OCT Phantoms Initiative

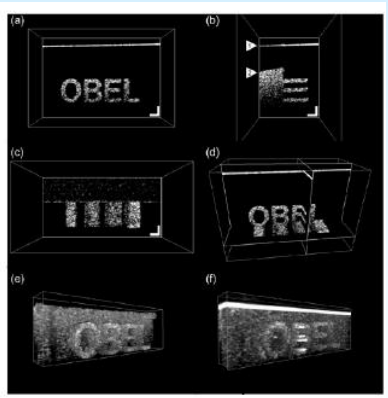
Phantom Subgroup

(Working Group for Intravascular Optical Coherence Tomography Standardization and Validation)

OCT Phantoms Initiative – WHY?

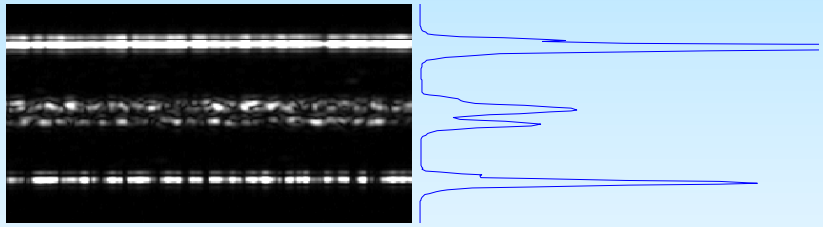
Standardized tools for OCT system characterization and validation

→ OCT community

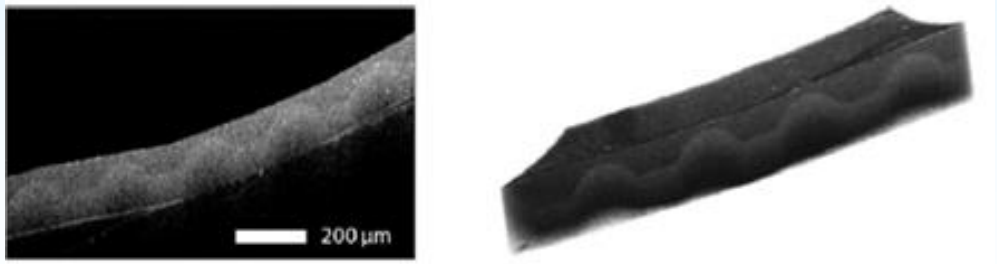


Curatolo et al, Opt. Express (2011)
Axial/lateral resolution
Contrast detectability

Rowe Technical Design phantom with custom eye model (commercially available)



Axial contrast transfer function phantoms
Agrawal et al, Proc. SPIE (2011)
Axial resolution



Skin phantom, de Bruin et al, J. Biomed. Opt. (2010)

OCT Phantoms Initiative – WHO?

Initial members:
Anant Agrawal (US Food and Drug Administration)
Brendan Kennedy (The University of Western Australia)
Guy Lamouche (National Research Council Canada)
Pete Tomlins (Queen Mary University of London)

Expertise:

- OCT
- Academic and government labs
- Phantom development
- Involved in standardization efforts
- Involved in commercialization

<u>The Initiative is an open structure welcoming any interested party</u>

OCT Phantoms Initiative – WHAT?

Identify and prioritize needs

SURVEY

Identify an promote best phantoms (existing or to-be-developed)

Facilitate pathways for consensus and dissemination

A SURVEY?

15 questions

- Respondent demographics
- Most important OCT system performance characteristics
- Phantoms/test targets in use
- Issues with phantoms

- 91 respondents

A SURVEY?

