Next Steps for LesionTracker: Integration with a Clinical Trials Workflow Informatics System

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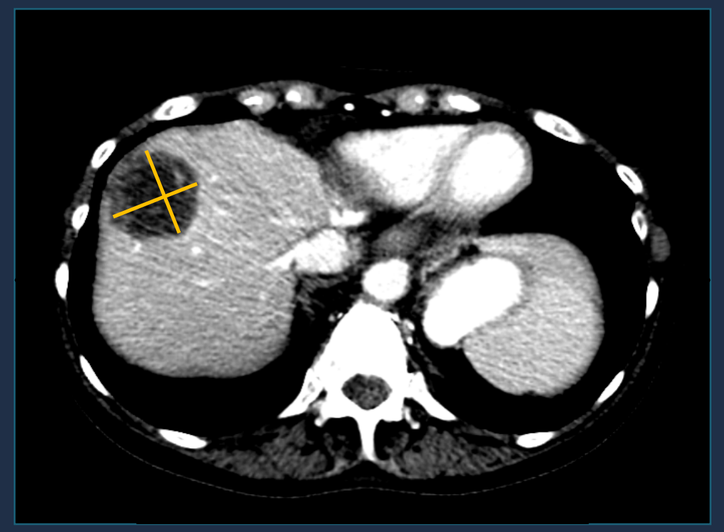
Mass General Hospital

June 1, 2017

Introduction

Background

- Oncology clinical trials rely on imaging to help determine patient eligibility and treatment efficacy



Challenges

- Progressively more varied and complex tumor metrics criteria
- Increasing demand for same day turnaround of tumor metrics
- Rising expectations for consistent and controlled results reporting

Solution

- Advanced cancer imaging informatics tools to promote protocol-compliant image evaluation and reviewer efficiency

LesionTracker

- Quantitative imaging package built on Open Health Imaging Foundation's (OHIF) open-source web viewer and optimized for oncology clinical trials workflow
- LesionTracker is funded by PAR-13-294 grant for Advanced Development of Informatics Technology (U24)
- Vendor-neutral, extensible zero-footprint image viewer for display and analysis of DICOM images
- LesionTracker will be integrated with the Precision Imaging Metrics clinical trials informatics platform (available 2018)

LesionTracker

Open Source
Commercially permissive software license (MIT) developed on GitHub and Jira

State-of-the-art
Performance and functionality expected in modern imaging viewers

Extensible
Framework for building imaging applications or integrating with 3rd-party software

Reliable
Implement software best practices and QMS

Secure
Roadmap for HIPAA and 21CFR Part 11

Zero-footprint
Web-based viewer using HTML5/CSS3/Modern JavaScript

Download the source code at: http://github.com/OHIF/Viewers or visit http://lesiontracker.ohif.org to test drive the application

LesionTracker

1 PACS Connection Protocols

- Supports DICOM message service elements (DIMSE) and DICOMweb protocols (WADO, QIDO)
- Tested against Orthanc and dcm4che

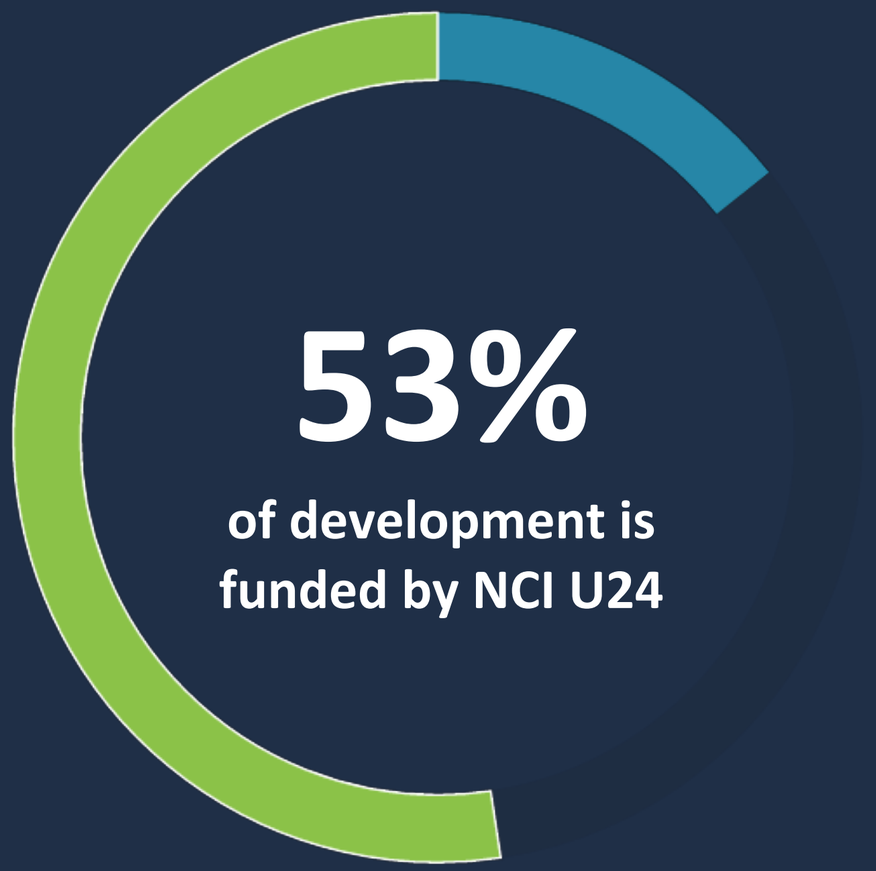
2 Architecture

- Cornerstone https://github.com/chafey/cornerstone
- dicomParser https://github.com/chafey/dicomParser
- Meteor https://www.meteor.com
- MongoDB https://www.mongodb.com

3 User Support

- Community web meetings (next on June 15, 2017)
- Public Jira instance: https://ohiforg.atlassian.net
- Cornerstone mailing list: https://groups.google.com/forum/#!forum/cornerstone-platform

LesionTracker



Usage and Contributions

- Commercial vendors such as NucleusHealth http://www.nucleushealth.io
- Students such as MGH/IACS Capstone's Saké Viewer http://sakeviewer.com
- Hospital research groups such as Precision Imaging Metrics https://www.precisionmetrics.org

