19] However, in some aspects, the confidence of nurses in this study was lower than that of Turkish nurses in 2020 (51.7%–86.5%).[9]

Incompatible to the level of knowledge and confidence, nurses' decisions and adoption of genomics were poor in clinical practice. For instance, only 5.5% of the nurses in general hospitals and 5.3% in cancer hospitals had always collected a complete FH in the previous 3 months. Less than 60% of nurses intended to learn more about genomics; this proportion was insufficient and similar to the willingness of Turkish nurses[11] but lower than that of American nurses.[5] This may be because some nurses think that genomics has little to do with their nursing practice, which has been demonstrated by other studies as well.[27] Therefore, how to promote nurses' application of the knowledge and train them in practical application skills should be addressed in the future.

Oncology nurses need to use more genomic knowledge and skills at work than general nurses. Unexpectedly, the nurses in cancer hospitals did not score significantly better than those in general hospitals in the domain of knowledge, although they performed better in some other domains, such as awareness of the importance of genomics and confidence in providing information about genetic testing. This finding emphasises the urgent need to prioritise genomic nursing training for oncology nurses to increase their genomic knowledge base. In addition, nursing managers need to strengthen the training of cancer hospital nurses to help them play a leading role in genomic nursing practice.

Gender, years of clinical nursing, initial level of nursing education, membership of the Chinese Nursing Association, whether the nursing curriculum included genetics/genomics content and attitude towards becoming more educated in genetics and genomics were significant predictive factors for genomic knowledge. Female nurses had more genomic knowledge than male nurses, which aligns with the results obtained by a previous study in Israel[6] and that in Turkey.[9] Nurses with an initial level of bachelor's degree or above had higher knowledge scores, consistent with the findings of an Australian study.[8] Nurses who had genetics/genomics content in their curriculum scored higher, which is consistent with Calzone *et al* findings.[5] Nurses who thought becoming more educated on genetics and genomics was important had higher knowledge scores. This result suggests that nursing leaders should provide nurses with relevant information to realise the importance of receiving genomics education. For example, they should make nurses realise the recent progress of genomics in practice and the important role that nurses play. Nurses who were members of the Chinese Nursing Association also had higher knowledge scores, perhaps because they had received more training opportunities in genomics than others. In addition, members of the Chinese Nursing Association may have had more exposure to mass media channels of communication and interpersonal channels, and enjoy a higher social status, which also verifies the DOI theory.[14] However, further studies should be conducted to understand this relationship. Interestingly, the longer the nurses worked in clinical nursing, the lower their knowledge scores. This may be related to the fact that the nurses with longer years of clinical nursing in this study received education without genetic and genomic content. Genomics has undergone rapid development in the last 20 years. Before that, it was rarely included in the nursing education curriculum in China.[28] In contrast, nurses on the clinical frontline in China are relatively younger nurses, while most senior nurses (> 40 years old) are engaged in certain clinical auxiliary departments and not involved in the direct care of patients. Thus, in training on genomic knowledge, attention must be paid to male nurses and nurses with lower levels of academic education or short working experience.

Based on this study's findings, we propose to improve the genomic nursing competency of nurses in the following ways. First, it is necessary to prepare nurses for their foundational education in genomics before entering practice. We can learn from the experiences of other countries by adding genomics-related courses to nursing undergraduate and graduate education in China. In 2015, a Chinese medical school explored setting up a genetics and genomics nursing course in the nursing undergraduate curriculum, and nursing students showed high participation and recognition in learning this course.[29] Second, it might be helpful to add genomics content to the continuing education of nurses, which can begin with a training programme for specialised nurses. Additionally, nurses should be educated to be more competent in precision medical practice with updated knowledge and skills in genomics. Finally, since

the Chinese Nursing Association membership appears to be associated with higher knowledge levels in this sample, hospitals can support and encourage nurses to participate in nursing associations at the national level, which can provide them more opportunities to access the evolving genomics knowledge. More importantly, the leaders of nursing associations or societies at the national level need to be aware of nurses' inadequate genomic competency in the era of precision medicine and emphasise nurse genomic training by creating training curriculum and materials, organising various forms of genomics training and supplementing more online training resources, such as the G2NA Webinar (www.g2na.org/index.php/g2na-webinars), to help nurses become more competent in genomics.

Limitations

The present study has some limitations. First, this study was conducted in tertiary cancer hospitals and general hospitals in five administrative regions of China. The study sample does not represent nurses at all levels of hospital in China. Second, the included hospitals were not randomly selected, which affects the generalisability of the findings to all nurses. Third, we did not collect socio-demographic variables of non-respondents and therefore it was not possible to handle the non-response error of our study, which may undermine to external validity of this study. However, given the relatively large sample size and diversity of our participants, this study provides clues to understanding current genomic nursing competency in mainland China.

