



# Accelerating Device Innovation Through Regulatory Science

**FDA Small Business Regulatory Education for Industry (REdI) Annual Conference**

May 29, 2024

**Ed Margerrison, PhD**

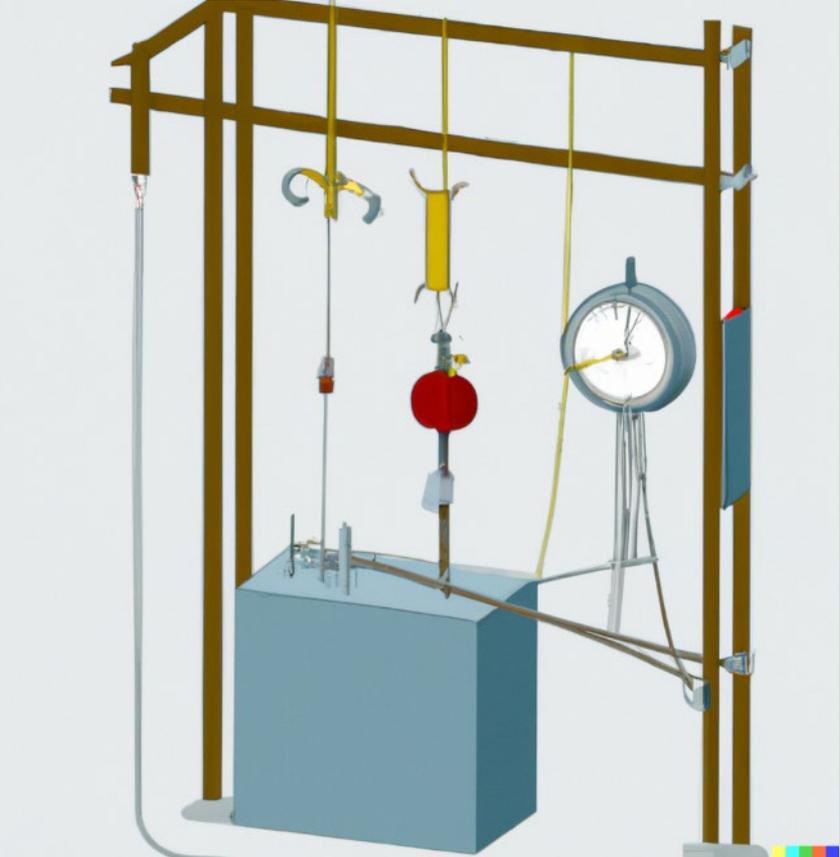
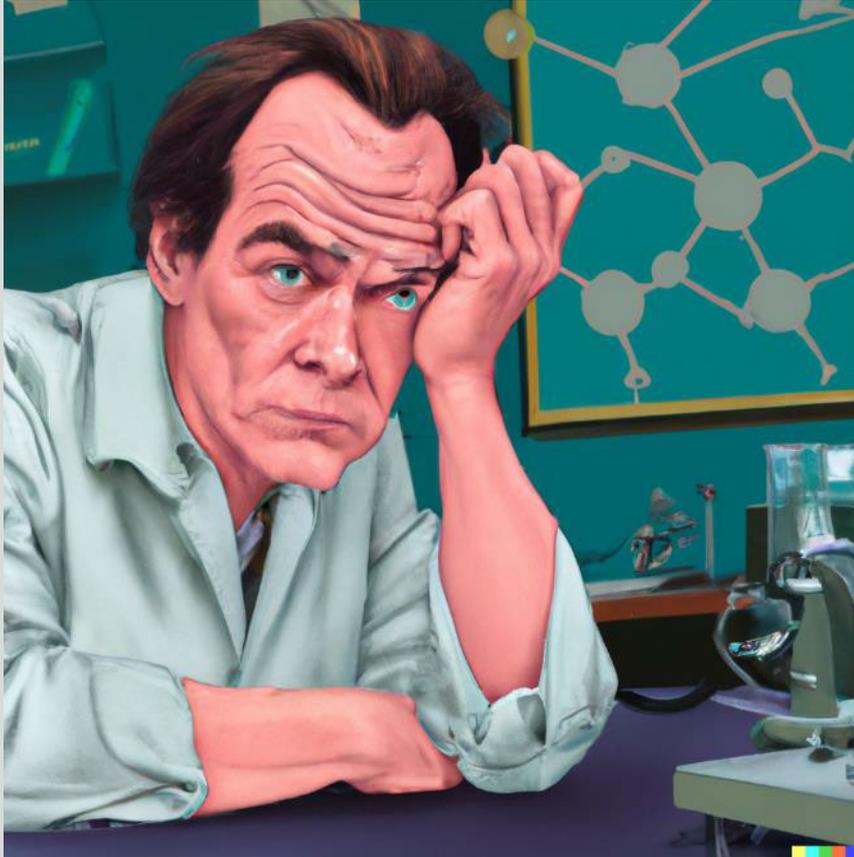
Director

