MIDRC
MEDICAL IMAGING AND DATA RESOURCE CENTER

Medical Imaging and Data Resource Center: Covid-19 and beyond

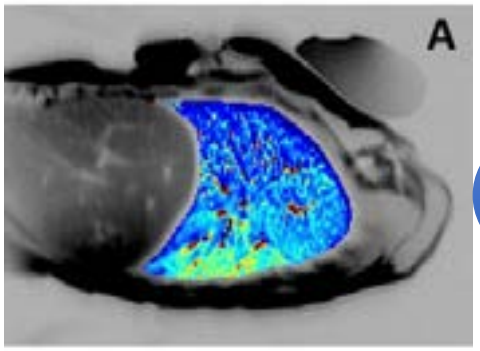
Rui C. Sá, Ph.D.
Data Scholar
NIBIB & ODSS

Assistant professor
University of California, San Diego

Quantitative functional imaging with MRI
Gas Exchange in the human lung

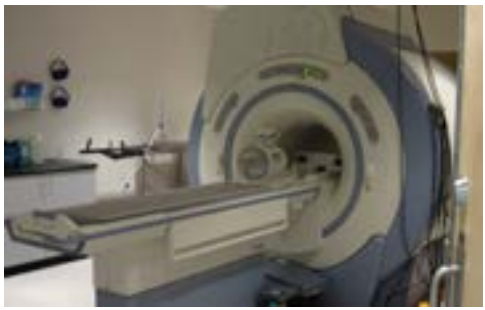
UC San Diego

Feet

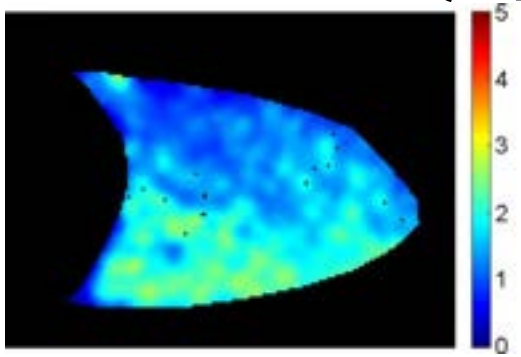


Head

gravity

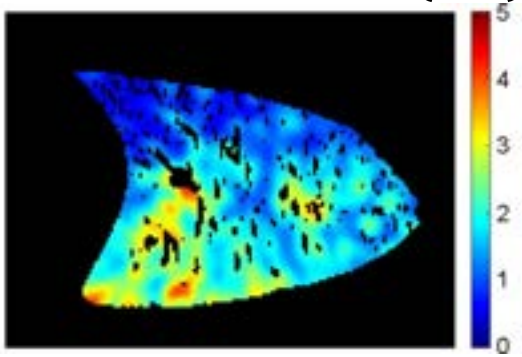


Ventilation $(\dot{V}_A)$



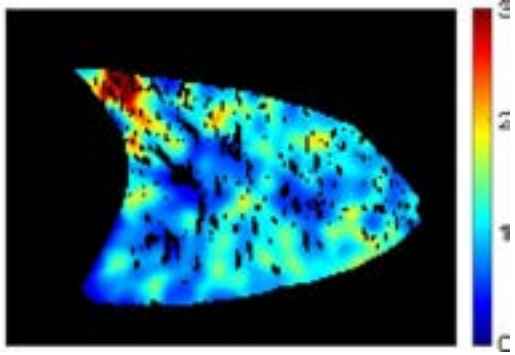
ml/min/ml

Perfusion $(\dot{Q})$



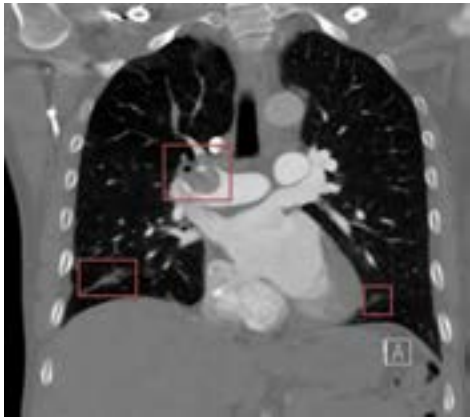
ml/min/ml

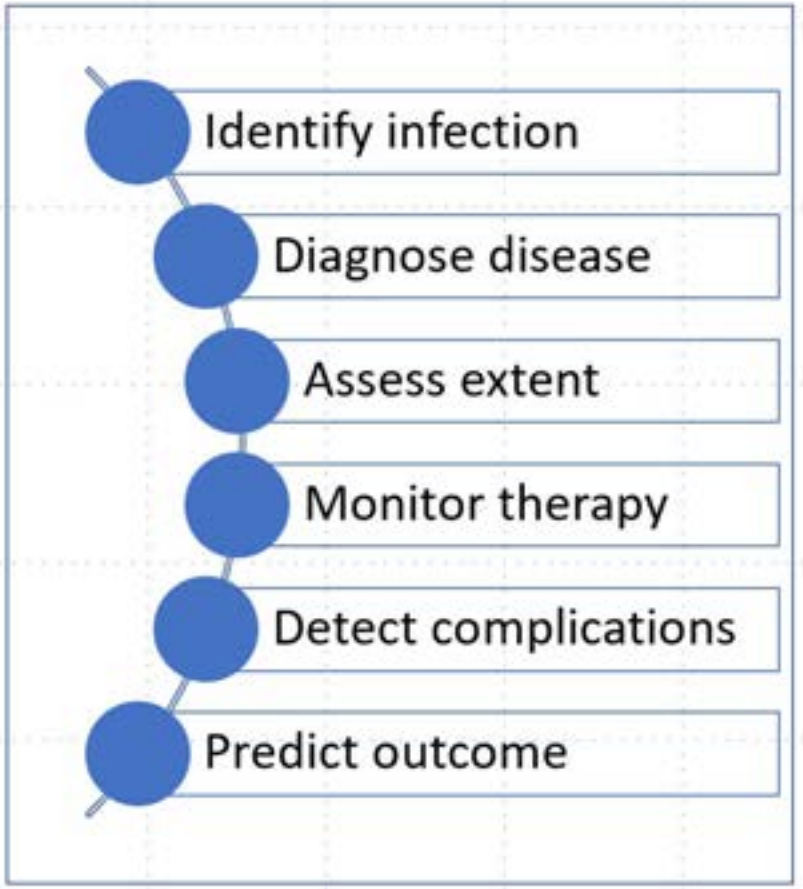
V_A/Q



R.C. Sá et al, JAP123(1), 2017

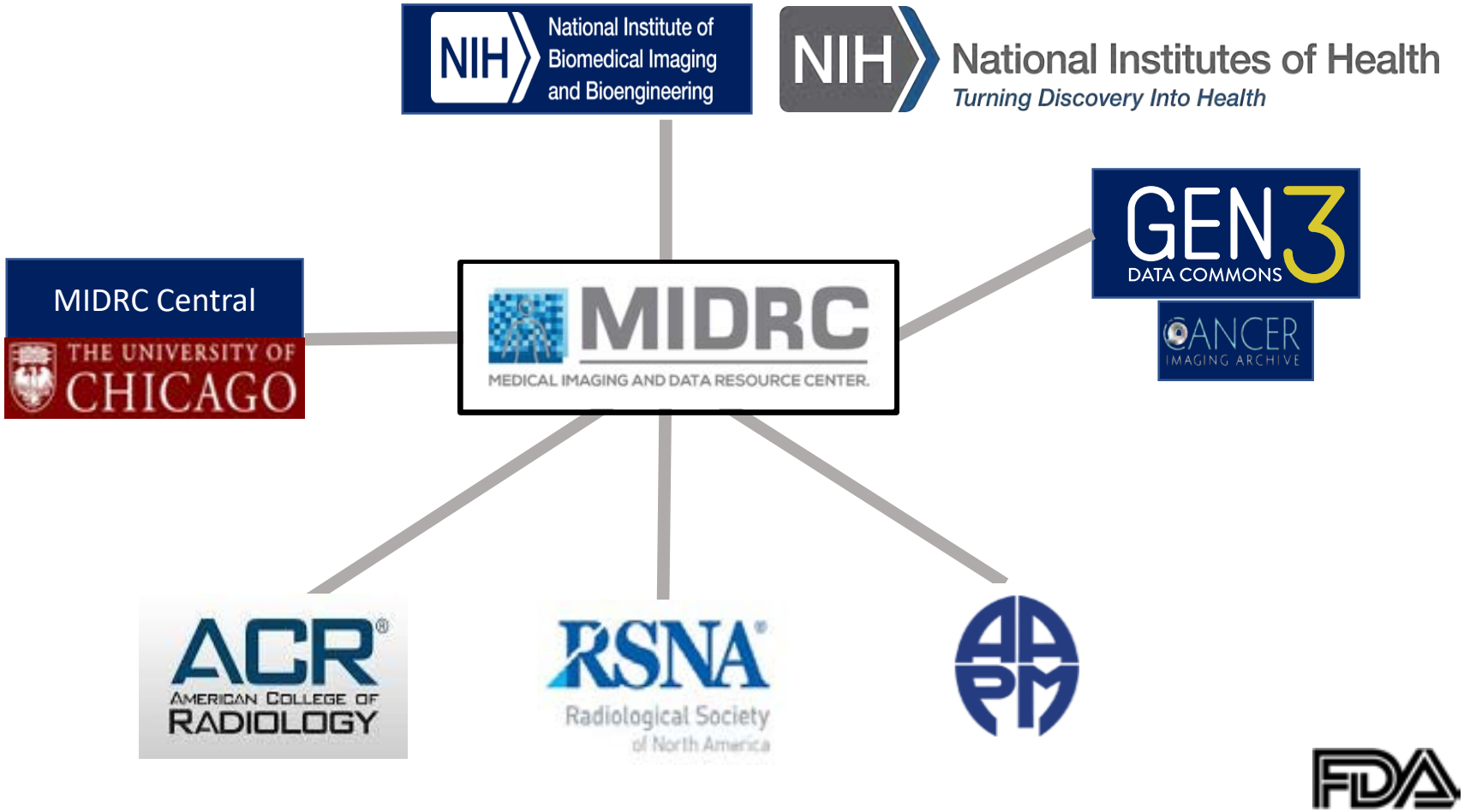
COVID-19 pandemic response





