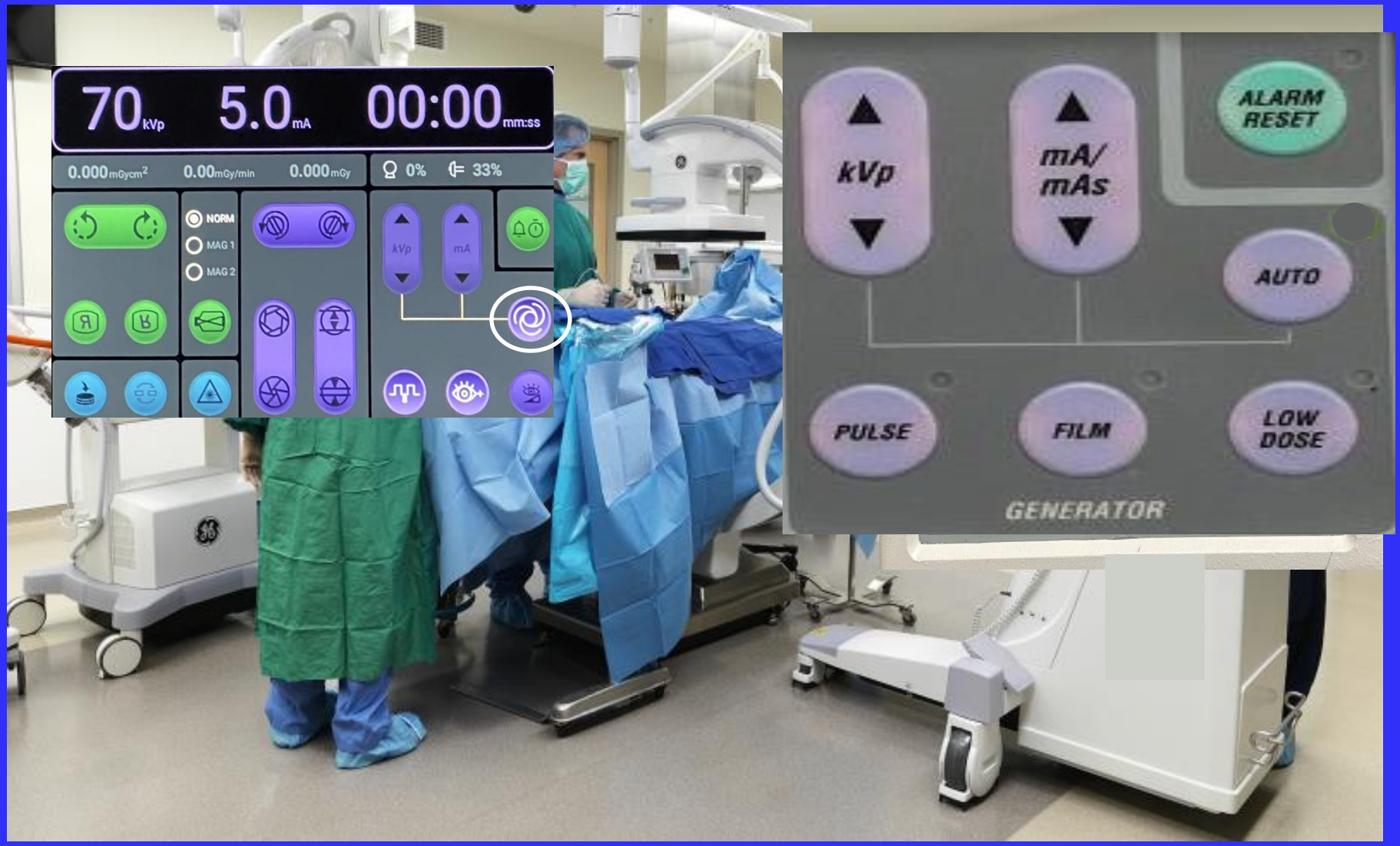
INTRAOPERATIVE FLUOROSCOPIC Radiation Exposure Update

OAOS
2025 Annual Meeting

Timothy Keenen, MD
Affiliate Associate Professor
OHSU
Orhtopedics and Rehabilitation

NO DISCLOSURES


FedEx


70 kVp
5.0 mA
00:00 mm:ss
0.000 mGycm²
0.00 mGy/min
0.000 mGy
0%
33%
NORM
MAG 1
MAG 2
kVp
mA
ALARM RESET
kVp
mA/ mAs
AUTO
PULSE
FILM
LOW DOSE
GENERATOR