CONCLUSIONS

This study found that the levels of genomic knowledge among mainland Chinese nurses in tertiary hospitals are moderate. The overall genomic competency of nurses in cancer hospitals was similar to that of nurses in general hospitals; in particular, there was no significant difference in the genomic knowledge scores. This emphasises the importance of developing a training programme or curriculum to improve genomic competency among nurses, especially cancer hospital nurses, as they have a more urgent need for genomic competency. In addition, gender, education level and genetics/genomics education experience are important influencing factors of nurses' genomic knowledge. These findings provide evidence supporting the value of future education programmes in genomics in nursing.

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Patient consent for publication Not applicable.

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REFERENCES

1 Tonkin E, Calzone KA, Badzek L, *et al*. A maturity matrix for nurse leaders to facilitate and benchmark progress in genomic healthcare policy, infrastructure, education, and delivery. *J Nurs Scholarsh* 2020;52:583–92.
2 Young AL, Butow PN, Tucker KM, *et al*. When to break the news and whose responsibility is it? A cross-sectional qualitative study of health professionals' views regarding disclosure of BRCA genetic cancer risk. *BMJ Open* 2020;10:e33127.
3 Consensus Panel on Genetic/Genomic Nursing Competencies. *Essentials of genetic and genomic nursing: competencies, curricula guidelines, and outcome indicators*. 2nd ed. American Nurses Association: Silver Spring, 2009: 11–13.
4 Calzone KA, Kirk M, Tonkin E, *et al*. Increasing nursing capacity in genomics: overview of existing global genomics resources. *Nurse Educ Today* 2018;69:53–9.
5 Calzone KA, Jenkins J, Culp S, *et al*. Introducing a new competency into nursing practice. *J Nurs Regul* 2014;5:40–7.
6 Dagan E, Amit Y, Sokolov L, *et al*. Integrating genomic professional skills into nursing practice: results from a large cohort of Israeli nurses. *J Nurs Scholarsh* 2021;53:753–61.

7 Godino L, Turchetti D, Skirton H. Knowledge of genetics and the role of the nurse in genetic health care: a survey of Italian nurses. *J Adv Nurs* 2013;69:1125–35.
8 Wright H, Zhao L, Birks M, *et al*. Genomic literacy of registered nurses and midwives in Australia: a cross-sectional survey. *J Nurs Scholarsh* 2019;51:40–9.
9 Yeşilçinar İlknur, Seven M, Şahin E, *et al*. Genetics and genomic competency of Turkish nurses: a descriptive cross-sectional study. *Nurse Educ Today* 2022;109:105239.
10 Wright H, Zhao L, Birks M, *et al*. Nurses' competence in genetics: an integrative review. *Nurs Health Sci* 2018;20:142–53.
11 Seven M, Pasalak SI, Guvenc G, *et al*. Knowledge level and educational needs of Turkish oncology nurses regarding the genetics of hereditary breast and ovarian cancer. *J Contin Educ Nurs* 2017;48:570–6.
12 Dodson C. Knowledge and attitudes of oncology nurses regarding pharmacogenomic testing. *Clin J Oncol Nurs* 2014;18:E64–70.
13 Wright H, Birks M, Zhao L, *et al*. Genomics in oncology nursing practice in Australia. *Collegian* 2020;27:410–5.
14 Rogers EM. *Diffusion of innovations*. 5th ed. New York, NY: The Free Press, 2003.
15 Jenkins J, Calzone KA. Establishing the essential nursing competencies for genetics and genomics. *J Nurs Scholarsh* 2007;39:10–16.
16 Kirk M, Tonkin E, Skirton H. An iterative consensus-building approach to revising a genetics/genomics competency framework for nurse education in the UK. *J Adv Nurs* 2014;70:405–20.
17 Calzone KA, Jenkins J, Yates J, *et al*. Survey of nursing integration of genomics into nursing practice. *J Nurs Scholarsh* 2012;44:428–36.
18 Jenkins J, Woolford S, Stevens N, *et al*. The adoption of Genomic-Related innovations by family physicians. *Case Studies Bus Ind Gov Stat* 2010;3:70–8.
19 Donnelly MK, Nersesian PV, Foronda C, *et al*. Nurse faculty knowledge of and confidence in teaching Genetics/Genomics. *Nurse Educ* 2017;42:100–4.
20 National Health Commission of the People's Republic of China. *China health statistical Yearbook in 2020*. Beijing: Peking Union Medical College Press, 2020: 25–6.
21 Li Y, Gong W, Kong X, *et al*. Factors associated with outpatient satisfaction in tertiary hospitals in China: a systematic review. *Int J Environ Res Public Health* 2020;17:7070.
22 Sung H, Ferlay J, Siegel RL, *et al*. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2021;71:209–49.
23 von Elm E, Altman DG, Egger M, *et al*. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol* 2008;61:344–9.
24 Sharma A, Minh Duc NT, Luu Lam Thang T, *et al*. A consensus-based checklist for reporting of survey studies (cross). *J Gen Intern Med* 2021;36:3179–87.
25 Beaton D, Bombardier C, Guillemin F, *et al*. Recommendations for the cross-cultural adaptation of health status measures. *New York: Am Acad Orthop Surg* 2002;12:1–9.
26 Polit DF, Beck CT. The content validity index: are you sure you know what's being reported? Critique and recommendations. *Res Nurs Health* 2006;29:489–97.
27 White S, Jacobs C, Phillips J. Mainstreaming genetics and genomics: a systematic review of the barriers and facilitators for nurses and physicians in secondary and tertiary care. *Genet Med* 2020;22:1149–55.
28 Zheng T, Wen X. Application progress of *genomics* in nursing education. *J Nurs* 2013;20:17–20.
29 Li J, Feng X. Explore to set up genetics and genomics for nursing course in nursing undergraduate curriculum. *Chin J Prac Nurs* 2016;32:1031–3.

