

Perspectives from the American College of Radiology

Mahadevappa Mahesh, MS, PhD, FAAPM, FACR, FACMP, FSCCT, FIOMP.

Chair of ACR Commission on Medical Physics

Professor of Radiology and Cardiology

Johns Hopkins University School of Medicine, Baltimore, MD, USA



@mmahesh1

The Sixth Gilbert W. Beebe Webinar, December 14, 2021

Dose Monitoring: What is currently possible?

- Dose metrics reported by imaging devices
 - CT Dose Index (CTDI), Dose Length Product (DLP)
 - Reference Air Kerma, Dose Area Product (DAP) or Air Kerma Product (KAP)
 - Effective dose are estimated
- None quantifies biological effect of radiation to individual patient
- **Effective dose** is not measure of radiation dose or risk but rather radiation protection quantity that estimates radiation detriment to population considering of all ages and both sexes

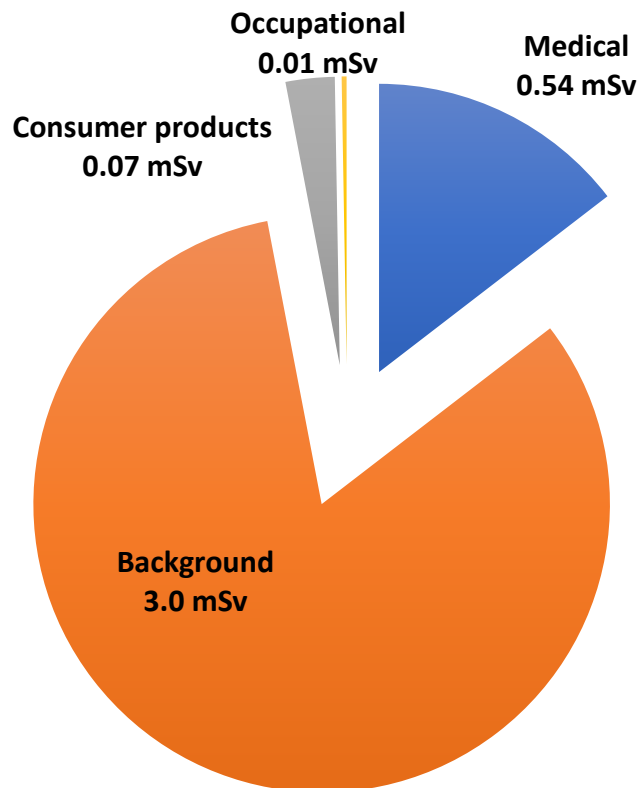
**Dose information tracked in EHRs is not
standardized – or even universally accepted**

Unintended Consequences

- Considering cumulative dose or effective dose values when deciding which imaging exam to order may be detrimental to patient's care
- Medically needed exam can be denied
- May be substituted with exam that does not use radiation, however
 - Ignoring diagnostic performance
 - Equipment availability, need for sedation, exam time
 - Cost

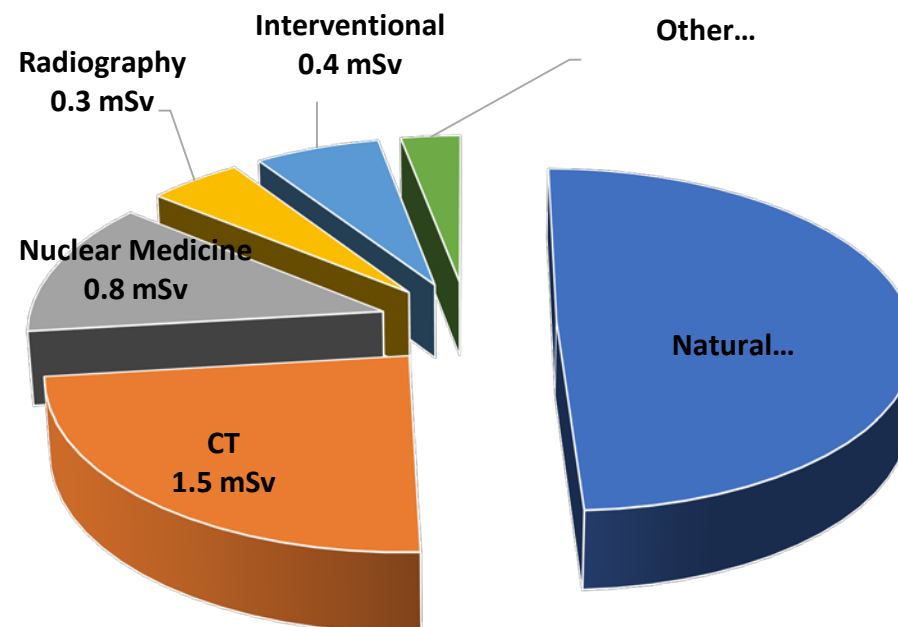
Past: Radiation Exposures to US population