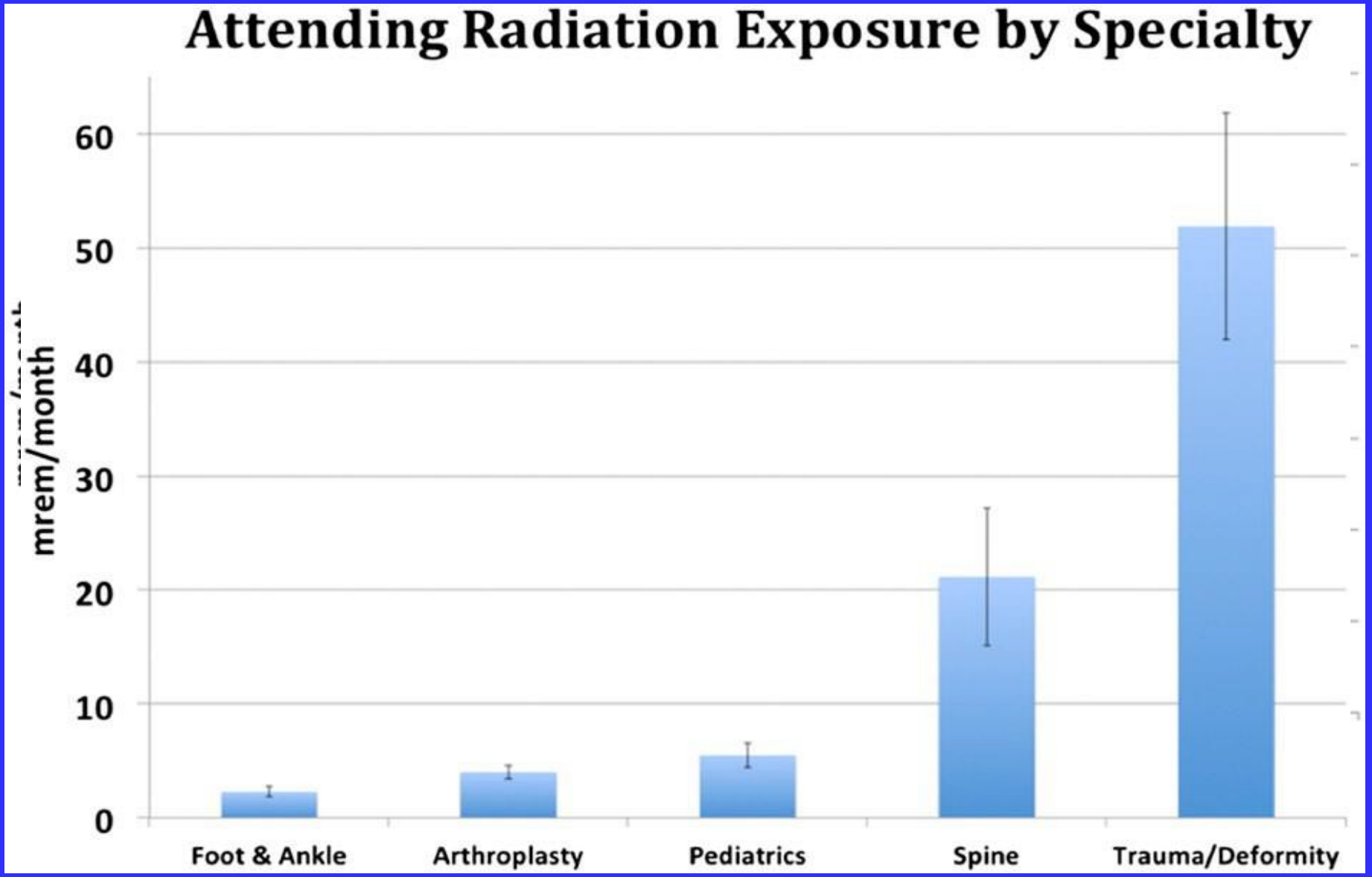

Better HOT
than NOT


NATIONAL GEOGRAPHIC
Photograph by Poh Siang Seah


Keenen, MD


In this Style 10/6
Keenen, MD

Gaudsen et al. J Bone Joint Surg Am. 2017;99:1324-9



Resident Radiation Exposure by Level of Training on the Trauma/Deformity Service