Role for AI / ML

Medical Imaging and Data Resource Center
Rapid Response to Covid-19 Pandemic



Medical Imaging and Data Resource Center
Rapid Response to Covid-19 Pandemic

NIBIB supported resource for medical imaging (CXR, CT)

Goal: **collect and curate medical images** with adjunct clinical data and **develop artificial intelligence** (AI / ML) methods to aid in the analysis & interpretation of medical images in response to Covid-19 pandemic

Two Major Scientific Components

Creation of Open Discovery Data Repository:
5 Technology Development Projects

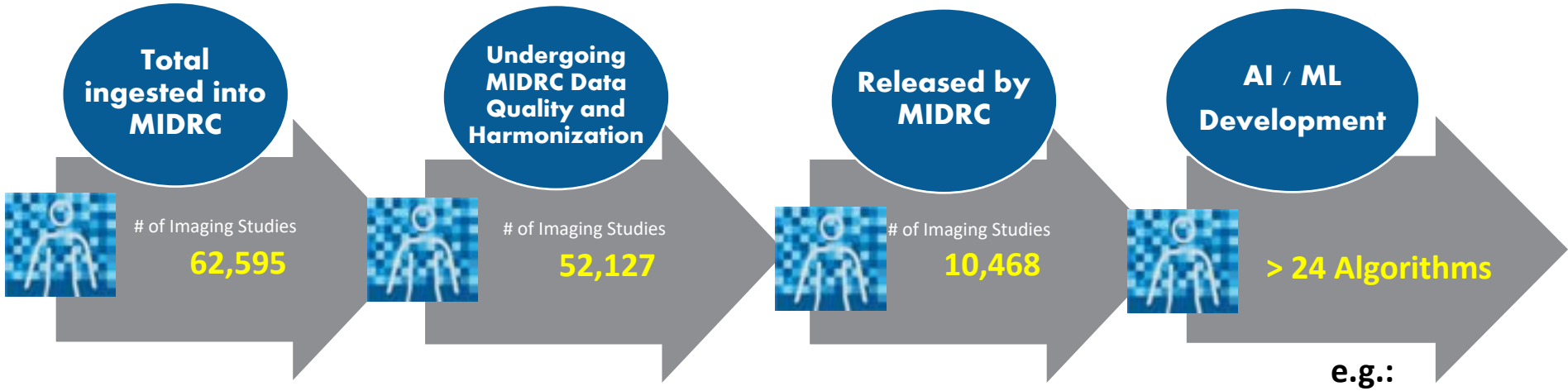
Machine Intelligence Computational Capabilities:
12 Collaborative Research Projects
And multiple trans-MIDRC scientific workgroups

Achievements: Infrastructure and standardization of processes

- Infrastructure & standardization:
  - Harmonization of data ingestion, quality control, data flow, common data model, de-identification procedures,…

Achievements: Infrastructure and standardization of processes

MIDRC Dashboard



Current MIDRC data (Chest Xray & CT)

Quality assessment
Diversity assessment
Sequestration - algorithm validation (FDA)

Publicly available curated, high quality, diverse and representative imaging studies

e.g.:

- **Segmentation: Lung, opacities**
- **Severity & length of hospital stay**
- **De-identification of radiological reports**

Critical gaps in AI/ML deployment
Lack of diverse and representative data

Geographic Distribution of Data to Train AI Algorithms

Kaushal A, Altman R, Langlotz C. JAMA. 2020;324: 1212–1213.