Office of Science and Engineering Laboratories

Center for Devices and Radiological Health

U.S. Food and Drug Administration

# How Do you Link Innovation and Reg Efficiency?



# Learning Objectives

- Describe regulatory science tools (RSTs) and explain why they're important
  - For **innovators**
  - For **product development engineers**
  - For **regulatory reviewers**
- Access the public RST app
- Discuss the scope and framework of context for RSTs

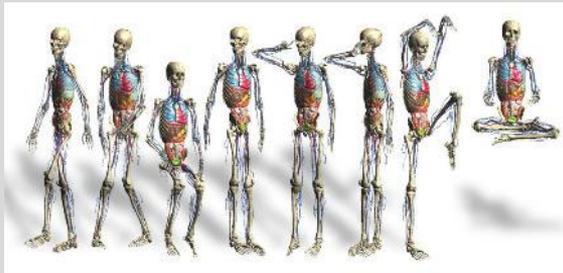
# CDRH Regulatory Science Tools

# CDRH Regulatory Science

- **Our work product is a collection of Regulatory Science Tools**
  - May be lab methods, AI training data sets, phantoms for medical imaging, computer models
  - Used by innovators and reviewers to standardise the evaluation of safety and effectiveness
  - Publicly available
  - Standardization of methods does not mean a guarantee of medical device quality

# Importance of CDRH Regulatory Science

- Proven link between regulatory process efficiency and stimulating upstream innovation
  - 3 NIH Institutes + NSF actively funding tool development
- Organized into 20 programs
  - Some are specific to product areas (such as cardiovascular) or technology (such as AI/ML)
  - Important because many technologies reach across many product areas (such as biocompatibility, cybersecurity)



# Impact of RSTs

- **3 years ago, we decided to publish a “catalog”**
  - Tools are now publicly available: [cdrh-rst.fda.gov](http://cdrh-rst.fda.gov)
  - Publications are validation of scientific basis of RSTs, not the work product
- **Early data suggests that product catalog has approx. tripled use of the tools**
  - Adding new tools at the rate of 50 a year
  - Looking to significantly expand capacity
- **RST utility is established upfront through voice of customer**
  - Active portfolio management and alignment with greatest needs

# CDRH Tools Catalog



## Tools Categories

- Lab Method (22)
- Computer Model (20)
- Dataset (5)
- Phantom (2)
- Physical (1)
- Clinical Outcome Assessment (1)

## Program Areas

- Cardiovascular (10)
- Medical Imaging and Diagnostics (17)
- Orthopedic Devices (8)
- Biocompatibility and Toxicology (6)
- Credibility of Computational Models (5)
- Materials and Chemical Characterization (5)
- Neurology (5)
- AI / Machine Learning (2)
- Electromagnetic and Electrical Safety (2)
- Ophthalmology (2)
- Patient Monitoring and Control (2)
- Post Market Signal Response (2)
- Human Device Interaction (1)
- Medical Extended Reality (1)
- Sterility and Infection Control (1)

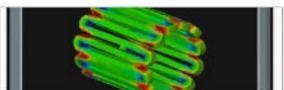


**Photoacoustic Imaging Phantoms for Assessing Image Quality and Oxymetry Performance**

This regulatory science tool presents a set of tissue-mimicking phantoms suitable for benchtop performance assessment of photoacoustic imaging (PAI) devices.

[Function](#)

Medical Imaging and Diagnostics



**Workflow for Assessing the Credibility of Patient-Specific Modeling in Medical Device Software**

This regulatory science tool presents a method for assessing credibility of patient-specific computational models implemented in medical device software.

[Computer Model](#) [Lab Method](#)

Credibility of Computational Models



**TEL/EEG/MOS (TEEM) Calculator**

This regulatory science tool is a method that applies the ISO 10093-17 technological risk assessment approach to medical device extractables screening data to assess systemic toxicity, genotoxicity, carcinogenicity or reproductive/developmental toxicity in the biocompatibility evaluation of a...

