Canadian nursing and genomics: An engagement initiative

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INTRODUCTION

Advances in genome sequencing technologies and biomarker discoveries are rapidly changing the practice of oncology nurses across the cancer care continuum from prevention through palliative care. Genetics and genomics are now integrated into the management plans of cancer patients, informing the recommendations for risk-reduction interventions and screening protocols; treatment selection based upon an individual’s molecular profile; and guidance of dosing decisions based on drug metabolism genetic variation. Advances in genomics are also contributing to the emergence of precision healthcare where disease prevention and treatment recommendations incorporate one’s genetic and genomic data (Denny & Collins 2021; Fu et al., 2020). The speed at which new genomic technologies are developed and the requirements to translate these into practice are creating new ethical, social, and clinical challenges for nurses. To actively participate in precision healthcare and support patients, oncology nurses require genomic literacy and the ability to apply genomic knowledge to common practices such as family history taking, health teaching and medication administration. Oncology nurses in Canada are interested and ready to engage with additional education to contribute to the safe and equitable delivery of precision healthcare (Hebert et al., 2022; Limoges et al., 2022). Oncology nurses see the significant potential of genomics to address ethical and safety challenges in cancer care to improve health outcomes. The following article showcases opportunities for nurse leaders and early adopters of genomics to support genomics informed nursing practice and the preparation of oncology nurses for the genomic era.

THE CLINICAL RELEVANCE OF GENOMICS ON CANCER CARE

Advances in genetic testing and genomic technologies in the previous 20 years have transformed cancer care. Specifically, the completion of the Human Genome Project and International HapMap Project enhanced our understanding of the critical genetic drivers and molecular pathways associated with critical carcinogenic processes (Bancroft, 2013; Borden, 2010; Gray et al., 2012). In addition, the emergence of next-generation sequencing, which offers rapid and cost-effective sequencing technology, has increased access to comprehensive forms of genetic testing in clinical care (Kurian et al., 2013). As a result, cancer screening now involves more expansive forms of genetic testing, such as multi-gene panel testing, and molecular profiling is now routinely used in clinical practice to both stratify patients and guide treatment decisions. One striking example is how genetic testing for hereditary breast and ovarian cancer (HBOC) has shifted from sequential screening high-risk individuals for BRCA1 or BRCA2, towards adopting multi-gene panel testing, where individuals are screened for a number of genes implicated in cases of hereditary cancer (Kurian et al., 2013; Tung et al., 2016).

In addition, advances in genomics have contributed to predictive biomarkers that direct therapy selection, such as the testing of mismatch repair deficiency in colorectal cancer and PD-L1 expression in lung and head and neck malignancies, to inform treatment with immunotherapy. There are a number of genomic discoveries that are currently being studied and offered through clinical trials, including liquid biopsies and...
whole-genome sequencing. As these genomic advances are integrated into clinical care, oncology nurses will be at the forefront of their clinical application.

Although advances in genomics have contributed to significant clinical benefits, these discoveries have also introduced additional sources of clinical, ethical and legal uncertainty. Examples include the management of individuals’ with a pathogenic variant in a moderate- or low-penetration gene, where the cancer risk estimates are not well established (Tung et al., 2016). These concerns pose challenges for patients and providers as they navigate decisions regarding cancer screening and risk reduction surgery. Other concerns such as issues of autonomy arise, as individuals make decisions about testing and test results that could have implications for family members. In addition, as whole genome sequencing becomes mainstream, the management of incidental findings poses significant challenges, both in terms of patient understanding and decisions regarding return of results, as well as the additional strain placed on the healthcare system (Mighton et al., 2019; Mighton et al., 2020).

**GENOMICS INFORMED NURSING PRACTICE: ESTABLISHING NURSING ROLES**

Oncology nurses are early adopters of genomics-based practice and are engaged in activities such as education initiatives supporting genomic literacy. Nurses consistently work in an interdisciplinary environment and collaborate with all members of the healthcare team. Therefore, when nurses are engaged in genomics-informed care, they are able to successfully engage other disciplines within their settings (Jenkins et al., 2015). This highlights the leadership potential of nursing in the genomic era. To realize the full impact of nurses on precision healthcare further strategies are needed to ensure nurses can provide leadership in the development of new care pathways that keep pace with the rapid scientific advancements, and fully participate in interprofessional collaborative care and research.