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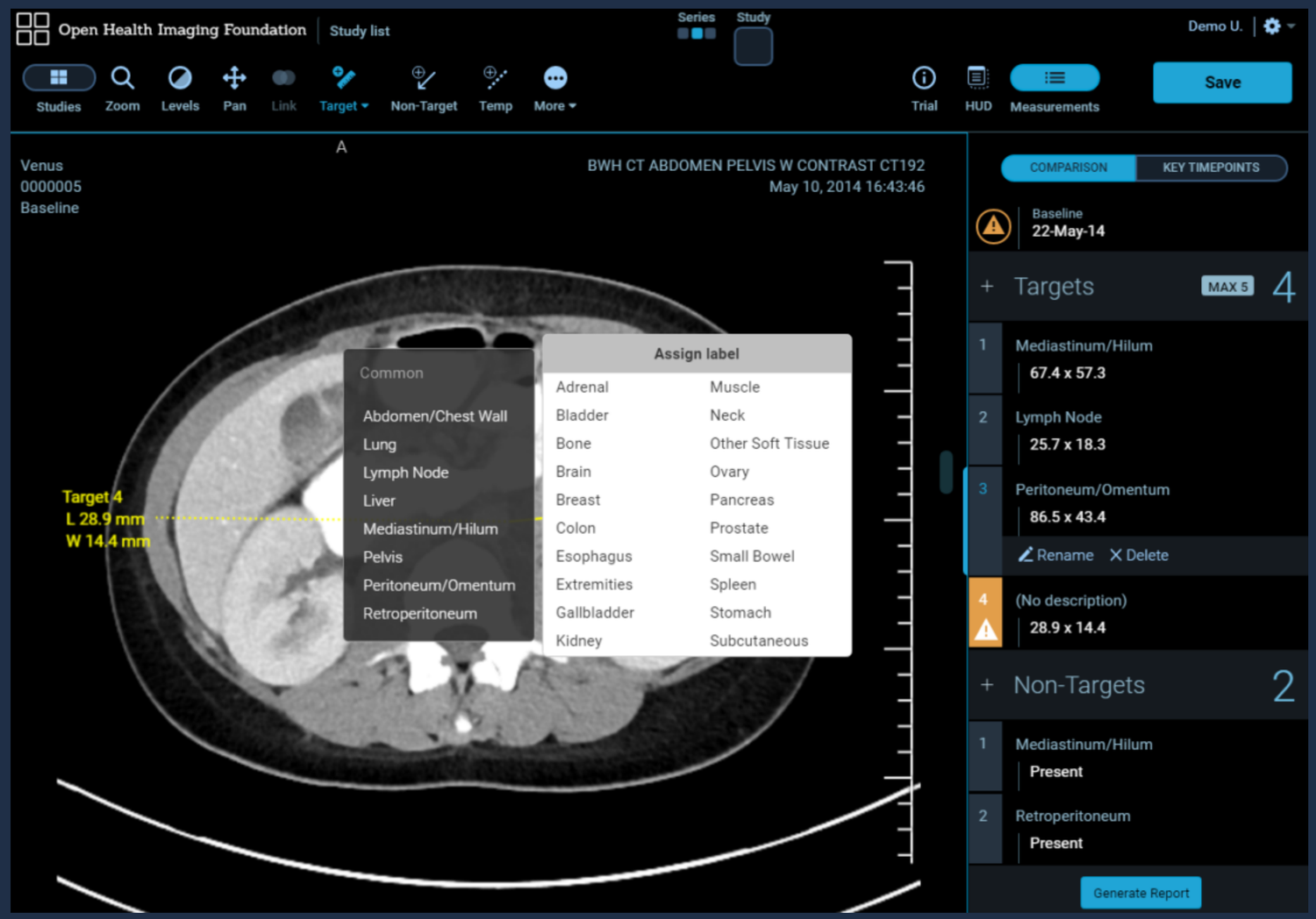
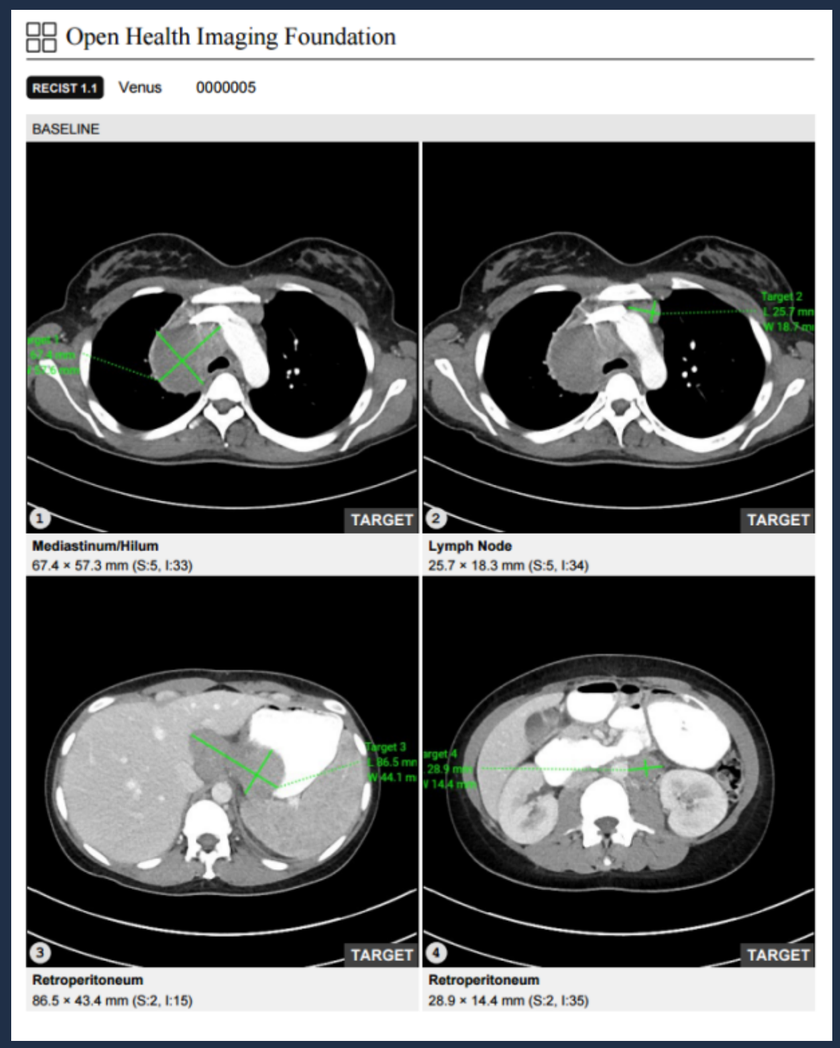
LesionTracker