Supplementary File 1

Survey of Attitudes, Knowledge and Competence Related to Genetics and Genomics in Nursing Practices

Dear Registered Nurse:

You are invited to take a survey that will evaluate primary issues in genetics and genomics. As the front line of care, nurses have a central role in seeing that genetic and genomic discoveries lead to disease prevention and population health improvements. We will evaluate a general assessment of your knowledge. Knowing your baseline knowledge will help you determine your learning needs.

Before choosing to participate, please consider that:

• You have been invited to complete this survey because you are a registered nurse. Questions in the survey relate to your current practices, knowledge and opinions about implications of genetic and genomic medicine for preventing and treating common diseases such as cancer, diabetes and heart disease.

• The survey will take about 15-20 minutes to complete.

• Your participation in this survey is completely voluntary and you can choose to skip any questions that you do not wish to answer.

• There are no risks, penalties, or costs to your participation. There are no direct benefits to your participation other than contributing to research.

• Many of the questions relate to your attitudes about genetics and genomics for which there are no right or wrong answers.

• All information you provide is anonymous.

I have read this informed consent form to know the purpose and process of the study, and I have volunteered to participate in this study.

○ Agree ○ Disagree

Instruction to filling the questionnaire:

1. The data collected in this questionnaire is only used for a research study. We will keep your information confidential. Please fill it according to your actual situation.

2. Related concepts: ① genetics is a science that explores biological genetics and variation, and studies the structure, function, variation, transmission and expression rules of genes.② genomics is the science that explores the role of the whole genome in life activities at the holistic level.

Part 1: Socio-demographics and Work-related Information Questionnaire

1. What is your gender?

☐ Male

☐ Female

2. How old are you? (i.e. 30)

_____ years old

3. What is your China ethnicity?

☐ Han nationality

☐ Minority

4. What is your marital status?

☐ Not married

☐ Married

☐ Other

5. Which province is your hospital in?

☐ Beijing

☐ Shandong province

☐ Hunan province

☐ Guangxi Zhuang autonomous region

☐ Xinjiang Uygur autonomous region

6. What is the type of your hospital?

☐ General hospital

☐ Cancer hospital

7. Total number of years you have worked in Nursing: _____years

8. What is the **initial nursing degree** that you have you received?

☐ Diploma

☐ Associate Degree in nursing

☐ Bachelor's Degree in nursing

☐ Master's Degree in nursing

☐ Doctorate Degree in nursing

9. What is the **highest nursing degree** that you have you received?

☐ Diploma

☐ Associate Degree in nursing

☐ Bachelor's Degree in nursing

☐ Master's Degree in nursing

☐ Doctorate Degree in nursing

10. What is your nursing **professional title?**

☐ Junior title

☐ Intermediate title

☐ Senior title

11. What is your average monthly income ?

☐ ≤ 5,000 CNY

☐ 5,001–10,000 CNY

☐ > 10,000 CNY

12. Are you a member of the Chinese Nursing Association?

☐ Yes

☐ No

13. Are you a nursing researcher?

☐ Yes

☐ No

14. What percentage of your work-time is spent taking care of patients?

☐ ≤ 25%

☐ 26%–50%

☐ 51%–75%

☐ 76%-100%

Part 2：Genetics and Genomics in Nursing Practices Survey (GGNPS)

1. How important do you think it is for nurses to receive more education about genetics/genomics of common diseases?

a. Very important

b. A little important

c. Neutral/Not sure/Don't know

d. Not very important

e. Not important at all

2. Please indicate whether you think each of the following would be a **potential advantage** of integrating genetics/genomics of common diseases into your practice.