[Lab Method](#)

Biocompatibility and Toxicology



**Chemicals List for Analytical Performance (CLAP)**

Chemicals List for Analytical Performance (CLAP)

[Dataset](#) [Lab Method](#)

Biocompatibility and Toxicology | Materials and Chemical Characterization

Search Tool Catalog



**Benchmark Validation Dataset for Laminar Flow in an Anatomical Vascular Model of the Inferior Vena Cava**

This tool provides a benchmark validation data set for laminar flow in an anatomical vascular model of the inferior vena cava (IVC).

[Dataset](#)

Cardiovascular



**EEG based Machine or Deep Learning Algorithms for TBI & Stroke Classification (EMATS)**

This RST contains a set of machine or deep learning algorithms which can be utilized in the development of relevant medical devices to assist in the prediction of traumatic brain injury (TBI) and stroke according to revealing electroencephalography (EEG).

[Lab Method](#)

Neurology



**Mock Circulatory Loop Generated Database for Dynamic Characterization of Pressure-based Cardiac Output Monitoring Systems**

This RST is a database tool consisting of nine mock circulation loop (MCL)-generated datasets for characterizing three dynamic attributes of pressure-based cardiac output monitoring systems that apply an algorithm to intravital arterial blood pressure waveforms for cardiac output and stroke volume variation...

[Dataset](#)

Cardiovascular | Patient Monitoring and Control



**A "threshold-based" Approach to Determining an Acceptance Criterion for Computational Model Validation**

This RST, a "threshold-based" validation method, provides a means to determine an acceptance criterion for computational models. A "credible" computational model has the potential to provide a meaningful evaluation of safety in medical device submissions [1, 2].

[Computer Model](#)

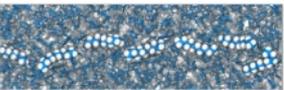
Cardiovascular



**Strategy to Estimate Low to High Cycle Fatigue Transition of Nitinol for Fatigue to Fracture Test Planning**

This RST outlines a strategy for estimating the presence of cyclic phase transformation to aid in the determination of appropriate load levels for fatigue to fracture testing of nitinol components. Specifically, it includes a flowchart (Figure 1 in Appendix) to estimate the low to high cycle fatigue transition using either...

[Lab Method](#)



**Device and Material Safety Evaluation Library (DAMSEL)**

The DAMSEL tool is a digital collection of published information related to the safety profile of materials commonly used in the manufacture of medical devices. This interactive application allows users to filter and access key response data for studies relating to material biocompatibility along with hyperlinks to the...

[Dataset](#)



**VICTRE: In Silico Breast Imaging Pipeline**

The Virtual Imaging Critical Trials for Regulatory Evaluation (VICTRE) computer modeling pipeline is a set of tools that allow for the exploration of clinical trials of in silico breast radiographic images for the evaluation of digital mammography (DM) and digital breast tomosynthesis (DBT) devices.

[Computer Model](#)



**Targeted Box and Blocks Test (IBBT)**

A performance based method requiring controlled grasping, transport, and release of objects that can be used to evaluate upper limb functional ability

[Clinical Outcome Assessment](#)

# Examples of CDRH RSTs

- **iMRMC**
  - Statistical Model Developed for use in imaging and digital pathology
  - To date, has been used in 62 premarket submissions covering 14 different product codes across 4 OHTs, including devices with breakthrough designation

**MRMC = multiple readers and multiple cases**

**OHT = Office of Health Technology**

# Examples of CDRH RSTs

- **Evaluation of AI-based algorithms and bias**
  - Developed 2 separate approaches to assess bias and evaluate impact on AI algorithm development
  - Tool (DRAGen) is currently being publicly released
  - Used in reducing X-ray dose for CT scanning of susceptible patients including pediatrics