Image Analysis



Results Reporting



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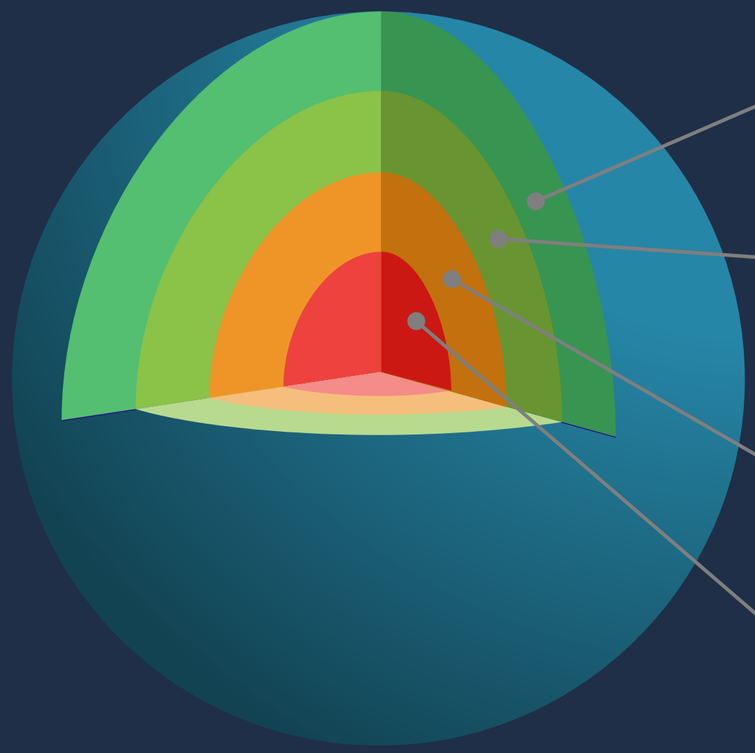
LesionTracker

Feature Highlights	
• Ability to define time points i.e., baseline or follow-up	• Longitudinal, interactive measurement table
• User interface (UI) to label lesions consistently across patients, trials, and sites	• Synchronized scrolling of images from multiple time points
• Bi-directional measurement tool	• Audit logs which captures all data changes –who, what, and when
• Non-target annotation tool with pre-defined response options	• Results reporting with screen captures of annotated images
• Built-in response criteria conformance checks for RECIST 1.1 and irRC	• UI mechanisms to simplify and accelerate switching between imaging studies

Click to view LesionTracker highlights video on YouTube

LesionTracker & Precision Imaging Metrics (PIM)



Workflow Management

- Precision Imaging Metrics enhances communication between imaging & cancer center teams and drives image analysis

Data Management

- Precision Imaging Metrics manages trial specific data and supports response criteria customization at the trial level

Image Management

- LesionTracker: Orthanc
- Precision Imaging Metrics: Nucleus.io

Image Analysis

- Today: ClearCanvas with customized oncology plugins
- Future: LesionTracker with customized automated workflows

PRECISION Imaging Metrics

In 2004, Dana-Farber/Harvard Cancer Center investigators were struggling to get reliable, timely, compliant assessments:

- Deviations from trial protocol parameters
- Delays in results to oncologists (or investigators)
- Inefficient workflows
- Lack of QA and QC
- Poor fiscal management
- Difficulty in audit preparation

Tumor Imaging Metrics Core (TIMC), co-Directed by Drs. Harris and Van den Abbeele, was formed to address these issues

PRECISION Imaging Metrics

Adequate imaging assessment / reporting tools were only available to Clinical Research Organizations (CROs), not meeting needs of cancer center site reads

PIM system was developed by TIMC to manage:

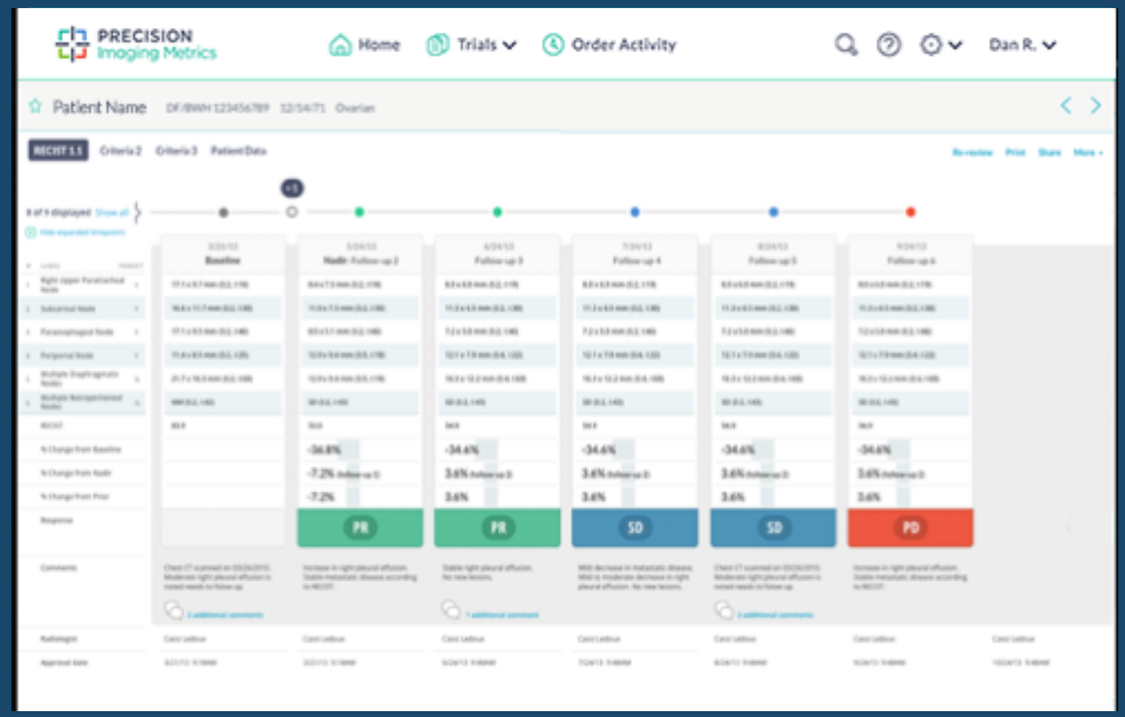
- Results reporting and protocol compliance
- Demanding requirements for turnaround time
- Communication between radiology and oncology