We acknowledge the large contribution to they data analysis from Bobby Mote and Krishan Agrawal (Virginia State University)

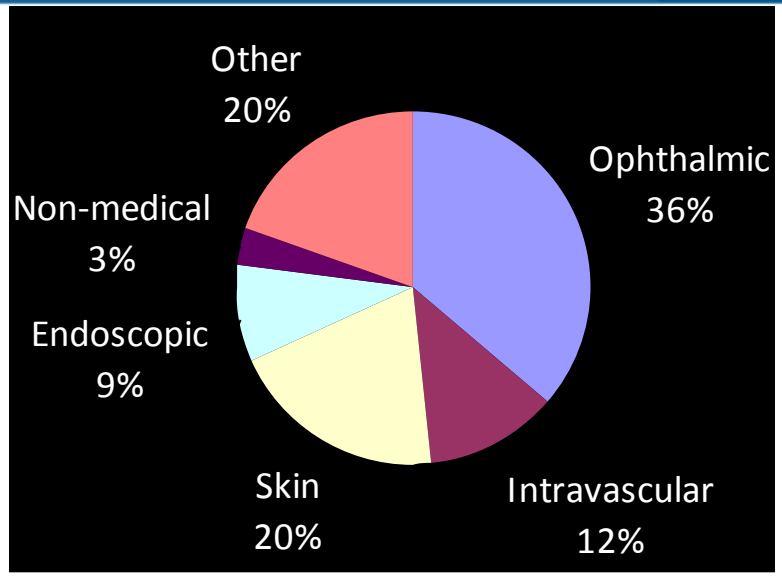
15 questions

- Respondent demographics
- Most important OCT system performance characteristics
- Phantoms/test targets in use
- Issues with phantoms