Despite nurses being interested and engaged, research suggests that they are not fully prepared with sufficient understanding of cancer genetics and pharmacogenomics (Hebert et al., 2022; Swadas et al., 2022). In addition, Canadian nurses report being unaware of educational resources and tools to support their genomic literacy (Hebert et al., 2022). The clinical and economic benefits from advances in genomics and the adoption of precision healthcare will be amplified by nurses with genomic literacy, which is why engaging and motivating nurses to develop genomics-informed practice is so important (Seed et al., 2021; Calzone et al., 2018). Nurses with genomic literacy can enhance the clinical utility of genomics, and address equity and ethical concerns secondary to genomics (Aiello, 2017; Calzone et al., 2018; Dewell et al., 2020).

Nurses work within diverse communities, which will enable them to advocate for access to genetic counselling and testing services. The following topics illustrates how nurses can use genomics to support patient health outcomes and how nurses can further engage in education and leadership.

**CASE STUDY: SHOWCASING NURSES’ CONTRIBUTIONS**

The following case study highlights how genomics intersects with oncology nursing practice at different points across the cancer continuum and showcases how oncology nurses can impact patient health outcomes with genomic literacy. Clinical leadership strategies that can accelerate further integration of genomics into practice are discussed.

Mary Smith (pseudonym) was referred to the genetic counselling team at the local familial cancer genetic clinic at the age of 35, after the Nurse Practitioner working with Mary’s family practice team completed her annual health assessment. This included taking a family history of cancer and other diseases. The Nurse Practitioner identified that Mary was at risk of Hereditary Breast and Ovarian Cancer syndrome based upon the multiple cases of breast and ovarian cancer on her father’s side of the family. Mary completed testing for BRCA1 and BRCA2, which are two high-risk genes implicated in cases of breast and ovarian cancer. She tested negative for a pathogenic variant in either of these two genes but, based upon her family history of cancer, she was enrolled into a high-risk breast cancer screening program.

The Nurse Navigator responsible for managing the care of patients enrolled in the high-risk screening program met with Mary frequently during the first year of the program to provide education about her cancer risks, risk-reduction options, and the implications of her genetic test results for her relatives. Mary elected to complete annual mammography and breast MRI and expressed interest in considering risk-reduction surgery (prophylactic bilateral mastectomy) in the future.

Unfortunately, at the age of 41, Mary was found to have suspicious findings in the right breast on her annual breast imaging. She later underwent a biopsy, which confirmed that she had invasive mammary carcinoma. When she met with her oncology nurse to discuss her treatment plan, the nurse also reviewed her family history of breast and ovarian cancer and genetic testing history and introduced the idea of multi-gene panel testing. Mary met with the genetic counselling team at the cancer centre and elected to undergo panel testing. Her results showed that she had a pathogenic variant in a moderate penetrance gene (ATM). After receiving this result, Mary had many questions about what ‘moderate penetrance’ meant and how this pathogenic variant would impact her risk of developing cancer, what the implications were for her children, and how this result should inform her treatment decisions. The oncology nurse met with her nurse educator to seek out some additional resources to inform her own understanding of this genetic finding. The oncology nurse then met with Mary to discuss her different questions, as well as provided written educational materials. She also advocated for a team meeting with all members of Mary’s care team to discuss how her genetic findings should influence the treatment plan.
DEVELOPING THE ONCOLOGY NURSING WORKFORCE THROUGH EDUCATION

Similar to Mary, many patients are highly motivated to undergo genetic testing, yet they have variable understanding of the different forms of testing, the meaning and significance of different test results, and preferences for return of results. Patients and families need access to tailored education and support to accurately understand their genetic testing results, and how their test results impact their cancer risks and/or inform the characteristics of their cancer. Patients and families look to nurses for this education and access to informational resources (Flowers et al., 2020). Nurses with genomic literacy can assist patients to make informed decision surrounding cancer prevention and treatment options, adopt appropriate lifestyle changes, and accurately communicate their test results to family members. As demonstrated in the above case, genomics informed nursing practice requires that nurses integrate their knowledge of genetics and genomics with their other knowledge forms, such as pathophysiology and pharmacology, and relational skills to guide all aspects of their nursing practice.