Visit http://www.precisionmetrics.org for more information

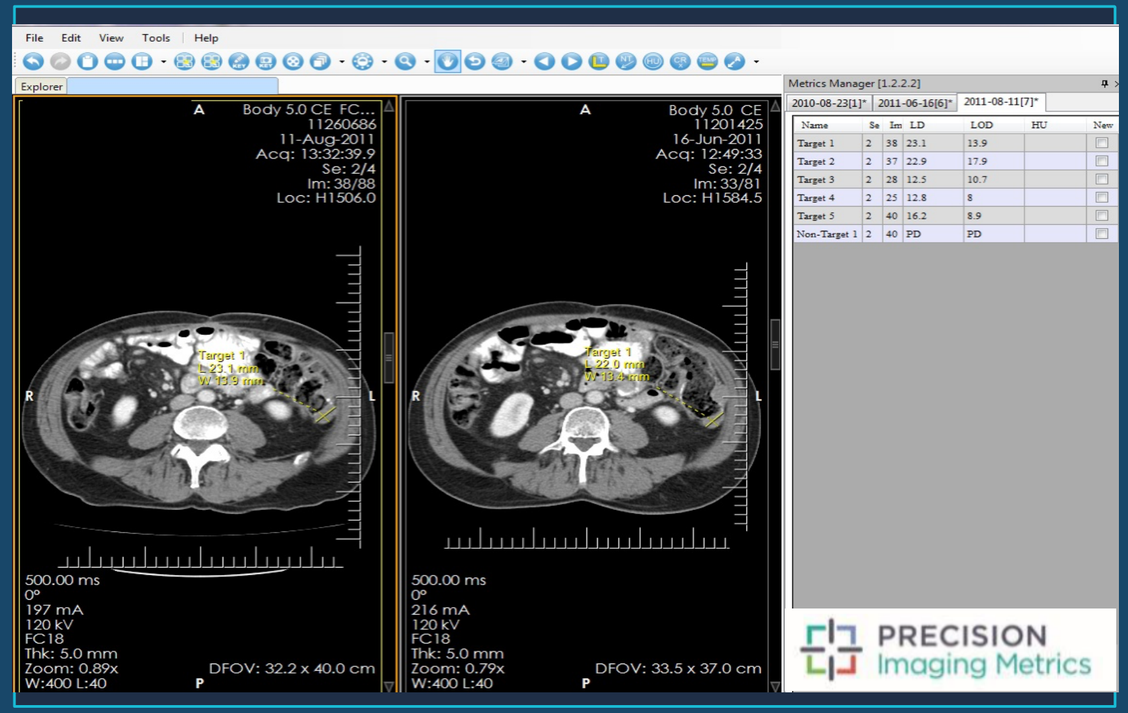
PIM Solution

Consists of two integrated applications:

1) Workflow & data management system



2) Image analysis platform (Current)



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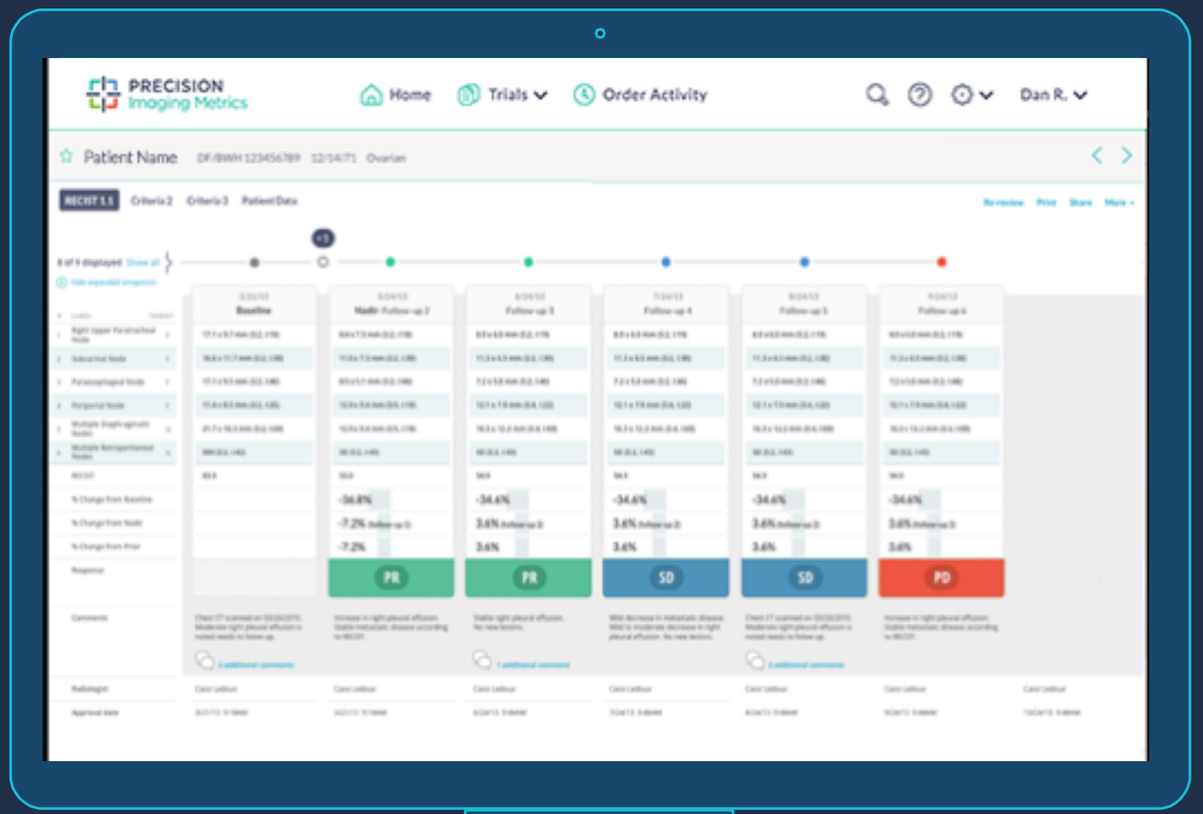
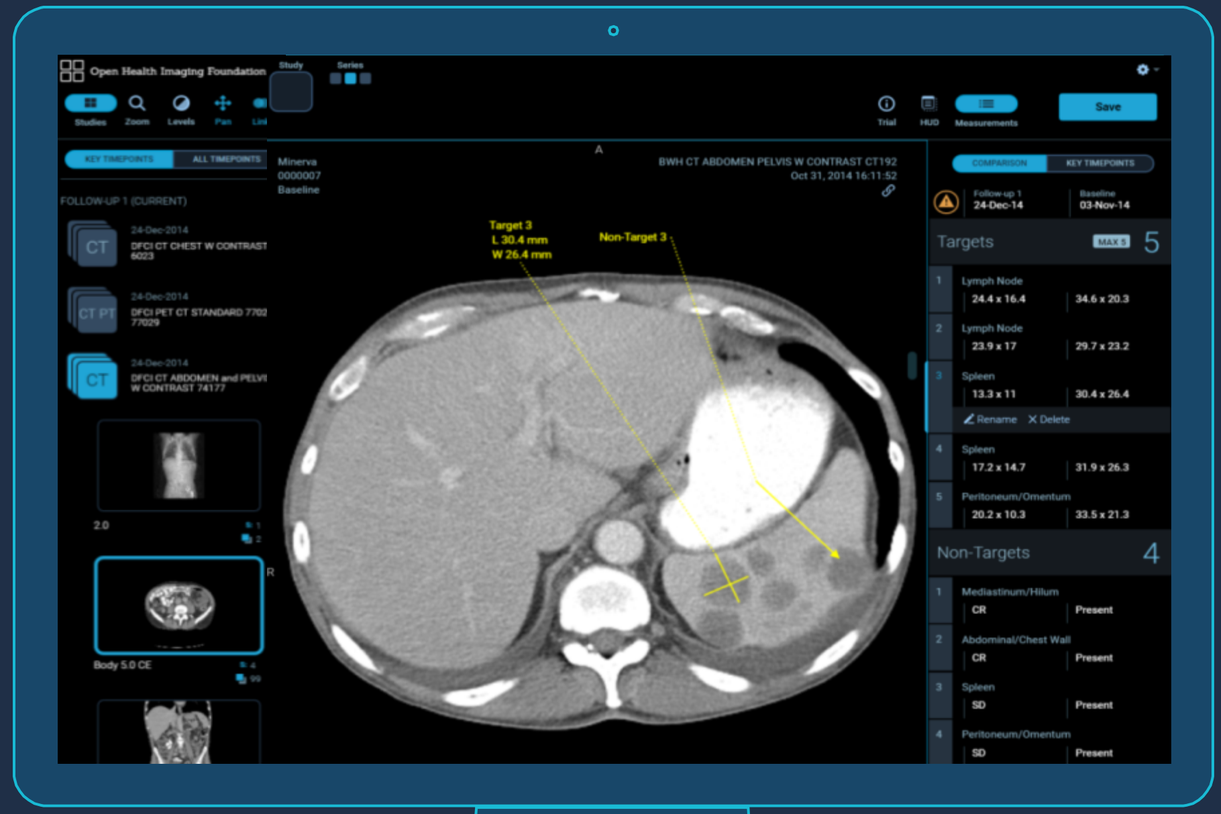