1980



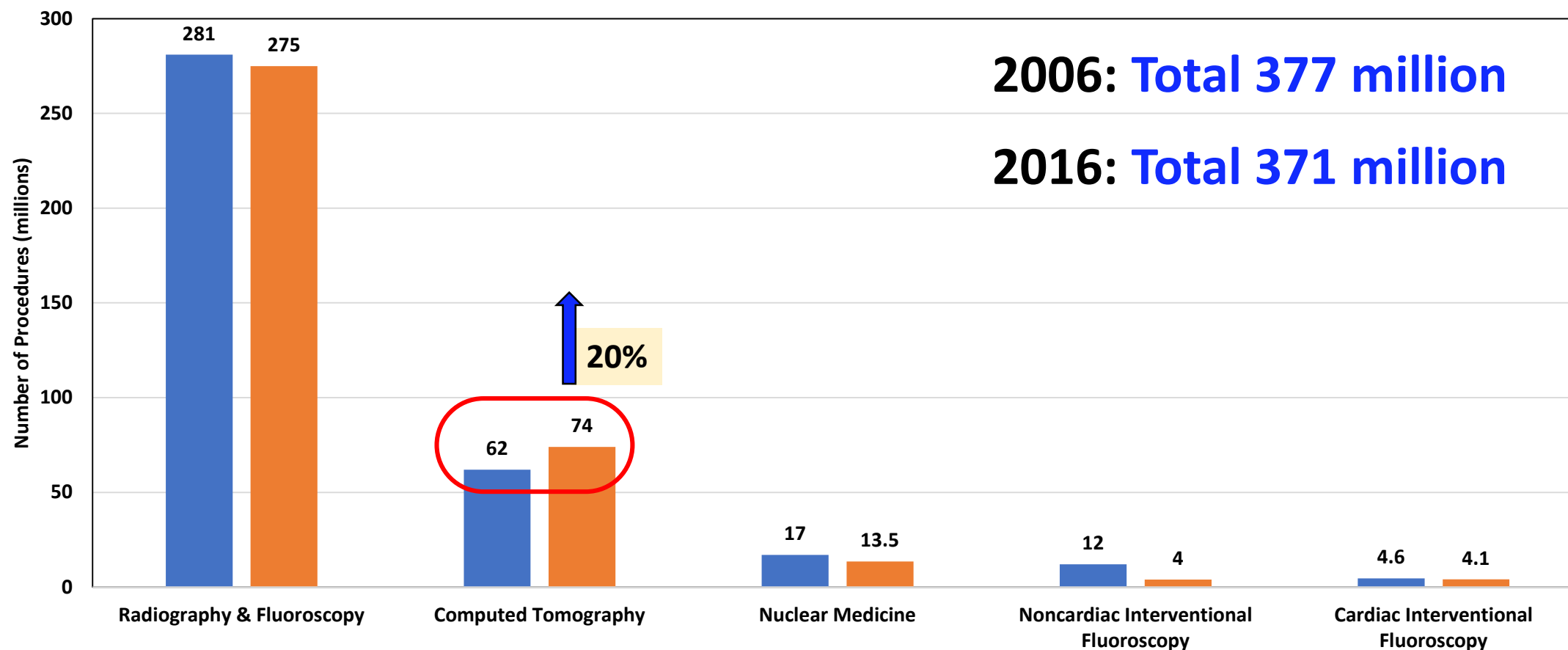
Medical 0.54 mSv per capita
Total 3.6 mSv per capita