Leadership is needed to support changes in nursing curriculum and ongoing clinical education to ensure that student nurses and practicing nurses have opportunities to use and hone their newly developed genomic literacy (Limoges et al., 2022; Calzone et al., 2017; Daack-Hirsch et al., 2011). Many faculty and clinical nurse educators will require support to develop genomic competencies as this was not part of their education programs (Dagan et al., 2021). Therefore, undergraduate and graduate nursing programs, and healthcare organizations must invest in strategies to support the development for expertise in the field of genetics and genomics (Read & Ward, 2016; Daack-Hirsch et al., 2011). New curriculum and clinical education programs covering foundational genomic knowledge will enable nurses and nursing students to meet the evolving practice requirements arising from genomic discoveries. As well, pathways are need for nurses who decide to pursue a specialization in genomics. These pathways will require academic and clinical champions to ensure professional roles are developed and sustained for nurses with expertise in this area.

ONCOLOGY NURSES: LEADERS IN GENOMICS ACROSS THE DOMAINS OF PRACTICE

The case of Mary Smith exemplifies genomics informed nursing practice across different clinical settings. Each of these settings will need to make changes to clinical pathways, patient education resources and policies to support the integration of genomics into practice. Nurses have an opportunity to be leaders in the field of genomics and precision health, and to engage other disciplines to enhance clinical care and health outcomes. These leadership efforts will require collaboration across the five domains of nursing practice to build research capacity in the field of genomics, invest in curriculum development and competency statements, and develop opportunities for mentorship and inter-professional collaboration on genomics-focused clinical initiatives and policy creation. Examples of clinical leadership initiatives may include developing an educational program that expands family health history taking to identify individuals at risk of hereditary cancer syndromes. Collaboration with informatics professionals can ensure that the EMR is structured to collect these data and eventually make them available for further analysis. Nurse researchers may consider conducting focus groups with patients about their experiences with genetic testing to identify patient education resources and/or tools that best support patients and families. Nurses can collaborate with other disciplines to host education events on topics such as biomarker testing, genetic counselling, pharmacogenomics, which will promote interprofessional practice and genomic literacy.

Nursing leadership within clinical institutions can create opportunities for mentorship and training in the area of genomics, both for nursing students and practicing nurses. Clinical nurse educators can partner with genomic champions within the organization to develop educational programming based upon the unique needs of the nurses within their clinical setting (Calzone et al., 2017). Finally, academic and clinical institutions can invest in capacity building for nurse researchers to expand on the expertise and training in the field of genomics. Supporting nurses to lead research grants and building interdisciplinary research teams for small and large-scale projects will ensure that the evidence base for nursing practice is generated. Nurse-lead research projects will answer important clinical questions, such as the impact of different forms of genomic technologies on patients and families and clinical workflow. In addition, investing in nurse leaders with a focus in genomics will support efforts to respond to the ethical and equity issues that emerge from genetic testing, such as creating policy that supports the awareness and access of rural and underrepresented populations to genetic counselling services.

AN INVITATION TO ENGAGE WITH THE CANADIAN NURSING AND GENOMICS INITIATIVE

With the mainstreaming of genomics into the Canadian healthcare system, it was recognized that nurses would require resources and infrastructure to support genomics-informed practices. Therefore, in 2020, a steering committee with nurses from across Canada was formed and launched the Canadian Nursing and Genomics Initiative (https://www.nursingandgenomics.com/). The CNG has members with expertise in genomics, research, education and leadership, and is committed to building strong collaborative partnerships with different nursing organizations (e.g., CANO and CASN) and institutions (e.g., Genome Canada, Ontario Genomics) on various initiatives. The CNG has developed strong...
networks in Canada and with international experts in nursing and genomics (e.g., G2NA). The CNG initiatives support Canadian nurses to engage with genomics and to develop genomic literacy. The CNG’s mandate is to support and accelerate the integration of genomics for safe, ethical and competent nursing care. The CNG advocates for collaboration between all nursing designations, between nurses from the five domains of practice, and with healthcare providers from different healthcare sectors and educational backgrounds (Limoges & Carlsson, 2020). Collaboration is a key strategy to prepare nurses for the genomics era.