2) Image analysis platform (Future)



PIM: Trial Staff View

PRECISION Imaging Metrics | Home | Trials | Order Activity | Site Investigator

Activity in the last 14 days

Add Patient | Add Order

All Orders | My Orders | Starred Patients

408 Upcoming

VIEW ALL

1a2b3c4d	White, Snowyyy	In process	19-Aug-2014
1a2b3c4d	White, Snowyyy	In process	19-Aug-2014
IE11 test	Obama, Barack	In process	29-Aug-2014
IE11 test	Washington, George	In process	04-Sep-2014
IE11 test	Baggins, Bilbo	Inquiry	24-Sep-2014
IE11 test	Baggins, Bilbo	In process	24-Sep-2014
IE11 test	Baggins, Bilbo	Inquiry	24-Sep-2014

128 Completed

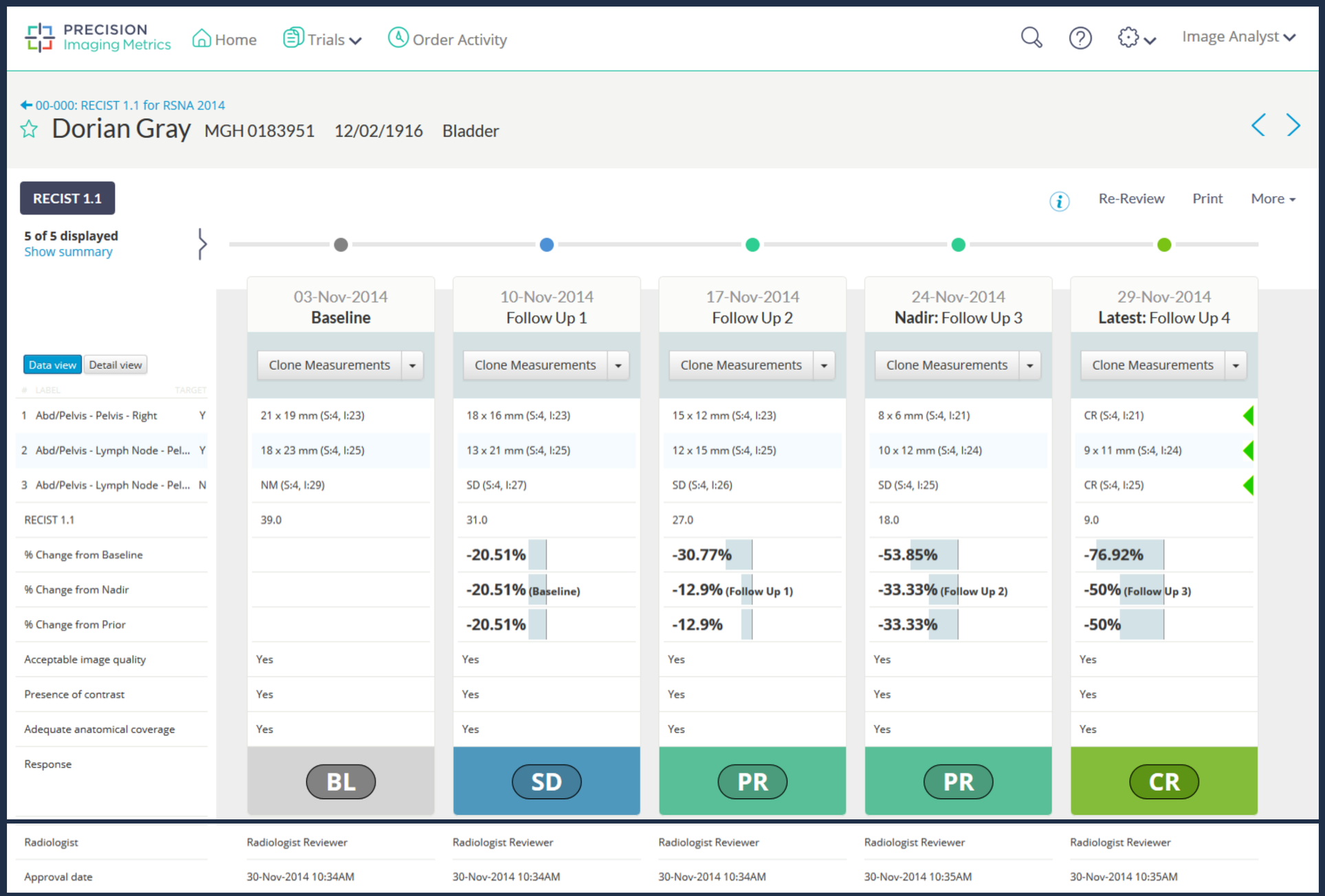
VIEW ALL

PD	00-0011	Kerouac, Jack	04-Feb-2015
SD	00-0011	Dog, Clifford	04-Feb-2015
SD	00-0011	Dog, Clifford	04-Feb-2015
BL	00-0011	Dog, Clifford	04-Feb-2015
BL	00-010	Austen, Jane	03-Feb-2015
PD	1a2b3c4d	White, Snowyyy	03-Feb-2015
PD	1a2b3c4d	White, Snowyyy	03-Feb-2015