2009



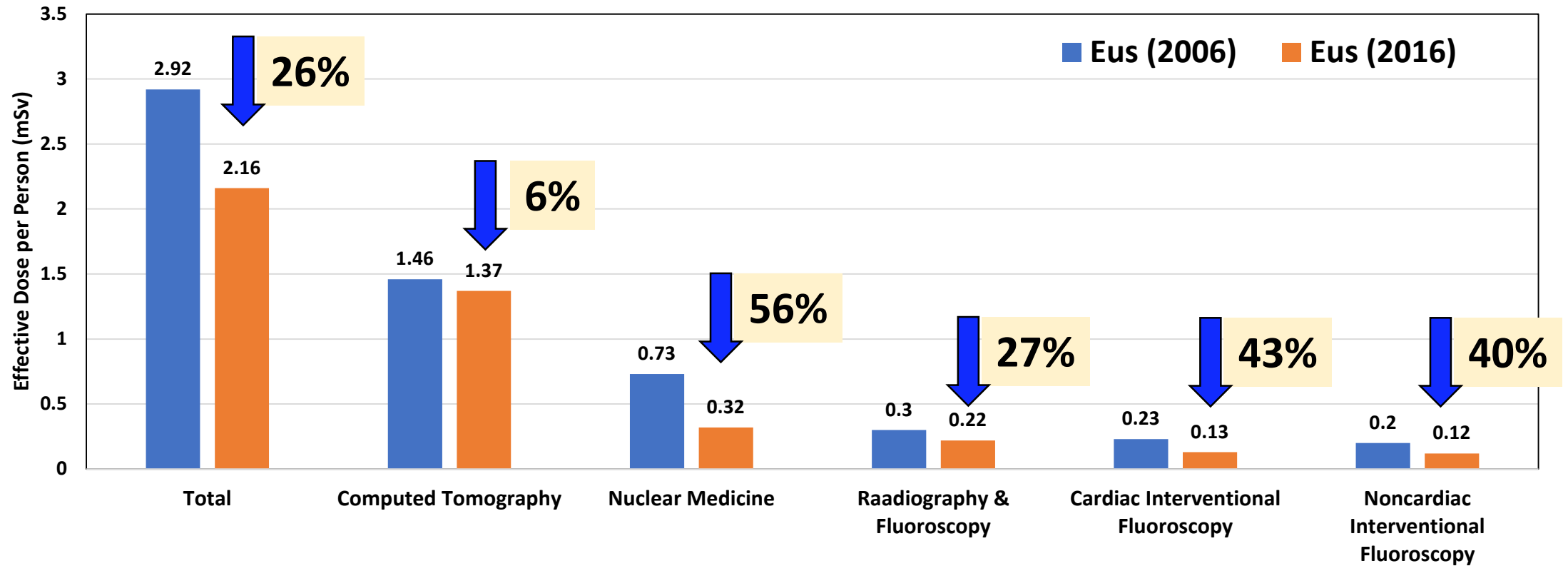
Medical 3.0 mSv per capita
Total 6.2 mSv per capita

Number of Procedures: 2006 vs 2016



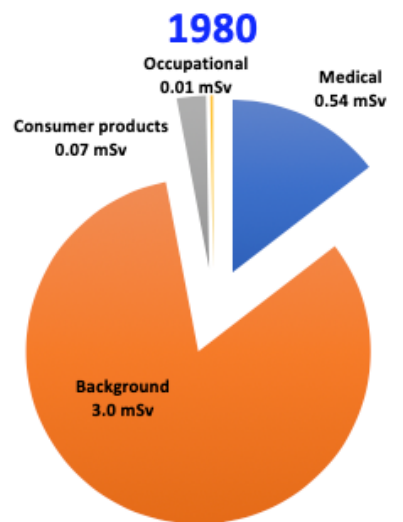
Average effective dose per person for US Population*

