Precision Imaging Metrics: Changing the Way Clinical Trial Imaging Assessment is Managed

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Introduction

Oncology clinical trials have become increasingly dependent upon image-based surrogate endpoints for determining patient eligibility and treatment efficacy. As therapeutics have evolved and multiplied in number, the response criteria used to characterize therapeutic response have become progressively more varied and complex. The growing intricacies of image-based response evaluation, together with rising expectations for rapid and consistent results reporting, make it difficult for site radiologists to adequately address local and multicenter imaging demands. These challenges demonstrate the need for advanced cancer imaging informatics tools that can help ensure protocol-compliant image evaluation while simultaneously promoting reviewer efficiency.

Need for Clinical Trial Informatics

- Trial requirements are growing in complexity
  - Not just RECIST anymore; over a dozen criteria
  - Modifications to standard criteria are common
- Adequate clinical trial imaging review/reporting tools usually only available to Clinical Research Organizations (CROs)

Precision Imaging Metrics System (PIM)

The system was developed to manage:

- Trial/patient registration & assessment requests
- Demanding requirements for turnaround time
- Protocols review, worklists, and results reporting
- Communication between radiologists & oncologists

Methods

Tumor Imaging Metrics Core

The Tumor Imaging Metrics Core (TIMC) was established in 2004 to address the Dana-Farber/Harvard Cancer Center needs by providing centralized imaging review services for patients enrolled in clinical trials. To support the service, the Precision Imaging Metrics system was developed in-house to promote communication between oncology and radiology teams.

Precision Imaging Metrics System

PIM is comprised of an integrated cloud-hosted imaging analysis application and a workflow and data management system. Our goal is to improve protocol adherence by eliminating common discrepancies, which may impact patient care decisions, as well as to accelerate turnaround of tumor measurements so that radiologists can provide same-day results.

Cancer Center Imaging Core Network

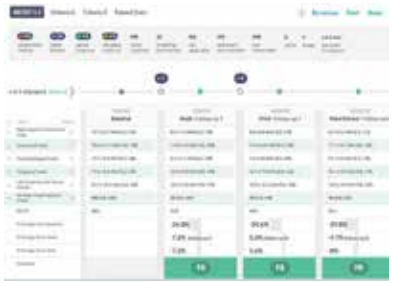
PIM was implemented by the Fred Hutchinson/University of Washington Cancer Consortium in 2014 and is currently in use at seven other NCI-designated cancer centers (Table 1) with three additional centers coming onboard this summer. The system is available as a NCI-shared resource through an academic licensing model.

Cancer Center	Location	Date Active	Trials	Time Points
Dana-Farber/Harvard Cancer Center	Boston, MA	2004	1,974	93,588
Yale Cancer Center	New Haven, CT	2013	608	17,047
Fred Hutch/UW Cancer Consortium	Seattle, WA	2014	627	17,486
Huntsman Cancer Institute	Salt Lake City, UT	2015	288	2,977
Massey Cancer Center	Richmond, VA	2015	69	818
Winship Cancer Institute	Atlanta, GA	2017	316	2,785
Medical College of Wisconsin Cancer Center	Milwaukee, WI	2017	45	252

Precision Imaging Metrics System

1) Cloud-hosted Imaging Analysis Application

2) Workflow and Data Management System



Results

Common Errors (Pre-PIM)

- Follow-up response discrepant with trial's imaging criteria (29% of errors)
- Missing measurements and/or response data (24% of errors)
- Targets do not meet size criteria at baseline (18% of errors)
- Incorrect response criteria applied (e.g. RECIST 1.1 vs. irRECIST; 16% of errors)
- Incorrect baseline used as comparison (8% of errors)
- Not considering baseline and nadir in response calculations (5% of errors)

Error Reduction (Post-PIM)

PIM has shown to reduce imaging assessment errors from over 25% to less than 3% at participating cancer centers.

Lessons Learned

These clinical trial challenges demonstrate the need for advanced imaging informatics tools. Most applications focus on Clinical Research Organizations and do not fully meet the needs of site reads. The PIM system has been designed and developed specifically for cancer centers and continues to evolve based on the feedback provided by the oncologists, radiologists, and clinical research teams that use PIM.

Future Directions

A future development goal for the application is to add analysis tools to promote advanced visualization and statistical exploration of trial data. In the era of molecularly targeted therapies, the evaluation of treatment efficacy may be impacted by inconsistencies in response patterns, which may not be uncovered until after the trial has been closed. PIM will help investigators better visualize a patient's response pattern, create analyses to test their hypotheses, and apply them to all patients enrolled in a trial in real-time. For example, oncologists may wish to evaluate lesions by organ group to identify varying response to treatment throughout the body.

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PRECISION Imaging Metrics