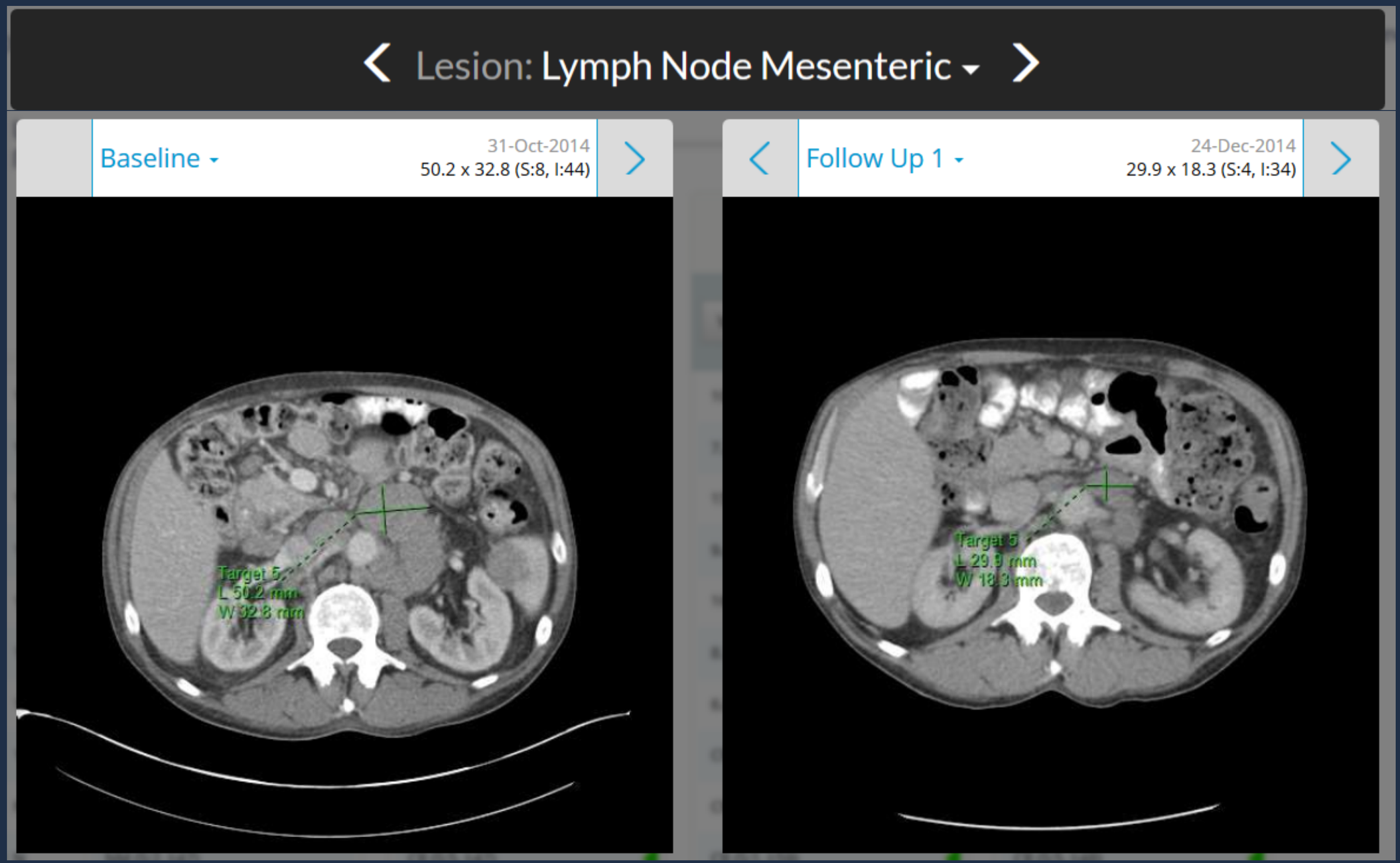
Starred Trials

Trial Name / Number	Status	Phase	Criteria	PI / Sponsor	Sub-Group	Patients	
RECIST 1.1 for RSNA 2014 00-000	Active	II	RECIST 1.1	Lewis, Rob Trinity LTD	Early Therapeutics, Gastrointestinal (GI), Genitourinary (GU), TIMC	9	Data

