Information Technology and Precision Medicine

Pamela H. Carney

Objectives: *To provide oncology nurses with an overview of clinical decision support (CDS) and explore opportunities for genomic CDS interventions. The nation's first personalized cancer decision support tool, My Cancer Genome, is presented as an exemplar of a novel CDS tool.*

Data Sources: *Published nursing and medical literature and the internet for an exemplar.*

Conclusion: *CDS is a sophisticated health information technology that can translate and integrate genomic knowledge with patient information, providing recommendations at the point of care.*

Implications for Nursing Practice: *Nurses, as key stakeholders, must have an understanding of CDS interventions and their application to fully participate in all stages of CDS development and implementation.*

Key Words: *Clinical decision support, web-based application, knowledge base, electronic health record, precision medicine*

Scientific and technologic advances have dramatically increased the understanding of genetics and the molecular basis for the development and proliferation of cancer cells.[1] The translation of genomic discoveries to relevant clinical implications is changing the way cancer is managed. Precision cancer treatment, based on the genomic characteristics of the patient's disease, is quickly becoming a reality. During the past decade numerous gene mutations and pathways have been identified as targets for therapeutic interventions and over 800 experimental drugs are in clinical trial development.[2] As scientific and clinical knowledge of genomics increases, the application of precision medicine will expand beyond treatment to the full spectrum of cancer care. For example, an individual's genomic make-up will be a significant consideration in determining the risk of developing cancer. A genomic-based risk assessment would enable a clinician and patient to establish a highly individualized cancer screening and prevention strategy; leading ultimately to earlier diagnosis and improved outcomes. Subsequently, successful treatment and increased survival rates will warrant personalized survivorship care, with risk-adjusted screening for recurrence and secondary malignancies.[3]

Many health care providers lack the knowledge and formal training to utilize genomic information and the challenge of understanding and interpreting genomic data are compounded by the demands of clinical practice.[4] Even for those who have an

Pamela H. Carney, MSN, RN, OCN®: *Clinical Application Analyst III, Research Informatics Core, Vanderbilt-Ingram Cancer Center, Nashville, TN.*

Address correspondence to Pamela H. Carney, MSN, RN, OCN, Vanderbilt-Ingram Cancer Center, 691 Preston Building, Nashville, TN 37232.

0749-2081/3002-$36.00/0.

http://dx.doi.org/10.1016/j.soncn.2014.03.006

understanding of genomics, the application of that knowledge and the interpretation of a patient's genomic profile is complex and challenging. For example, approximately 17% of patients with non–small cell lung cancer harbor epidermal growth factor receptor (EGFR) mutations, of which 80% to 90% confer sensitivity to EGFR tyrosine kinase inhibitors (eg, EGFR L858R). However, other EGFR mutations are associated with primary or secondary resistance to the same drugs (eg, EGFR T790M).[5] In addition, mutations that predict responsiveness to therapy in some cancers may be associated with a lack of response in others, as is the case in melanoma and colon cancer. BRAF V600E mutated melanomas are sensitive to BRAF inhibitors such as vemurafenib and dabrafenib, while BRAF V600 mutated colorectal cancers may not be sensitive to these drugs.[6] Consider the busy clinician faced with deciding if erlotinib is the best treatment for a lung cancer patient. The clinical decision is based on a number of patient and disease characteristics including detection of genomic mutations and the clinical implications of all the patient-specific data. Ready access and interpretation of this type of information in the fast-paced clinical environment often proves to be difficult and time-consuming. However, the same busy clinician, utilizing computerized physician order entry and electronic clinical decision support (CDS) receives an electronic alert if the patient's tumor harbors a variant known to confer resistance to erlotinib. The clinician is enabled to quickly make appropriate treatment decisions and avoid patient exposure and expense to a drug that will provide little benefit.

The traditional model of a provider reading current literature to stay abreast of optimal care will be inadequate in light of the increasing scale and complexity of cancer genomics. Realization of precision medicine depends on the ability to collect, disseminate, and process complex genomic information in the context of clinical care.[7] CDS is a sophisticated health information technology (HIT) which can translate and integrate genomic knowledge with patient information, providing intelligently filtered recommendations, and enabling genomic-informed decisions at the point of care.[8] The steady infusion of new HIT solutions, like CDS into the clinical settings, is revolutionizing the way that health care is provided. Nurses, as key stakeholders, must have an understanding of CDS interventions and their application to fully participate in all stages of CDS development and implementation. The purpose of this article is to provide oncology nurses with an overview of CDS and explore opportunities for genomic CDS interventions. The nation's first personalized cancer decision support tool, My Cancer Genome, is presented as an exemplar of a novel CDS tool.

Overview of CDS Technology

CDS software is designed to support clinical decision-making by matching the patient characteristics to a computerized clinical knowledge base and patient-specific assessments or recommendations are presented for clinical care decisions.[9] Initially, CDS systems were stand-alone programs designed to provide diagnostic support and medication selection guidance. The early systems had limited availability and required the user to manually enter pertinent patient information. Once the data entry was complete, the user had to interpret the results and determine clinical relevancy.[10] Several limitations associated with initial CDS technology were surmounted by integrating CDS with other clinical systems, such as the electronic health record (EHR) and the computerized physician order entry. One significant advantage of an integrated system is the user does not have to reenter information that is already stored electronically. Secondly, this type of CDS system can be proactive in providing alerts triggered by significant patient data without the user seeking assistance.[7]

CDS technology has been available for several decades; however, adoption has been slow. Implementation has been hindered by inadequate information technology (IT) infrastructure, the exorbitant cost of design, implementation and support of CDS, and a lack of standards and best practice guidelines.[11] Recently, CDS development and implementation has dramatically increased because of the Health Information Technology for Economic and Clinical Health Act (HITECH) of 2009. The HITECH Act establishes incentive payments under the Medicare and Medicaid programs for eligible providers and hospitals that use EHRs to achieve specified improvements in health care delivery. The Federal government, through HITECH, will make available up to 27 billion dollars in incentive payments over 10 years for hospitals and eligible providers who achieve federally defined objectives. The objectives of 'meaningful use' encompass IT functions, like CDS, which enable EHRs to support improved health care.[12]