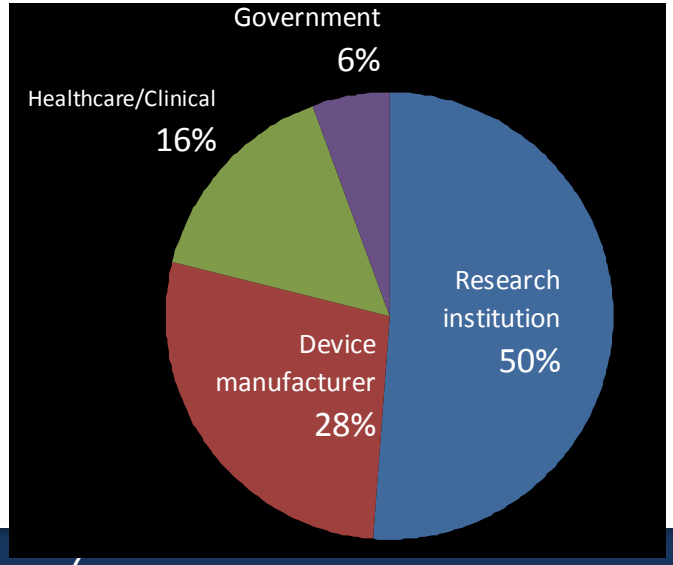
- 91 respondents

OCT SURVEY -> Participants from various horizons

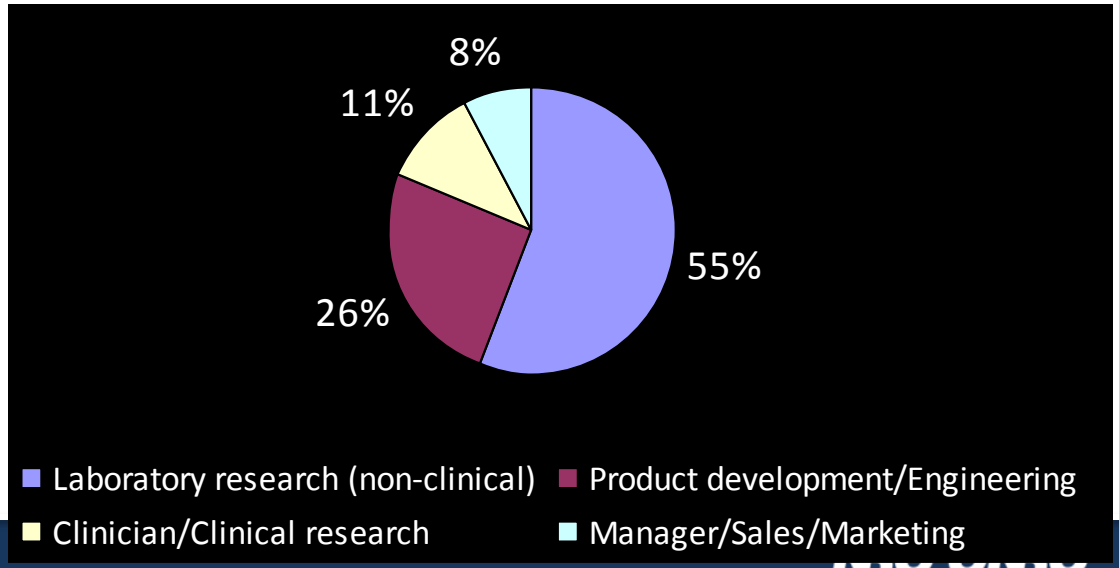
APPLICATIONS



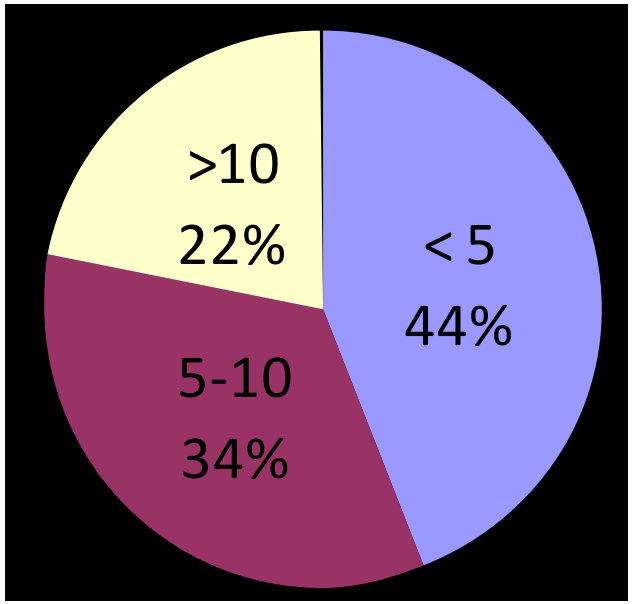
ORGANIZATION



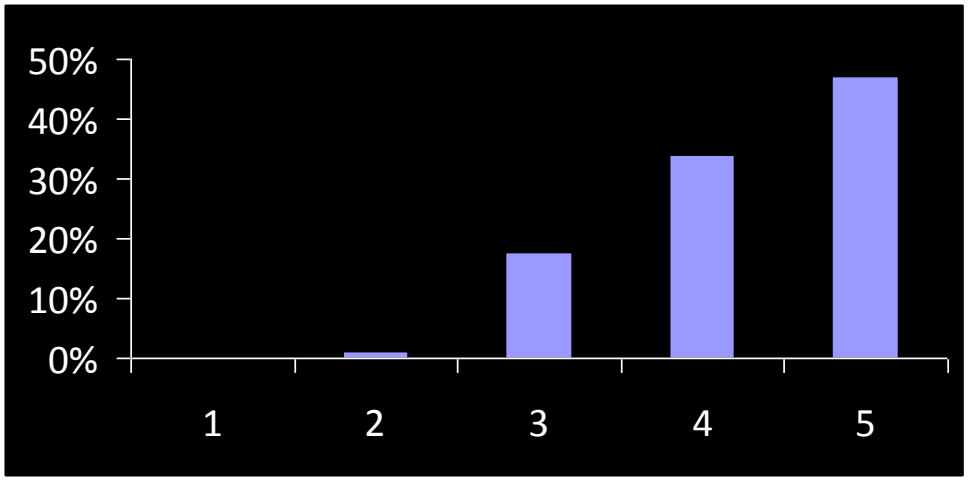
RESPONSABILITY



OCT SURVEY -> Knowledgeable participants



Years working with OCT



Self-proclaimed expertise level

Image quality is the most important criterion for evaluating the imaging performance of an OCT system