Underestimation of fluoroscopic exposure among orthopedic residents

Kelly D. Carmichael & Lattisha L. Bilbrew
Skeletal Radiology (2020) 49:383–385

19 residents 13 PGY 1-2 6 PGY 4-5

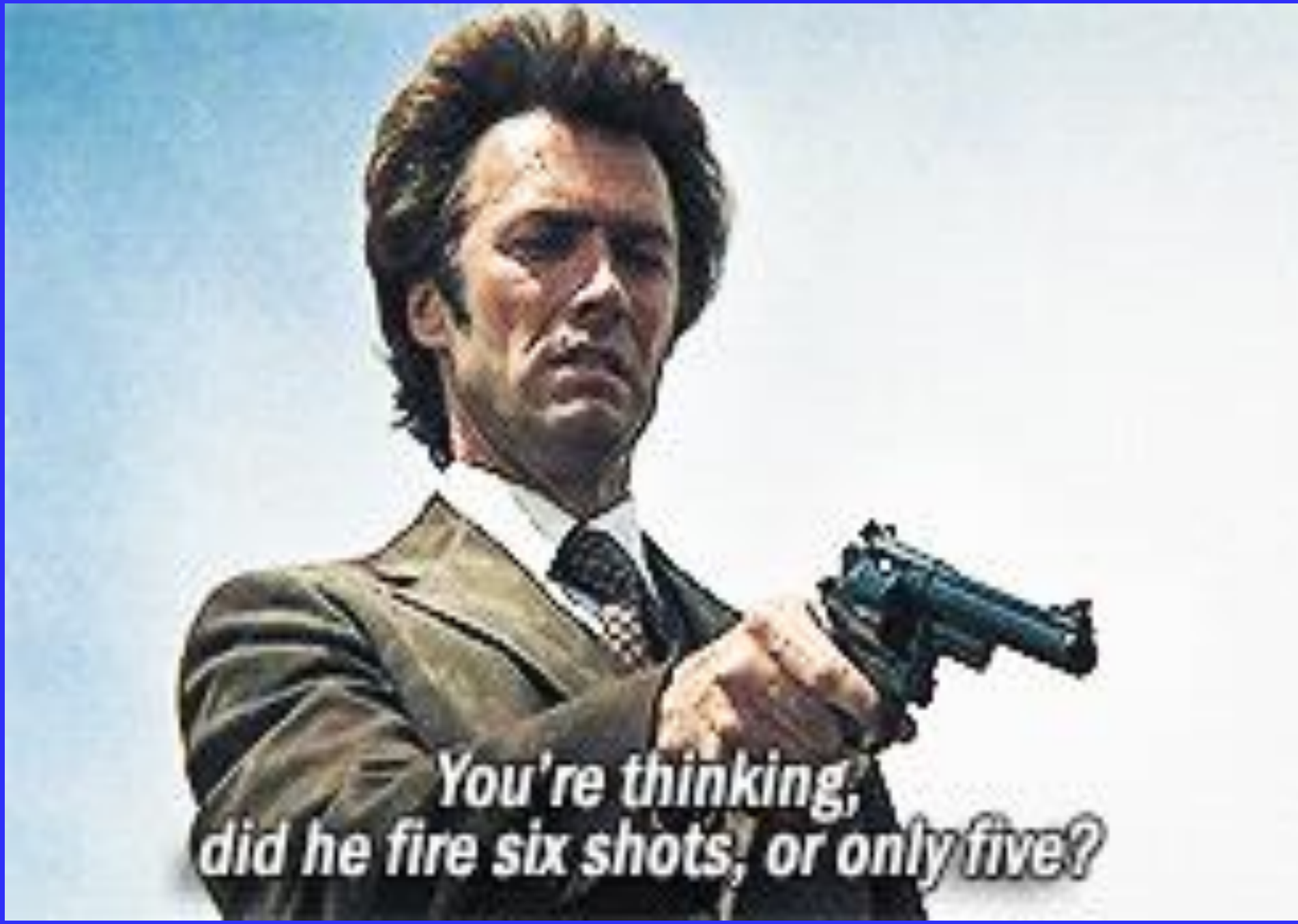
How many images were taken?