2006 vs 2016

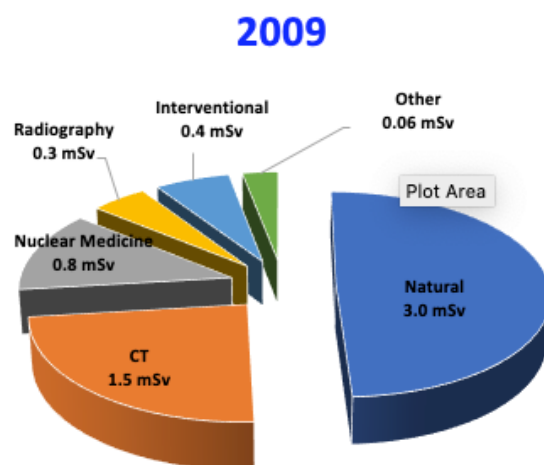


*values are not per patient, but per person in the US population

NCRP 184

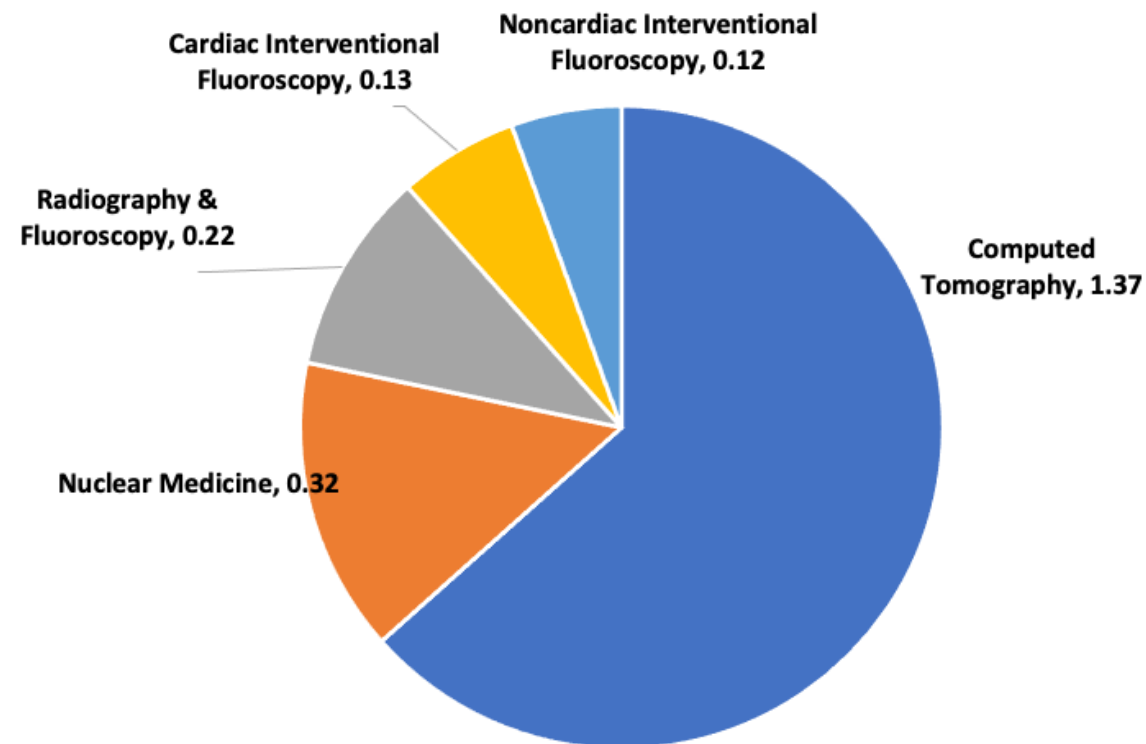


Medical 0.54 mSv per capita
Total 3.6 mSv per capita



Medical 3.0 mSv per capita
Total 6.2 mSv per capita

2019



2.16 mSv per capita

NCRP 184

Dose Monitoring: Is it beneficial?

- **Quality Assurance**
- **Protocol Optimization**
- **Compliance with accreditation and regulations**
- **Participating in Registries**
- **Establishing Diagnostic Reference Levels (DRLs)**

ACR Dose Index Registry

U.S. Diagnostic Reference Levels and Achievements

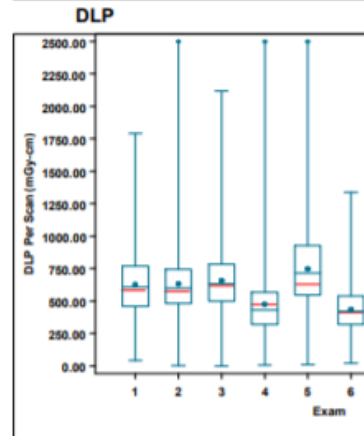
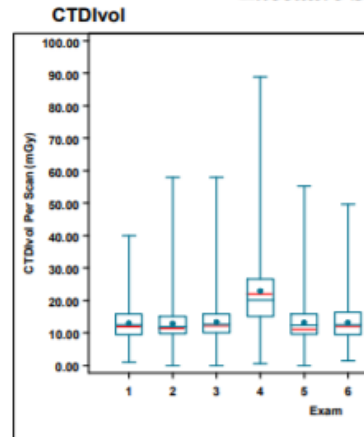
Using data from the American College of Radiology's Dose Index Registry, established U.S. national dose levels for the 10 most common adult CT patient-size based diagnostic reference levels (DRLs) and achievable dose examinations. A summary table of ADs and DRLs for median size patient all exams used water-equivalent diameter as an indicator of patient size.