Area	Current State of the Art
Data needs for machine learning research	Few public image data sets are available, mostly small in size and lacking real-world variation.

Langlotz CP, Allen B, Erickson BJ, et al. A Roadmap for Foundational Research on Artificial Intelligence in Medical Imaging: From the 2018 NIH/RSNA/ACR/The Academy Workshop. Radiology. 2019;291: 781–791. https://doi.org/10.1148/radiol.2019190613

AuntMinnie.com

Judy W. Gichoya

Is radiology AI technology racist?

August 6, 2021 -- Artificial intelligence (AI) models can recognize a patient's racial identity on medical images, even though radiologists can't, ...

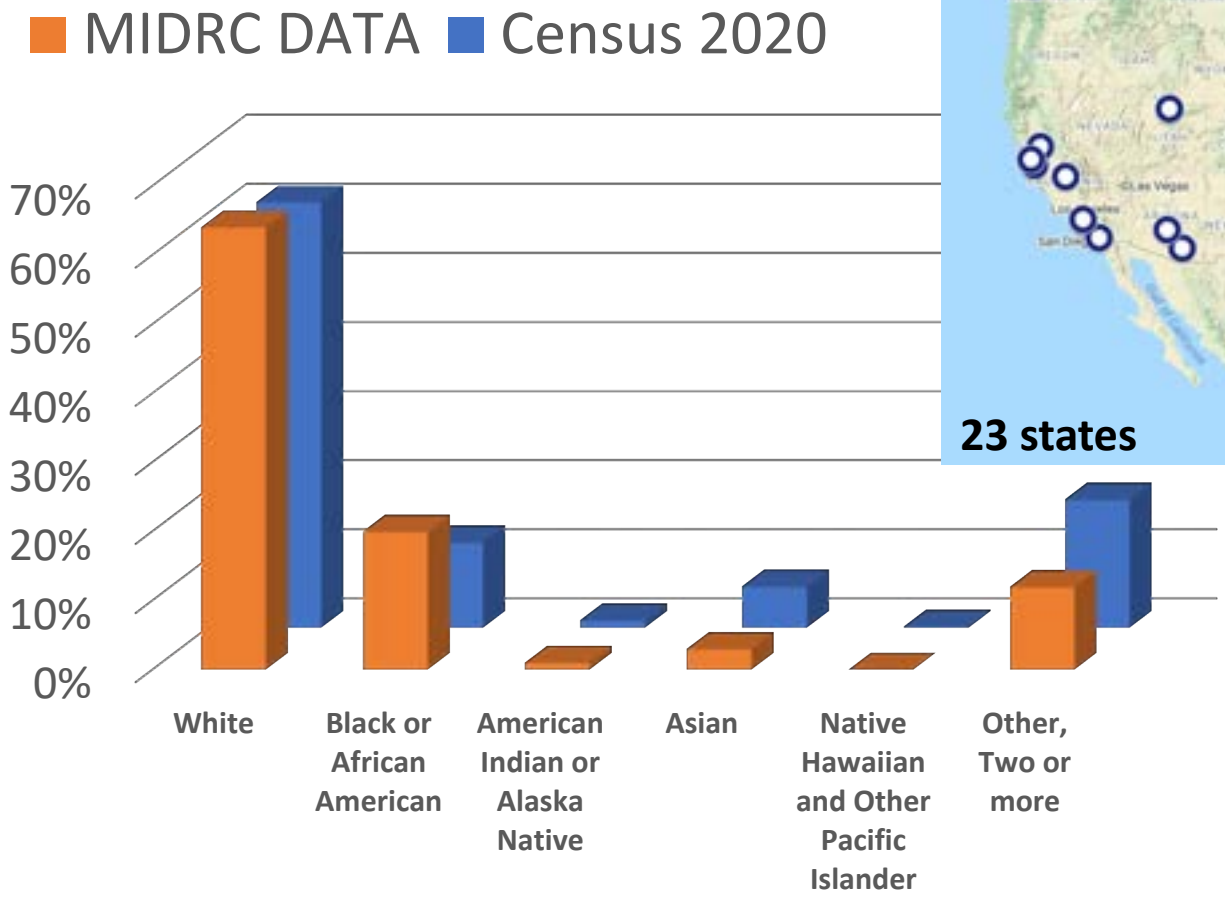
3 weeks ago

Area	Current State
Software use cases for AI	AI algorithms are being created based on use cases developed at single institutions working with single developers, limiting diversity and generalizability to widespread clinical practice.

"…report all results by relevant clinical and demographic group… " => **Need for representative dataset**

Allen B Jr, Seltzer SE, Langlotz CP, et al. A Road Map for Translational Research on Artificial Intelligence in Medical Imaging: From the 2018 National Institutes of Health/RSNA/ACR/The Academy Workshop. J Am Coll Radiol. 2019. https://doi.org/10.1016/j.jacr.2019.04.014

Achievements: Diversity and Representativity of MIDRC Data



Medical Imaging and Data Resource Center: Collaborations

MIDRC
MEDICAL IMAGING AND DATA RESOURCE CENTER

NIH National Center for Advancing Translational Sciences

N3C

SPIE.

The ACADEMY for Radiology & Biomedical Imaging Research

NIH National Heart, Lung, and Blood Institute

BioData CATALYST

ASNR
American Society of Neuroradiology

NIH National Institute of General Medical Sciences

IDeA-CTR

The association for medical ultrasound
aium
AMERICAN INSTITUTE OF ULTRASOUND IN MEDICINE

Medical Device Research Interest Group — **Trans-NIH, FDA, CMS**

Argonne NATIONAL LABORATORY

MDIC
MEDICAL DEVICE INNOVATION CONSORTIUM

Achievements: algorithms by MIDRC investigators

- Algorithms (two examples)