CT = computed tomography

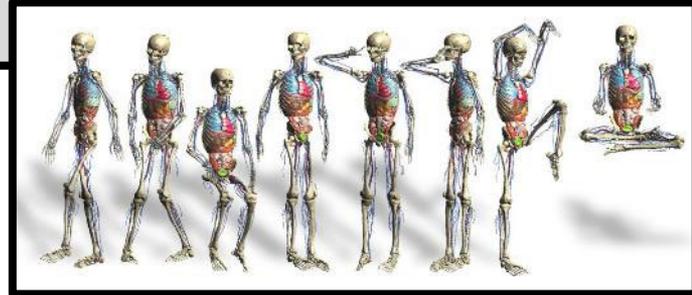
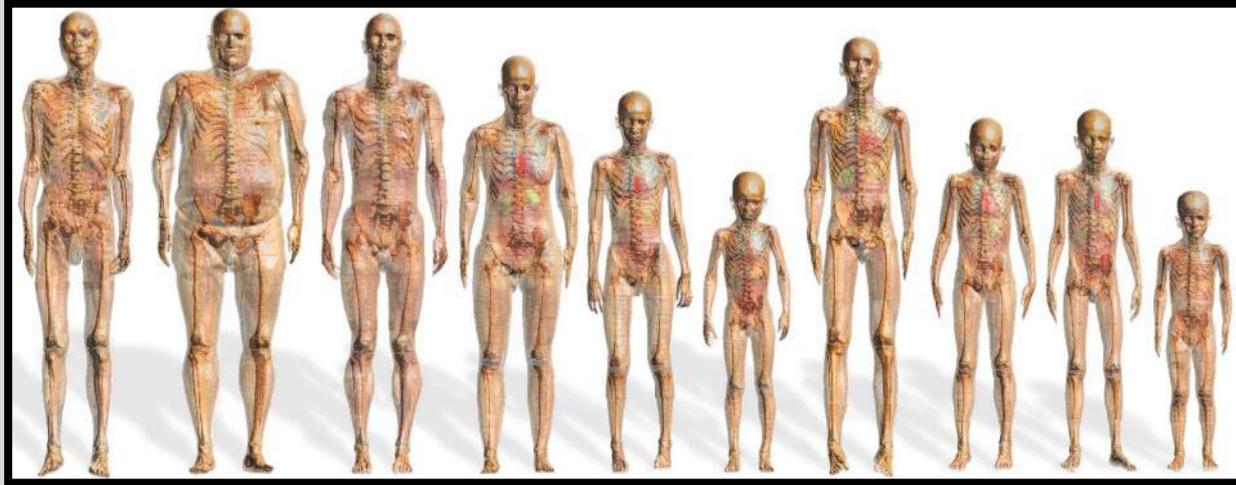
# Examples of CDRH RSTs

- **CHRIS Family**
  - Used for early biocompatibility evaluation prior to design freeze
  - Available at the public RST App: [cdrh-rst.fda.gov](https://cdrh-rst.fda.gov)

CHRIS = chemical risk calculators

# The Virtual Family

The Virtual Population is a set of anatomically correct whole body models for thermal, electromagnetic, and fluid dynamic simulations



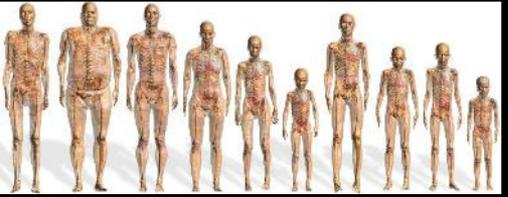
**male elderly**  
1.73m, 65kg

**male adult**  
1.74m, 70kg

**11 year old girl**  
1.46m, 36kg

**14 year old boy**  
1.65m, 50kg

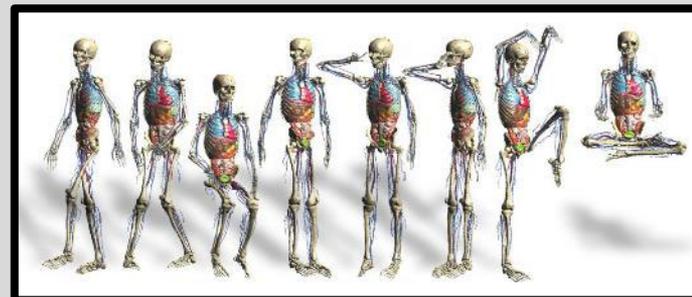
**8 year old boy**  
1.40m, 26kg



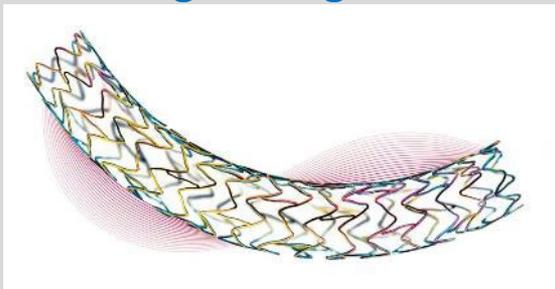
# The Virtual Family

The Virtual Population is a set of anatomically correct whole body models for thermal, electromagnetic, and fluid dynamic simulations

- Cited in over 850 premarket submissions
- Used in over 450 premarket submissions, including



