



# Cancer Genetics and Genomics: Essentials for Oncology Nurses

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Cancer genetics and genomics are rapidly evolving, with new discoveries emerging in genetic mutations, variants, genomic sequencing, risk-reduction methods, and targeted therapies. To educate patients and families, state-of-the-art care requires nurses to understand terminology, scientific and technological advances, and pharmacogenomics. Clinical application of cancer genetics and genomics involves working in interdisciplinary teams to properly identify patient risk through assessing family history, facilitating genetic testing and counseling services, applying risk-reduction methods, and administering and monitoring targeted therapies.

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Key words: genetics; genomics; biology of cancer; biotherapy; targeted therapy; staff development; staff education

Digital Object Identifier: 10.1188/14.CJON.355-359

Oncology nurses need to understand the essentials of genetics and genomics as a foundation for clinical practice. Science and technology continue to advance in genetic molecular markers, risk-reduction methods, and targeted therapies for cancer (Calzone, Jenkins, Bakos, et al., 2013; Oncology Nursing Society [ONS], 2012; Santos et al., 2013). In the fast-paced environment of oncology nursing, core competencies include risk assessment, facilitating access to genetic counseling or testing services, and knowledge about new cancer therapies and preventive care (Calzone et al., 2010; Calzone, Jenkins, Nicol, et al., 2013). Genomics also requires that oncology nurses provide tailored treatments to patients (Calzone, Jenkins, Bakos, et al., 2013). Greco, Tinley, and Seibert (2012) and the American Nurses Association (2009) provide resources for oncology nurses to learn the essentials of genetic and genomic nursing. The National

Institutes of Health's Genetics Home Reference (2014) and National Human Genome Research Institute (2012) also provide resources regarding terminology, training, education, and risk reduction. Those resources provide a foundation on (a) emerging basic science about genetic mutations and markers, as well as principles of application to therapies; (b) knowledge and skills about genetic risk assessment tools and prevention (e.g., family history, clinical algorithms); (c) information and technology; (d) follow-up preventive care needs; and (e) ethical, legal, and social implications.

## Preparation for Nurses

Clinical oncology nursing includes an understanding of cancer genetics (i.e., single gene disorders) and cancer genomics (i.e., identification of multiple genes, DNA sequences, and proteins, as well

as their interaction with one another) (ONS, 2012). Competency-based training for advanced practice nurses involves comprehensive risk assessment, facilitation of genetic testing and counseling, and follow-up patient care (ONS, 2012).

Clinical cancer care now includes epigenomics (i.e., epigenetic modifications of genetic material) related to inherited forms of cancer, as well as epigenomic testing, preventive care, and treatment responses (Calzone, Jenkins, Nicol, et al., 2013; ONS, 2012). Nurses also should be aware of early detection and preventive care of inherited cancers (e.g., breast, ovarian, colorectal, kidney, pancreatic, prostate, leukemia) (Robson, Storm, Weitzel, Wollins, & Offit, 2010) (see Table 1). Knowledge of pharmacogenomics and targeted therapies also are standard. Pharmacogenomics (i.e., drug therapies for identified mutations) are based on an understanding of whole-genome sequencing, leading to targeting receptors (e.g., *BRAF*, *KRAS*, *MTOR*, tyrosine kinase inhibitors). Targeted therapies include monoclonal antibodies or small molecular agents that penetrate the cell membrane with protein inhibitory properties (Genetics Home Reference, 2014). Nurses should be familiar with testing methods used to identify candidate genes and single nucleotide polymorphisms, which may lead to future genetic biomarkers (Conley et al., 2013).

In addition, knowledge of genetics and molecular biology (e.g., DNA structure and function, carcinogen effects on DNA and cell function, genetic mutations, genetic variants, polymorphism practices) is essential because they can affect risk-reduction strategies and underscore healthy lifestyles (ONS, 2012). Molecularly targeted therapies that are based on cancer mutations, DNA sequencing technologies (e.g., genetic variants, whole-genome sequencing, exome sequencing), and genomic data