19 proximal femur / femur ORIF cases

898 2056

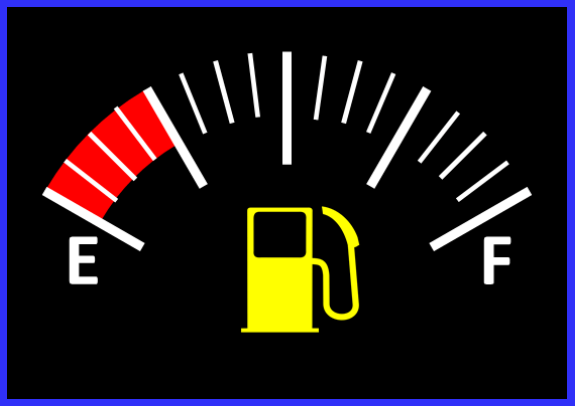
57%

108 images per case


You're thinking,
did he fire six shots, or only five?

- Invisible
- Odorless
- Colorless
- No immediate effects
- First effect is too late

Cummulative



How much radiation is too much?

.05 Sv

(5 rem)

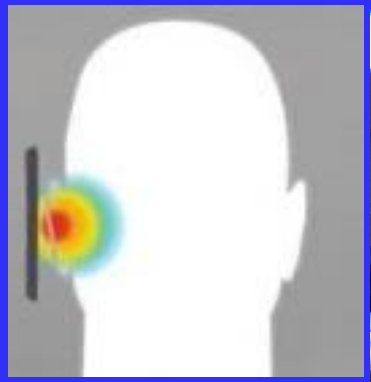
Says who?

August 6, 1945 Hiroshima
August 9, 1945 Nagasaki

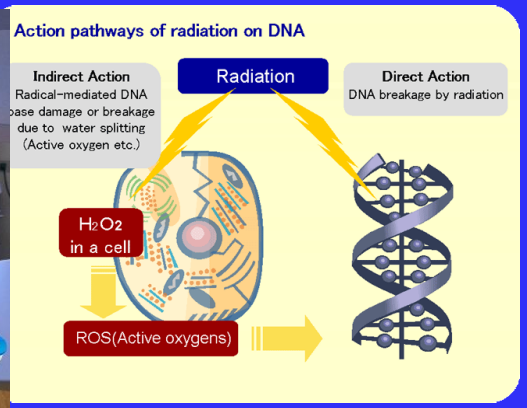
Life-Span Study

120,000 exposed survivors and unexposed resident of all ages
Over 70 years of follow up

