Pharmacogenomics

Principles and relevance to oncology nursing

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BACKGROUND: Pharmacogenomics is the fastest growing field in precision medicine. Based on current use, oncology encompasses the largest share of the precision medicine market, necessitating that oncology nurses understand the principles of pharmacogenomics and how it affects clinical practice.

OBJECTIVES: This article will define precision medicine and pharmacogenomics and will provide examples of pharmacogenomic tests, including those associated with tumor markers, and nursing implications.

METHODS: Educational and clinical resources are supplied for oncology nurses to expand their pharmacogenomics expertise.

FINDINGS: The knowledge surrounding precision medicine and pharmacogenomics will position oncology nurses to engage in current research, improve practice, and educate patients. As the focus of health care remains on reducing costs and improving morbidity and mortality, the reduction in adverse drug reactions will continue to be highlighted. Tailoring medications based on individual responses will not only help improve patient outcomes but also potentially affect the cost of health care as these genetic tests become a standard of care.

KEYWORDS
pharmacogenomics; precision medicine; oncology; nurses

DIGITAL OBJECT IDENTIFIER
10.1188/17.CJON.739-745

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PRECISION MEDICINE IS AN EMERGING METHOD for disease prevention and treatment that considers individual variations in genes, environment, and lifestyle. The term was established by the National Research Council (2011), a division of the National Academies of Sciences, Engineering, and Medicine, as the operative term rather than personalized medicine. The council felt that the term *personalized medicine* often was misinterpreted as having the ability to provide unique treatments that are specifically designed for an individual. Therefore, precision medicine has become the standard term for this field; however, the two terms often are used interchangeably (Genetics Home Reference, 2017b).

A branch of precision medicine is pharmacogenomics. Pharmacogenomics is the analysis of how a person's response to a particular drug is based on his or her genes. This field combines pharmacology and genomics to develop safe, effective medications and proper dosages that should be customized to variations in an individual's genes. The first pharmacogenetic discovery in the 1950s was in patients deficient in glucose-6-phosphate dehydrogenase who developed hemolysis after treatment with primaquine (Gardiner & Begg, 2006). As these discoveries have become more apparent, the U.S. Food and Drug Administration ([FDA], 2017) has published a guidance document to facilitate the use of pharmacogenomic discoveries in drug development. Currently, 165 drugs or drug combinations are linked to pharmacogenomic information, 58 of which are specific to hematology-oncology, and these discoveries are likely to increase (FDA, 2017).

Precision medicine has become a reality for many patients in the past decade. Based on current use, oncology encompasses the largest share of the precision medicine market and is expected to increase by 12% by 2022; the worldwide projection of the cost of precision medicine is expected to reach $88 billion by that year (Trent, 2016). Pharmacogenomics, a subset of precision medicine, is the fastest growing portion of this field; it is a type of genetic testing that is based on genomic variability in drug metabolism and response. One key note is the difference between genetics and genomics. The study of a single gene and its impact on the individual is referred to as genetics, whereas the study of all parts of the individual's genome is genomics. Therefore, a pharmacogenetic test refers to the individual's genetic test and the study of pharmacogenomics assesses all aspects of the genome to identify variations in the genome that affect drug metabolism and response (PharmGKB, 2017).

Relevance to Nursing Practice

UpToDate® reported that an estimated 380,000–450,000 preventable adverse drug reactions (ADRs) occur annually in U.S. hospitals (Zhu &