**Drug eluting stents**



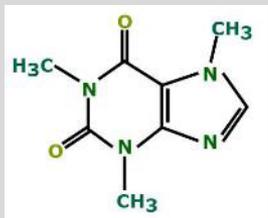
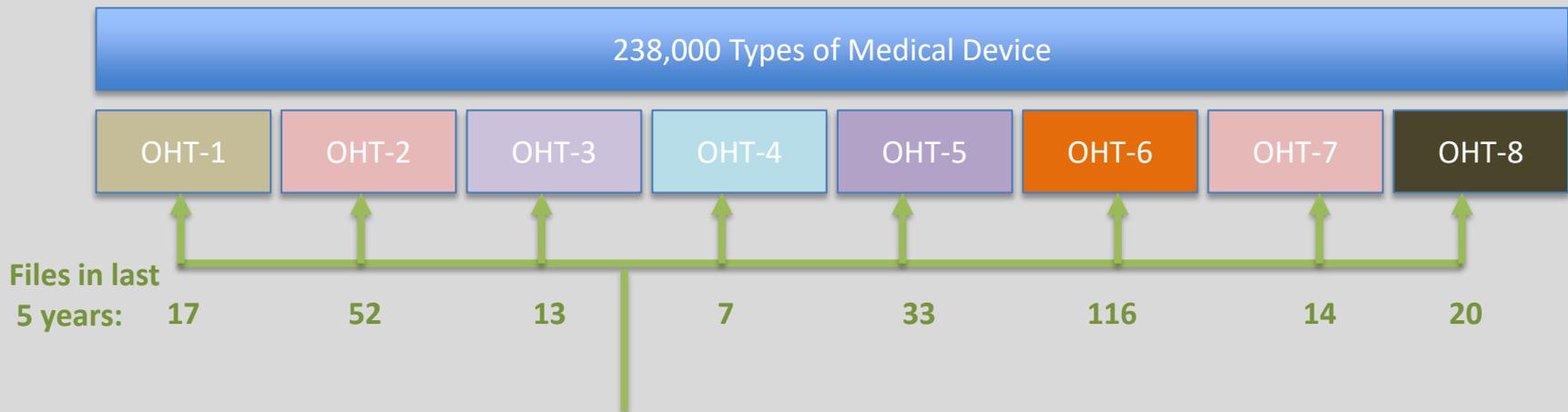
**Orthopedic Bone Plates**



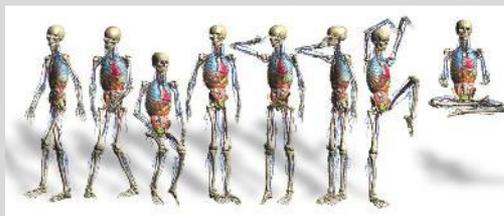
**World's First 7T MRI Scanner**



# Tools Impact Multiple Product Areas



CHRIS



Virtual Family



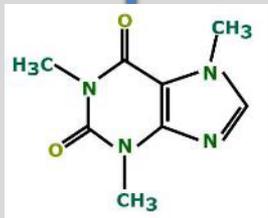
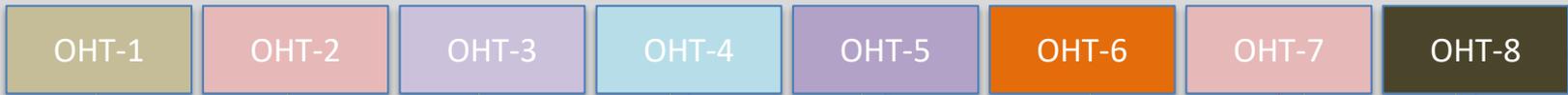
ViCTRE

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

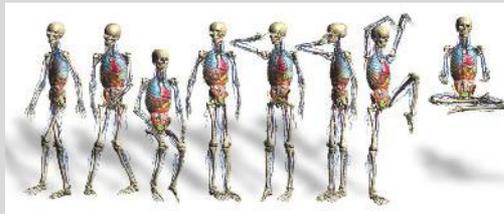
iMRMC

# Tools Impact Multiple Product Areas

257,400 Types of Medical Device



CHRIS



Virtual Family



ViCTRE

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

iMRM  
C

# Knowledge Check

Who can use regulatory science tools?

1. Researchers in academia
2. Industry product development teams
3. CDRH reviewers
4. All of the above



# Knowledge Check

True or False: Regulatory Science Tools guarantee FDA clearance or approval of your medical device application?

- 1. True
- 2. False



# Summary

- Regulatory science tools are publicly available
- They help **innovators**, by allowing them to focus on how good the technology or product is, and not how well is it tested
- They help **product development teams** by allowing easier benchmarking of a product early in development
- They help **CDRH reviewers** through familiarity with evaluation methods

# Questions



# Your Call to Action

- **Learn more about regulatory science tools**
  - Start by going to catalog
- **Explore where you may put RSTs to use**
  - Let us know what is needed