1=most important
3=least important

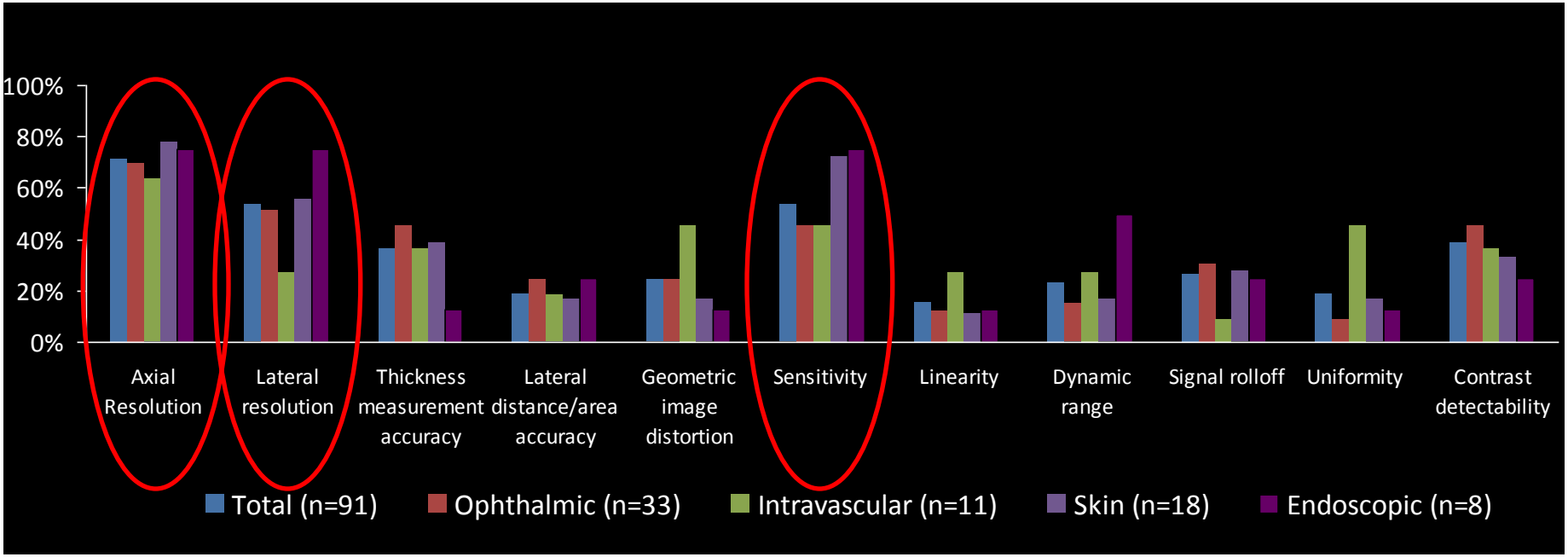
	Skin (*n*=18)	Ophthalmic (*n*=33)	Intravascular (*n*=11)	Total (*n*=91)
Image quality, visibility of key structures	1.4	1.7	1.9	1.5
Accuracy/precision of spatial dimensions/measurements	2.1	1.8	1.6	1.9
Accuracy/precision of intensity-derived parameters (e.g., attenuation)	2.5	2.5	2.5	2.6

Image quality is the most important criterion for evaluating the imaging performance of an OCT system

1=most important
3=least important

	Product development (n=23)	Lab research (n=50)	Total (n=91)
Image quality, visibility of key structures	1.6	1.5	1.5
Accuracy/precision of spatial dimensions/measurements	1.7	2.1	1.9
Accuracy/precision of intensity-derived parameters (e.g., attenuation)	2.7	2.5	2.6

Sensitivity, axial resolution and transverse resolution are the most important parameters



Axial res.
Lateral res.*
Sensitivity*
Contrast det.