  - Extracting information from radiology reports

Cascaded deep transfer learning on thoracic CT in COVID-19 patients treated with steroids

Jordan D. Fuhrman,[a] Jun Chen,[b] Zegang Dong,[c] Fleming Y. M. Lure,[c] Zhe Luo,[d,e,*] and Maryellen L. Giger[a,*]

- Sequestration:
  - Diverse & representative sequestered dataset as a tool for independent testing of AI/ML algorithms for regulatory/translation.

MIDRC
MEDICAL IMAGING AND DATA RESOURCE CENTER

Immediate future

- **Collect and disseminate Covid-19 medical imaging** data for discovery and technology deployment
  - Expand from chest CXR & CT to **other organs/systems** (heart, brain, ...)
  - **Increase the range of modalities** (MRI, ultrasound, …)
- **Support Post Acute Sequelae of SARS-CoV-2 infection (PASC)** response, including longitudinal monitoring
- Expand to other **acute and chronic diseases**
- Develop, validate and **deploy AI/ML algorithms for medical imaging**

Sustainability: MIDRC as a National resource

- Support the Medical Imaging AI/ML ecosystem
  - High quality, representative, trustworthy data
  - Culture of collaboration
  - Promote standards, sharing, transparency, best practices
  - Lower barrier of access
- Accelerate translation of AI/ML
  - Real-world quantification of algorithm performance (sequestered dataset)

It takes a village…

NIH National Institute of Biomedical Imaging and Bioengineering

- Kris Kandarpa, MD, PhD
- Behrouz Shabestari, PhD
- Guoying Liu, PhD
- Julia Ringel
- Qi Duan, PhD





NIH National Institutes of Health
Turning Discovery Into Health

Office of Data Science Strategy

- Natasha Hurwitz, MS
- Allissa Dillman, PhD
- DATA Scholars cohort, in particular
  - Judy W. Gichoya, MD
  - Mohammad Ghassemi, PhD

MIDRC
MEDICAL IMAGING AND DATA RESOURCE CENTER

- Maryellen L. Giger, PhD
- Paul E. Kinahan, PhD
- Etta Pisano, MD
- Michael Tilkin, MS
- Curtis P. Langlotz, MD, PhD
- Adam Flanders, MD
- Robert L. Grossman, PhD

UC San Diego

Pulmonary Imaging Laboratory

NIH funding:
NHLBI, NIBIB, NIA
NASA funding (NSBRI)
Amazon AWS grant