Energy absorbed



Biologic effect

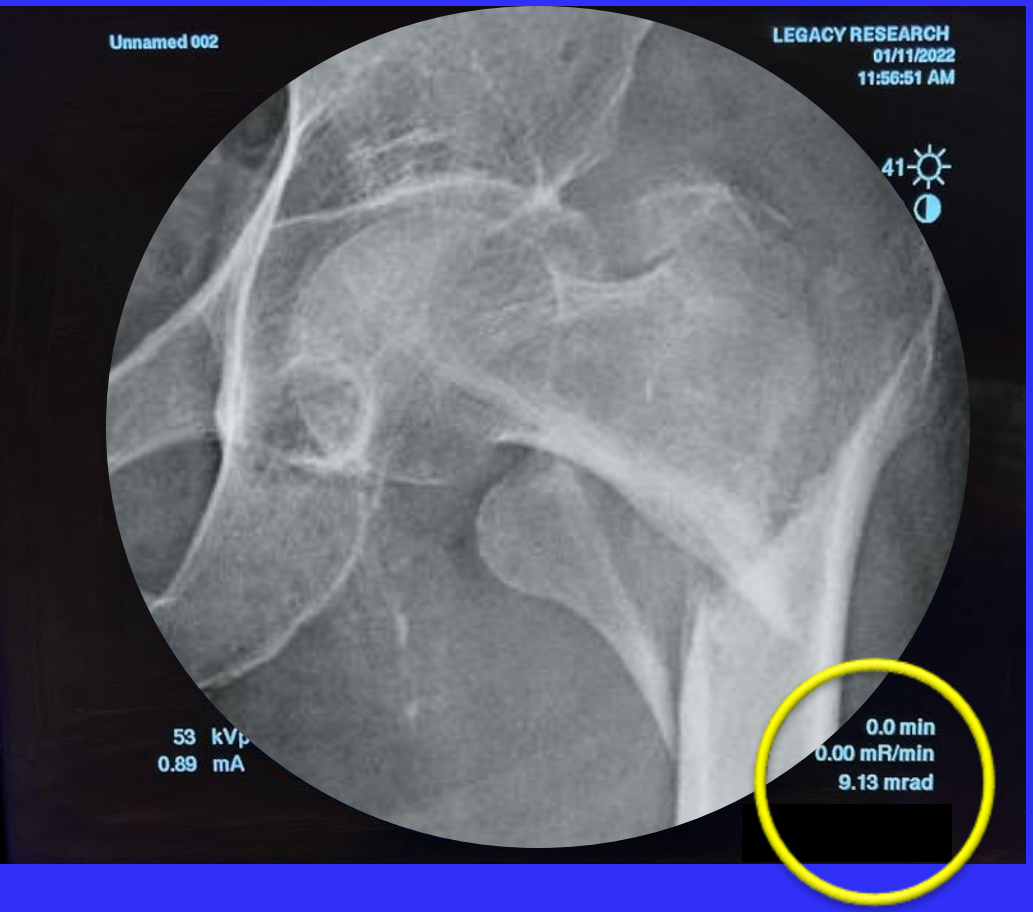


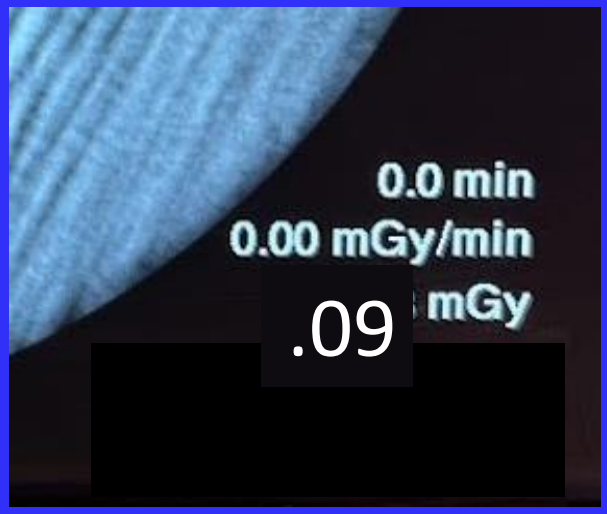
rad = rem

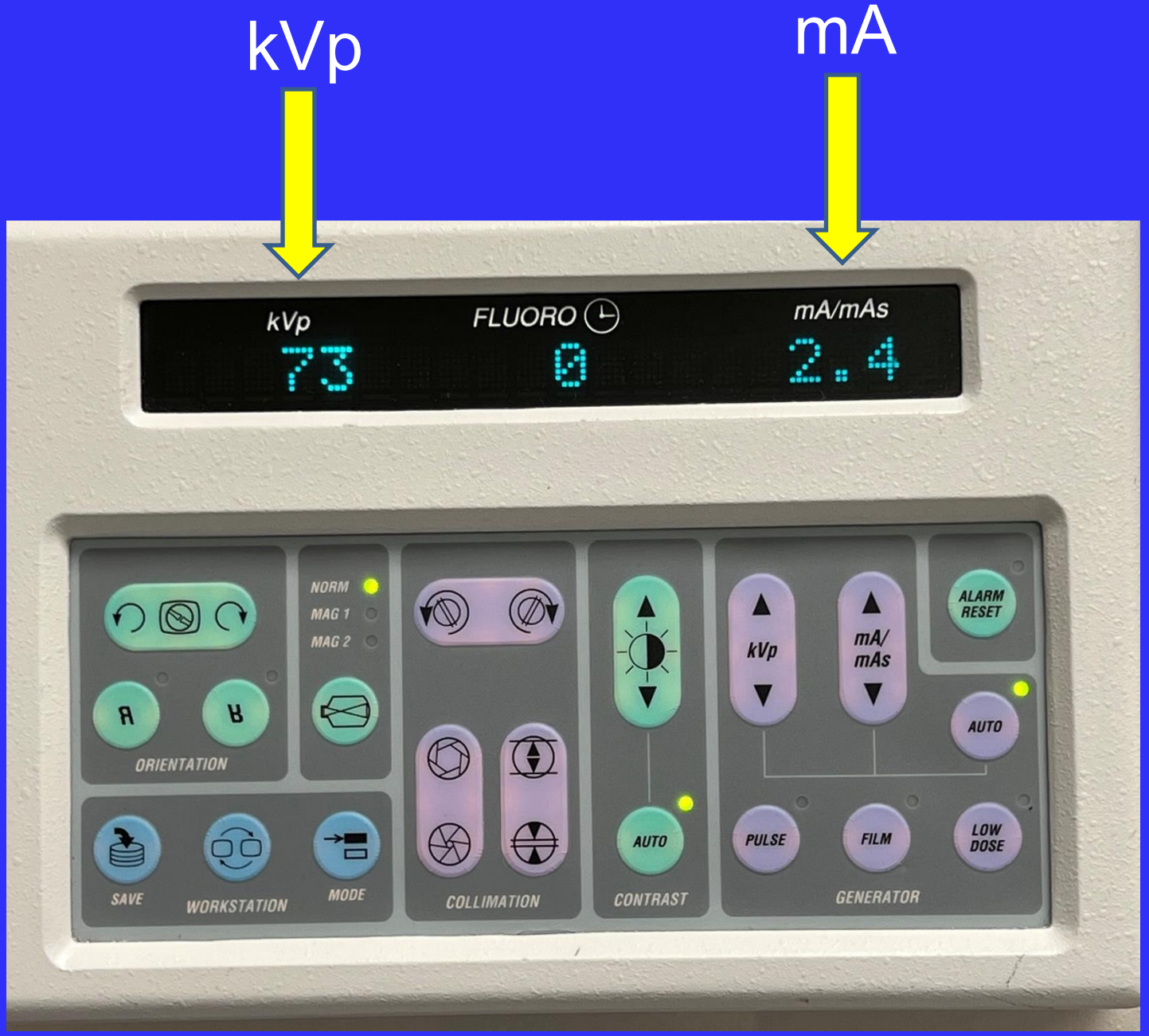
Gray (Gy) = Sievert (Sv)

CAK

Cumulative Air Kerma






kVp
mA
kVp
FLUORO
mA/mAs
73
0
2.4
NORM
MAG 1
MAG 2
ORIENTATION
SAVE
WORKSTATION
MODE
COLLIMATION
AUTO
CONTRAST
kVp
mA/
mAs
ALARM
RESET
AUTO
PULSE
FILM
LOW
DOSE
GENERATOR

Seconds of Fluoroscopy time

ICRP

International Commission on Radiologic Protection

ICRP 103 (2007) 118 (2012)

NCRP

National Council on Radiation Protection and Measurements

NCRP Commentary 26 (2016)