*Equal percentage

Axial res.
Lateral res.
Thickness meas.*
Sensitivity*
Contrast det.*

Axial res.
Geom. img distort.*
Uniformity*
Sensitivity*

Axial res.
Sensitivity
Lateral res.
Thickness meas.

Axial res.*
Lateral res.*
Sensitivity*
Dynamic range

Phantoms are used but not from commercial sources

	Yes	No
Using phantoms/calibration targets?	74%	26%
Using commercially-available phantoms/calibration targets?	24%	76%
Using self-made phantoms or calibration targets?	54%	46%

What characteristics should a phantom have?

Preferred type of phantom

	Lab	PD/E	All
Application-independent	43%	69%	59%
Application-specific	57%	31%	41%

Relative importance of phantom properties

1. Accuracy/precision of dimensions and properties
2. Similarity to biological tissue
3. Durability
4. Controllable mechanical properties
5. Biocompatibility

OCT Phantoms Initiative - What next?

- Publish survey results
- Debate over survey results
- Devise actions to meet the needs

Phantom Subgroup

(Working Group for Intravascular Optical Coherence Tomography Standardization and Validation)

ELSEVIER

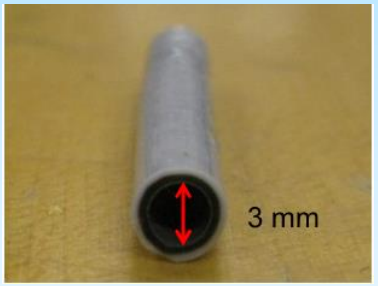
Journal of the American College of Cardiology

Volume 59, Issue 12, 20 March 2012, Pages 1058–1072

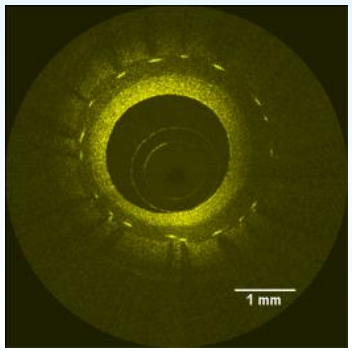
Mini-Focus Issue: Optical Coherence Tomography

Consensus Standards for Acquisition, Measurement, and Reporting of Intravascular Optical Coherence Tomography Studies : A Report From the International Working Group for Intravascular Optical Coherence Tomography Standardization and Validation

Guillermo J. Tearney, MD, PhD□, ♟, ✉ (Writing Committee Co-Chair), Evelyn Regar, MD, PhD† (Writing Committee Co-Chair), Takashi Akasaka, MD‡ (Writing Committee Co-Chair), Tom Adriaenssens, MD, Peter Barlis, MD, Hiram G. Bezerra, MD, Brett Bouma, PhD, Nico Bruining, PhD, Jin-man Cho, MD, PhD,



Layered restenosis



Phantom Subgroup

Participants from:

National Research Council
Erasmus Thoraxcenter
Case Western University
University of Texas
FDA
St. Jude Medical
Abbott Vascular
Volcano
Wellman Ctr for Biomedicine
…

- Initiated in April 2012
- Interaction through a few phone conferences

- **GOAL** :
  - White paper describing the needs in phantoms for the IVOCT community

4 Buckets with different needs for phantoms

- Industry
  - No phantoms for OCT system maintenance
  - Phantoms to support a standardized measurement procedures
- Clinical and pre-clinical
  - Phantoms needed to support standardized measurement procedures (neo-intimal thickness, tissue coverage, …)

4 Buckets with different needs for phantoms

- Tech R&D (Strong need for phantoms)
  - Phantoms to simulate different plaque types, different stents with or without neo-intima
  - Phantoms for testing development of automated segmentation algorithms

- Training
  - Train users to operate OCT systems
  - Train users to identify diseased structures
  - Relevant to industry (Sales persons are currently doing the training)

(IVOCT) Phantom subgroup - What next?

- White-paper by next fall