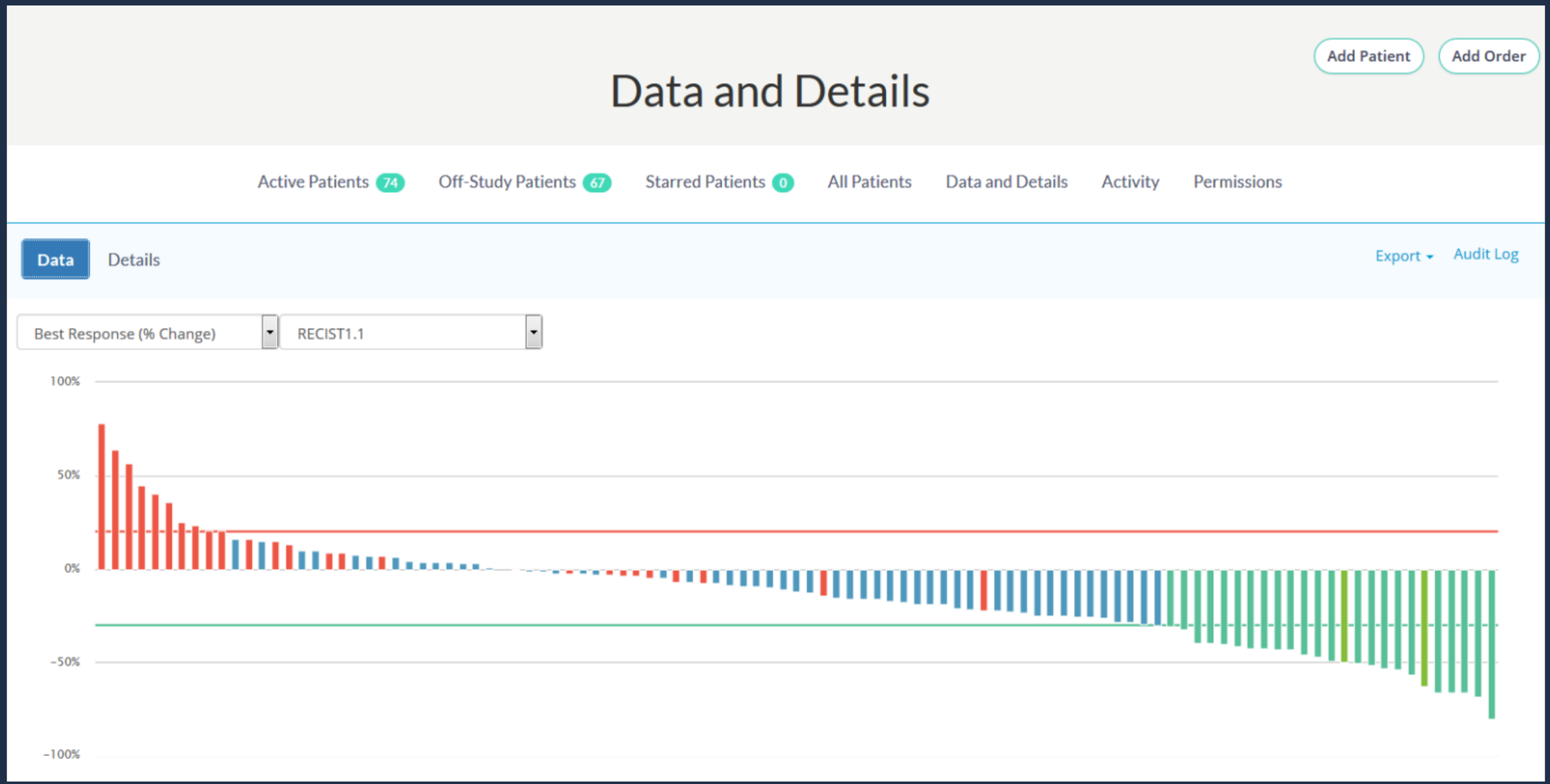
PIM: Longitudinal Metrics



PIM: Annotated Images



PIM: Analytical Tools



PIM: Training and Certification

RECIST Tutorial

RECIST (00:50 / 02:45) | ATTACHMENTS

TUMOR IMAGING METRICS CORE

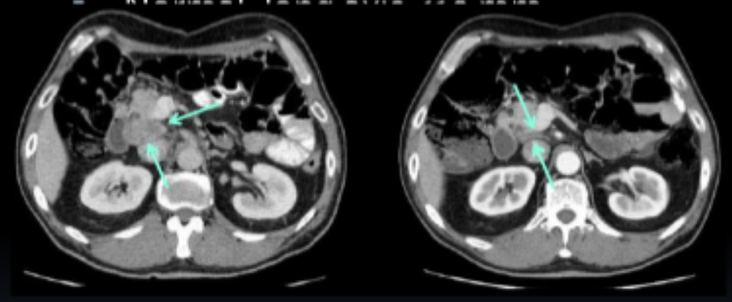
Outline | Thumbnails | Notes | Search

1. RECIST
2. Response Evaluation Criteria in Solid Tumors
3. Baseline Assessment
4. Target Lesion Documentation
5. Non-Target Lesion Documentation
6. Use of Cytology
7. Baseline Assessment: Measurable Lesions
8. Baseline Assessment: Measurable Lesions
9. Baseline Assessment: Non-Measurable Les
10. Baseline Assessment: Lymph Nodes
11. Baseline Assessment: Lymph Nodes
12. Baseline Assessment: Lymph Nodes
13. Baseline Assessment: Lymph Nodes
14. Bone Lesions
15. Cystic Lesions
16. Previously Treated Lesions
17. Definition of CR
18. Definition of PR
19. Definition of SD
20. Definition of PD
21. Possible PD by FDG-PET
22. Clarification of Target PD
23. Clarification of Non-target PD
24. New Lesions

Baseline Assessment: Lymph Nodes

RECIST1.0:

- Long axis is included in measurement total
- Normal: long axis <10 mm



Meets target criteria by RECIST1.0 and RECIST1.1

Does not meet target or non-target criteria by RECIST1.1

RECIST1.1:

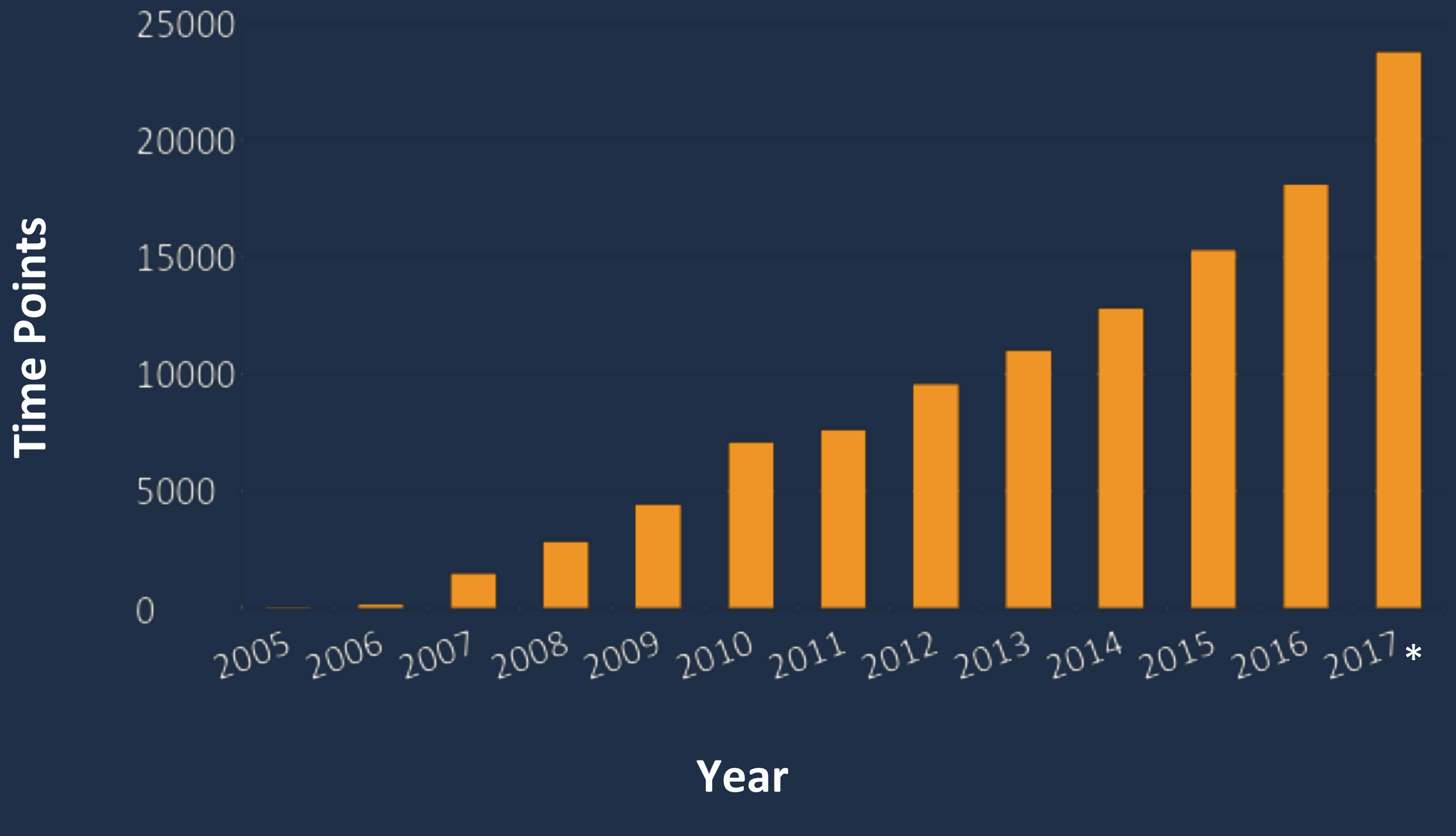
- Short axis is included in measurement total
- Normal: short axis <10 mm
- Measurable: short axis ≥15 mm
- Non-measurable: short axis ≥10 mm and <15 mm