Healthcare facilities can use this information to effectively compare their protocols so that dose is commensurate with the size of the patient, and

References - 1. Kanal KM, Butler PF, Sengupta D, et al. U.S. Diagnostic Examinations, Radiology 2017, ahead of print. (<http://pubs.rsna.org/doi>)

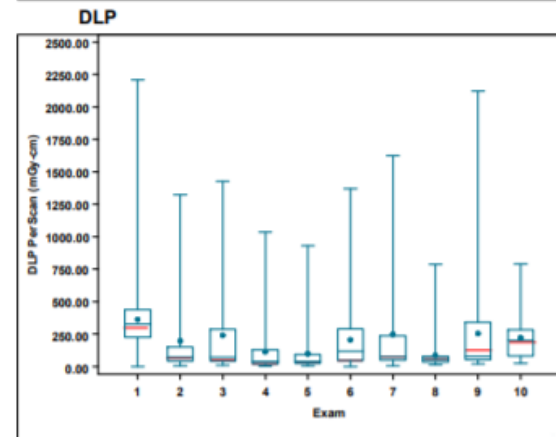
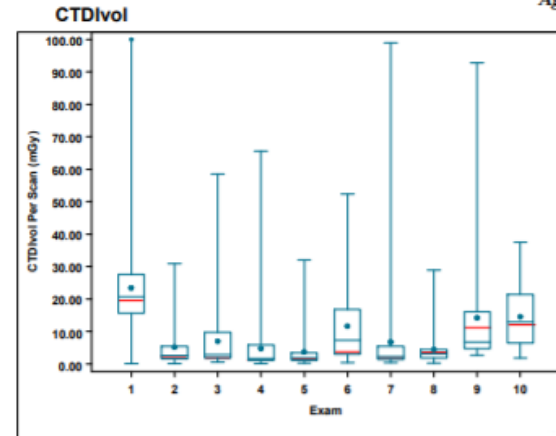
Exam Name	Median Patient Size (cm)
Head and brain without contrast	14-16
Neck with contrast	18-22
Cervical spine without contrast	18-22
Chest without contrast	29-33
Chest with contrast	29-33
Chest pulmonary arteries with contrast	29-33
Abdomen and pelvis without contrast	29-33
Abdomen and pelvis with contrast	29-33
Abdomen, pelvis and kidney without contrast	29-33
Chest, abdomen and pelvis with contrast	29-33

Executive Summary



Your Facility's Performance on the 10 High Volume DIR Exams (Pediatric)

Age group 0-2

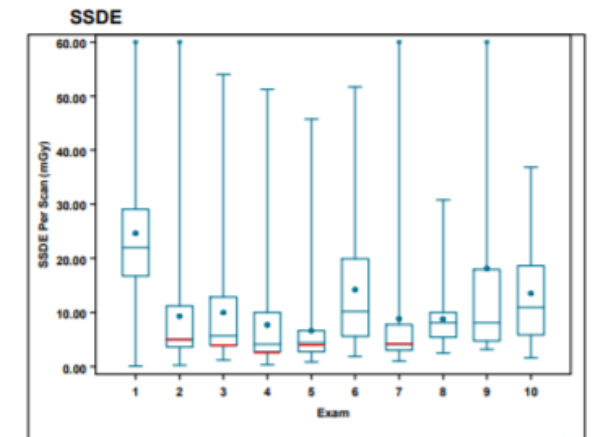


— : Your Facility Median

Exam Key

- 1 = CT HEAD BRAIN WO IVCON
- 2 = CT ABDOMEN PELVIS W IVCON
- 3 = CT ABDOMEN PELVIS WO IVCON
- 4 = CT CHEST WO IVCON
- 5 = CT CHEST W IVCON
- 6 = CT C SPINE WO IVCON
- 7 = CT CHEST ABDOMEN PELVIS W IVCON
- 8 = CT NECK W IVCON
- 9 = CT HEAD PARANASAL SINUSES WO IVCON
- 10 = CT HEAD MAXILLOFACIAL WO IVCON

* Extreme outliers were excluded for this exam for optimal presentation.



