ORIGINAL ARTICLE

Cancer Imaging at the Crossroads of Precision Medicine: Perspective From an Academic Imaging Department in a Comprehensive Cancer Center

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Abstract

The authors propose one possible vision for the transformative role that cancer imaging in an academic setting can play in the current era of personalized and precision medicine by sharing a conceptual model that is based on experience and lessons learned designing a multidisciplinary, integrated clinical and research practice at their institution. The authors' practice and focus are disease-centric rather than imaging-centric. A "wall-less" infrastructure has been developed, with bidirectional integration of preclinical and clinical cancer imaging research platforms, enabling rapid translation of novel cancer drugs from discovery to clinical trial evaluation. The talents and expertise of medical professionals, scientists, and staff members have been coordinated in a horizontal and vertical fashion through the creation of Cancer Imaging Consultation Services and the "Adopt-a-Radiologist" campaign. Subspecialized imaging consultation services at the hub of an outpatient cancer center facilitate patient decision support and management at the point of care. The Adopt-a-Radiologist campaign has led to the creation of a novel generation of imaging clinician-scientists, fostered new collaborations, increased clinical and academic productivity, and improved employee satisfaction. Translational cancer research is supported, with a focus on early in vivo testing of novel cancer drugs, co-clinical trials, and longitudinal tumor imaging metrics through the imaging research core laboratory. Finally, a dedicated cancer imaging fellowship has been developed, promoting the future generation of cancer imaging specialists as multidisciplinary, multitalented professionals who are trained to effectively communicate with clinical colleagues and positively influence patient care.

Key Words: Cancer imaging, precision medicine, disease-centric, multidisciplinary, training

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INTRODUCTION

Increased knowledge of cancer panomics (ie, the complex networks of molecular pathways and characteristics of the tumor microenvironment that interact to drive cancer, as defined in the American Society of Clinical Oncology's strategic planning and visioning process report [1]) has greatly contributed to our understanding of the molecular drivers of cancer and the immune system. The report predicts that by 2030, "panomics will be the driving force behind the vast majority of cancer care, enabling providers to individualize treatment for each patient" [1]. This new paradigm is

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illustrated by the FDA approval and routine clinical use of numerous novel anticancer drugs, including molecularly targeted therapies and immune checkpoint inhibitors. In his 2015 State of the Union address, President Obama launched the Precision Medicine Initiative, whose aim is to deliver "the right treatments at the right time, every time, to the right person," and proposed a $215 million investment in the 2016 budget to support this initiative [2].

The purpose of this report is to propose one vision for the transformative role cancer imaging can play in the current era of personalized medicine. Imaging and trained cancer imaging specialists will play a critical role in delivering precision imaging to the personalized and precision medicine initiative, guiding management and treatment decisions in patients treated with targeted agents. Given the escalating cost of cancer care [3-5] and the current focus on accountable care, we have sought to demonstrate added value in our imaging practice by (1) structuring our practice to meet the unique needs of the patients and referring physicians we serve, (2) integrating imaging into multidisciplinary disease-focused research, (3) committing to continuing practice quality improvement activities such as the development of decision support, and (4) training the next generation of cancer imaging specialists [6]. A conceptual model that is based on experience and lessons learned designing a multidisciplinary, disease-centric clinical and research practice is proposed, which can be expanded to other practices and institutions.

CONCEPT

Our mission is to optimize the care of patients with cancer by using imaging to inform individual management decisions, promote the successful and timely translation of cancer discovery into clinical practice, and train the future generation of cancer imagers. To achieve this, we have shifted from the traditional imaging-centric design common at most cancer centers (which is usually body part and imaging modality based, with academic research often focused on these imaging-centric areas) to a disease-centric model. The model (Fig. 1) has a "wall-less" or matrix infrastructure with vertical and horizontal integrations and bidirectional associations by design. The patient and the investigator are located at the top of the clinical and research pyramids, respectively. Our clinical practice is vertically integrated across body parts and imaging modalities within the Department of Imaging. It is also horizontally integrated with the multidisciplinary clinical practices, including oncology, surgical oncology, radiation oncology, and pathology, through our multidisciplinary clinics, Cancer Imaging Consultation Services, and "Adopt-a-Radiologist" campaign. Similarly, our preclinical and clinical cancer imaging research platforms are integrated under a single umbrella, the Center for Biomedical Imaging in Oncology (CBIO), across modalities, such that bidirectional exchanges between the preclinical trial (the Lurie Family Imaging Center [LFIC]) and clinical trial (Clinical Imaging Research [CIR]) arenas promote discovery. This blueprint has already facilitated the exchange of ideas and expertise across disciplines and consolidated true multidisciplinary collaboration as the way of day-to-day practice in clinical care and research arenas.

CLINICAL MODEL

Our clinical services are designed using a vertical and horizontal integration model that is well suited to the systemic nature of most cancers and potential systemic effects of cancer treatments. One example of vertical integration is the provision of integrated readings of all body parts (eg, chest, abdomen, pelvis) and multiparametric modality (PET and/or CT or MRI or plain radiography, or others as appropriate) results into a single report. For example, a PET/CT study may be reported by two radiologists who have cosigned a single report. Our practice is supported by a staffing model for imaging technologists and faculty members that is multidisciplinary by design and has produced great satisfaction among clinical providers.

Two examples of our horizontal integration model are the Cancer Imaging Consultation Services and the Adopt-a-Radiologist campaign.

Cancer Imaging Consultation Services

Our consultation services are designed around the multidisciplinary team approach to cancer care offered at our institution. The radiologist is a critical member of this team, providing a comprehensive evaluation of current and prior imaging studies performed at both the home and outside institutions within and outside our network. One unique aspect of our service is the daily physical presence of the cancer imaging expert in the midst of several medical, radiation, and surgical oncology clinics at our outpatient cancer facility. This physical presence promotes open dialogue among the care team members and comprehensive radiologic evaluations that