	No advantage	Advantage
Better treatment decisions (e.g. recommendations for clinical treatment options)		
Improved services to the patients		
Better adherence to clinical recommendations among patients		

3. Please indicate whether you think each of the following would be a **potential disadvantage** of integrating genetics of common diseases into your practice.

	No disadvantage	Disadvantage
Would take too much time working and studying		
Can't be reimbursed/cost too much		
Need to "retool" professionally (update knowledge and competence)		
Increase patient anxiety about risk		
Would increase insurance discrimination		

4. Each of the following statements relates to the genetics of common diseases and family history taking. By common diseases, we are referring to disorders that arise as a result of interactions between an individual's environment and his or her unique genetic makeup. Common diseases include diseases such as cancer, heart disease, and diabetes. Please indicate how confident you are that you can do each of the following:

	Not at all confident	Confident
Decide what family history information is needed to tell something about a patient's genetic susceptibility to common diseases.		
Discuss how family history affects recommended screening intervals.		
Decide which patients would benefit from a referral for genetic counseling and possible testing for susceptibility to common diseases.		
Access reliable and current information about genetics and		

genomics of common diseases.		
Give patients information about the **risks** of genetic testing for common diseases.		
Give patients information about the **benefits** of genetic testing for common diseases.		
Give patients information about the **limitations** of genetic testing for common diseases.		
Facilitate referrals for genetic services for common diseases.		

5. Please indicate whether you agree or disagree with the following statements.

	Agree	Disagree	Don't know
A family history that includes only 1st degree relatives such as parents, siblings, and children should be taken for every new patient.			
A family history that includes 2nd and 3rd degree relatives such as grandparents, aunts, uncles, and cousins should be taken for every new patient.			
Family history taking should be a key component of nursing care.			
There is a role for nurses in counseling patients about genetic risks.			

6. Are you actively taking care of patients?
   a. Yes
   b. No (If **NO** skip to **question 10**)
7. In the past three months, how often have you collected a complete family history from a patient that includes the following components: information on disorders from three generations, and age at diagnosis and death for each affected family member?
   a. Always
   b. Often
   c. Occasionally
   d. Rarely or never
8. In the past three months, has any patient initiated a discussion with you about genetics?
   a. Yes
   b. No

9. Thinking specifically about patients that you have seen **in the past three months,** please answer the following questions.

	Never	Rarely	Occasionally	Frequently
In the past 3 months, how often have you used family history information when facilitating clinical decisions or recommendations for your patients?				
In the past 3 months, how often have you facilitated referrals to genetic services?				

10. Do you think that genetic risk (e.g., as indicated by family history) has clinical relevance for the following:

	Not re	Somewhat	A Great Deal
Breast cancer			
Colon cancer			
Coronary heart disease			
Diabetes			
Ovarian cancer			

11. When patients indicate **a disorder in the family**, which of the following pieces of information do you collect in your standard family history assessment? Each family member's:

	Never (0)	sometimes (1)	always (2)
Age at diagnosis of condition			
Relationship to the patient			
Race or ethnic background			
Age at death from condition			
Both sides of the family (maternal/paternal)			

12. Thinking about how you support clinical decisions (such as administering drugs prescribed), how important do you think each of the following is to consider?

	Not at all	Essential	Don't know
Genetic test results			

Family history			

13.The following two questions are about human genetic variation. Please check the answer that indicates whether the statement is true, false or you do not know.

	True	False	Don't know
The DNA sequences of two randomly selected healthy individuals of the same sex are 90-95% identical.			
Most common diseases such as diabetes and heart disease are caused by a single gene variant.			

14. Some developed countries have incorporated the basic competences and curriculum guidelines for nurse genetics and genomics into one of the standards of nursing practice. Have you heard or read about these competences?

a. Yes

b. No

15.

	Excellent	Good	Poor
Please rate your understanding of the genetics of common diseases.			
In describing your genetic/genomic knowledge, would you consider it to be			

16. Learning more about genetics/genomics and its application to your professional practice:

	Yes	No
(1)Did your nursing curriculum include genetics/genomics content?		
(2)Since licensure, have you attended any courses that included genetics/genomics as a major component?		

	Yes	No	Don't know
(3)Do you plan to learn more about genetic/genomics ? Do you intend to learn more about genetics/genomics ?			
(4)Would you be able to attend genetics/genomics courses or training during work hours?			

(5)Would you attend genetics/genomics courses or training on your own time?			
(6)Do you think your senior staff members see genetics/genomics as an important part of **your** role?			
(7)Do you think your senior staff members see genetics/genomics as an important part of **their** role?			

THANK YOU FOR YOUR PARTICIPATION!