What about Patient's Medical Imaging History?

- **Beneficial**
- **Knowing patient's imaging history can help determine whether an additional imaging study is likely to be beneficial**
- **For example, if a patient had CT of the head in Hospital A and then travels to Hospital B on the same day, benefit to repeat the same study might be small or non-existent**
- **If physicians at Hospital B have access to previous study, additional imaging to answer same clinical question could be avoided**

Resources needed for Tracking Patient Dose History

- **Costly and Time consuming with no significant benefit**
- **On the other hand, resources can be better used for**
 - **Educating user about appropriateness of a study**
 - **Optimizing imaging protocols**
 - **Participate in registries for comparisons**

Question at Hand

Question:

Should patient-specific radiation dose history dose tracking systems be broadly established?

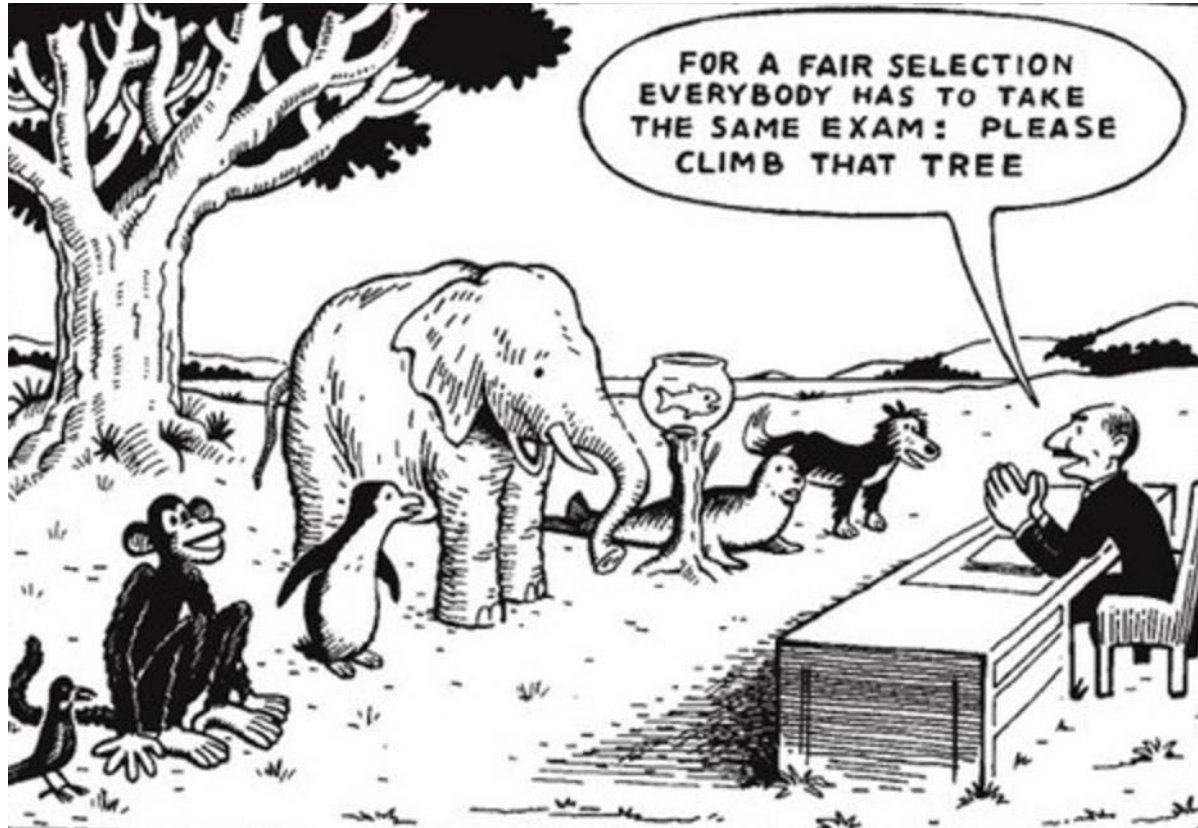
Position of the ACR Physics Commission:

No, for several reasons cited above and from my colleagues

**“decision to perform a medical imaging exam
should be based on clinical grounds, including
information available from prior imaging results
and not on the dose from prior imaging-related
radiation exposures”**



Thank You!



[AAPM-ACR-HPS
Statement](#)



[AAPM-ACR-HPS
FAQ](#)



[@mmahesh1](#)