An example of collaboration is the joint efforts between CANO/ACIO and the CNG in developing educational activities to raise awareness of genomic-informed nursing practice and research. The CNG is also involved in research, such as a national survey that will be launched in the fall of 2022 to measure Canadian nurses’ confidence, competence, and knowledge levels in genomics. Nurses will be given their knowledge scores and invited to join an online learning module. This study will provide important information to guide future activities in Canada.

An initial step of the CNG was to develop an engagement framework and then engage with nurses from across Canada. The engagement framework itself can be used by nurse leaders to structure activities to support genomics-informed practice. Additionally, through these engagement sessions, six key priorities (Table 1) were identified. Leadership strategies associated with these priorities and the framework (Limoges et al., 2022) can be a way to unify nursing efforts across the country to accelerate the integration of genomics into clinical care.

WHERE TO FIND RESOURCES

Our colleagues in the United States through the Oncology Nursing Society have developed several resources to support genomics informed nursing practice. Another useful place to start is for nurses to develop and use of consistent terminology, which can support interprofessional collaboration and communication with patients and families. Genomics informed nursing practice requires an understanding of key terms (examples below), such that this understanding can then be applied to one’s practice. For example, consistent and accurate use of this terminology will support patient teaching and interdisciplinary care plan discussions.

**CONCLUSION**

Advances in genetics and genomics have created an opportunity for oncology nurses to become leaders in precision healthcare. Collaborative efforts across the domains of nursing practice can ensure nurses are equipped with the foundational knowledge and skills to integrate genomics into their practice. Genomics is an evolving area, and as such, oncology nurses can capitalize on this opportunity to lead programs of research that are responsive to the impact of genomic technologies on clinical care and patient outcomes; to lead policy development that ensures the safe and equitable adoption of these technologies; and to advocate for creation of new care pathways that respond to the changing needs of patients, families and healthcare system in response to genomic discoveries.

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<th><strong>Canadian Nurses Key Priorities</strong></th>
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<td><strong>1.</strong> Highlight the clinical relevance of genomics for nursing practice and secure buy-in from key stakeholders</td>
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<td><strong>2.</strong> Role clarity and clarification of nurses’ unique and overlapping contributions to genomics and precision healthcare</td>
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<td><strong>3.</strong> Workforce development and education to enhance genomic literacy in entry-to-practice and continuing education</td>
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<td><strong>4.</strong> Leadership to develop evidence based clinical care strategies and policies that include genomics</td>
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<td><strong>5.</strong> Develop and enhance infrastructure and resources to support nursing practice in genomics</td>
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<td><strong>6.</strong> Research to produce knowledge for nursing practice and how to integrate genomics into clinical care</td>
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**Term** | **Definition** | **Clinical Example**
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Genetics | The study of inheritance and the association between a genetic variation and different clinical conditions. | Transmission of BRCA1 or BRCA2 within high-risk families
Genomics | The study of the genome, which encompasses all of the individuals' genes, and the study of gene-gene and gene-environment interactions. | Understanding how exposure to known environmental risks (e.g. air pollution or asbestos) can cause DNA damage that contributes to increased cancer risk.
Genetic Variant | A change or alteration in one’s genetic information (DNA or RNA). Such variants can be pathogenic, benign, or have uncertain clinical significance. Note: previously the term mutation was used, and now the preferred term is variant. | Determining whether an individual’s BRCA1 variant is pathogenic (associated with increased risk of breast cancer) or has uncertain clinical significance.
Biomarker Testing | Testing for a marker in the blood or tissue, which provides information about disease biology and/or treatment response. | Testing for KRAS in colorectal cancer or BRAF in melanoma
Genomic Literacy | The application of foundational knowledge of genetics and genomics to health assessments, patient teaching and care coordination. | Enabling oncology nurses to support patient understanding of their cancer risk after undergoing genomic profiling.

*adapted from the Oncology Nursing Society Genomics-Taxonomy https://www.ons.org/genomics-taxonomy/genome-foundations

**REFERENCES**