New to RECIST1.1:
Short axis of lymph node is the critical measurement

Current PIM Usage

Cancer Center	Location	Activation Date	Trials	Time Points
Dana-Farber / Harvard Cancer Center	Boston, MA	August 2004	1,468	74,949
Yale Cancer Center	New Haven, CT	September 2013	358	12,612
Fred Hutchinson Cancer Research Center	Seattle, WA	September 2014	455	13,876
Huntsman Cancer Institute	Salt Lake City, UT	June 2015	72	1,568
Massey Cancer Center	Richmond, VA	September 2015	54	463
Winship Cancer Institute	Atlanta, GA	February 2017	127	409
Medical College of Wisconsin	Milwaukee, WI	Summer 2017	TBD	TBD

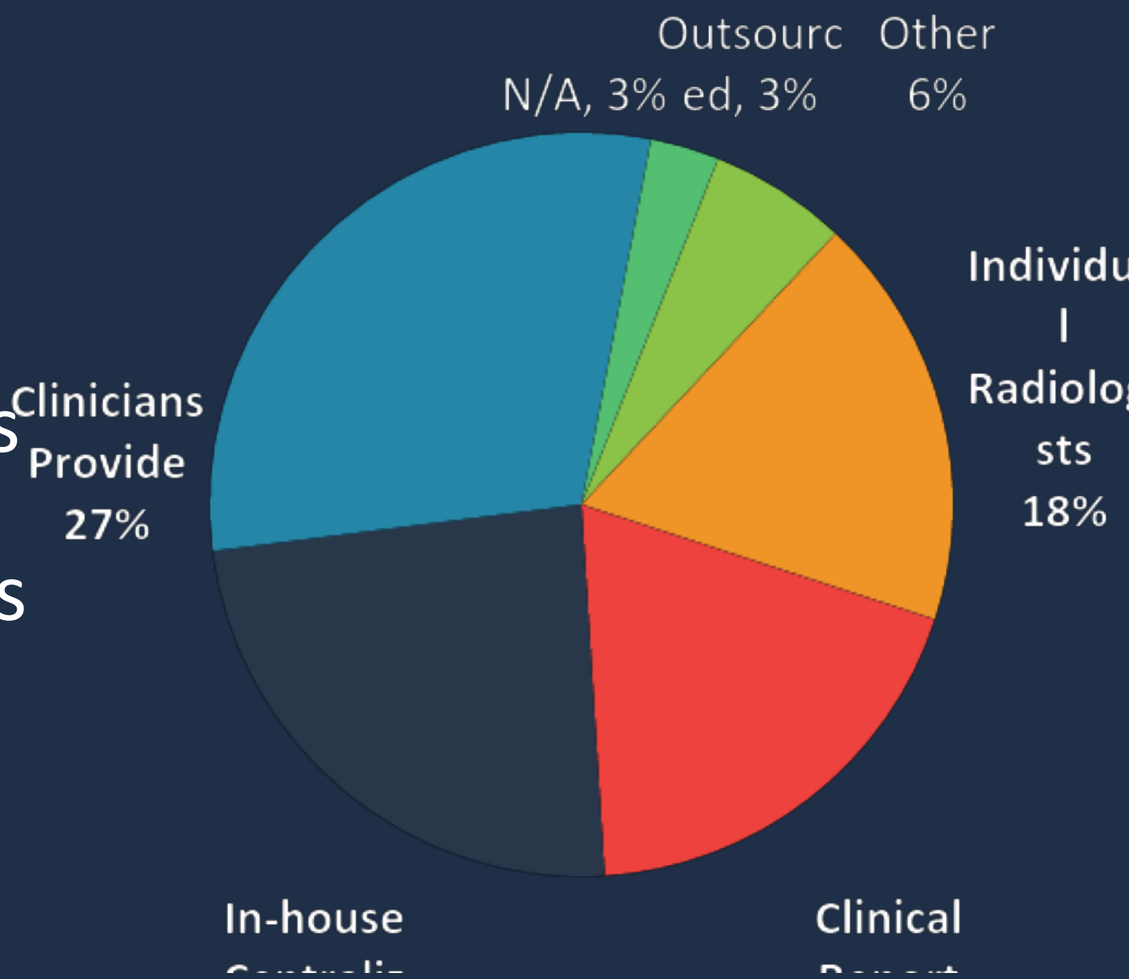
Current PIM Usage



* Projected

Summary

- Most cancer centers struggle to obtain reliable, timely, protocol compliant tumor metrics
- There is a need for advanced cancer imaging informatics tools
- Implementation may vary across cancer centers
  - LesionTracker
  - Precision Imaging Metrics



LesionTracker Development Team

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Development Consultant

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