Annual Guidelines

.02 Sv whole body

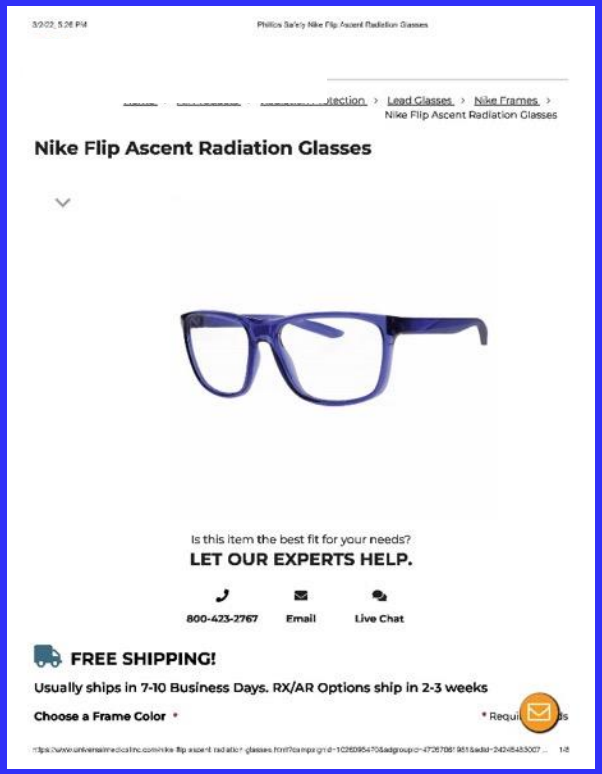
.05 Sv whole body

.02 Sv eye

.05 Sv eye

0.5 Sv skin / hands

0.5 Sv skin / hands



3/2/22, 5:26 PM Phillips Safety Nike Flip Ascent Radiation Glasses

...ection › Lead Glasses › Nike Frames › Nike Flip Ascent Radiation Glasses

Nike Flip Ascent Radiation Glasses

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Choose a Frame Color *

Types of Cataracts

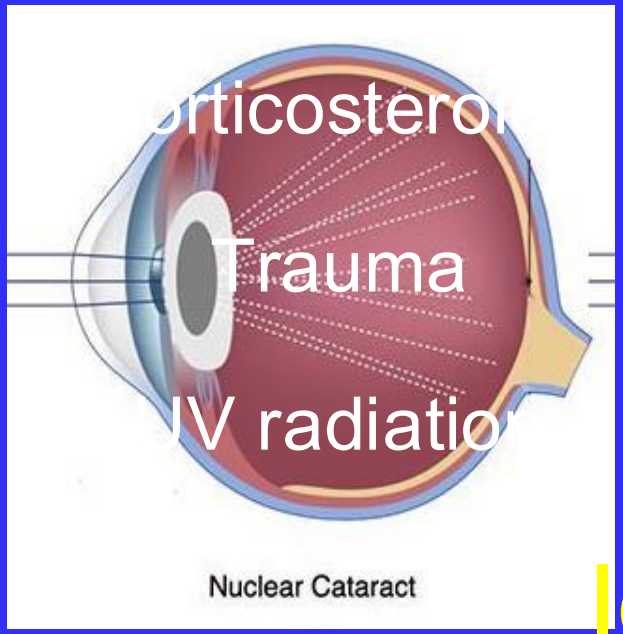
10 %

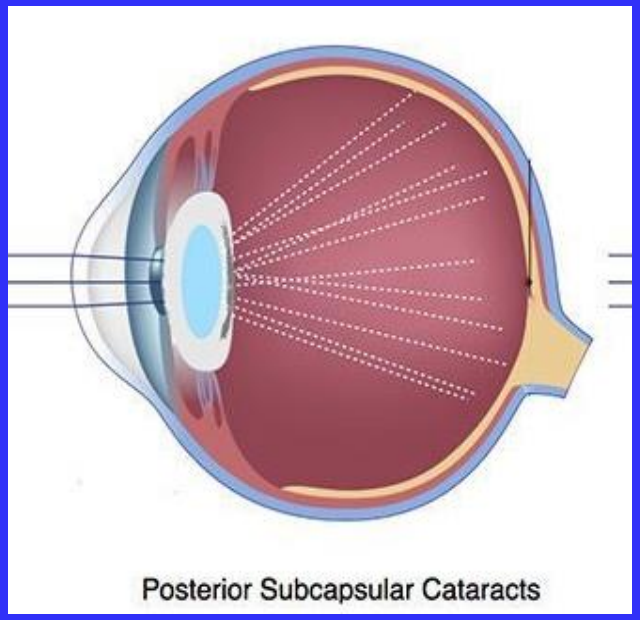
Diabetes

rticosteroi

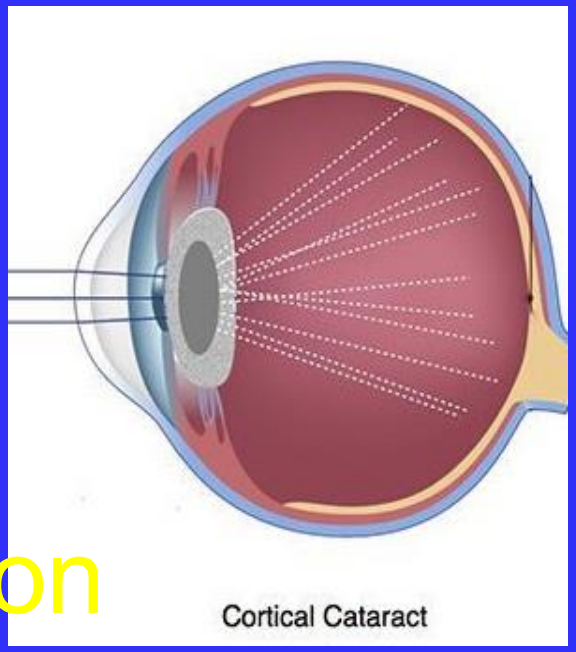
Trauma

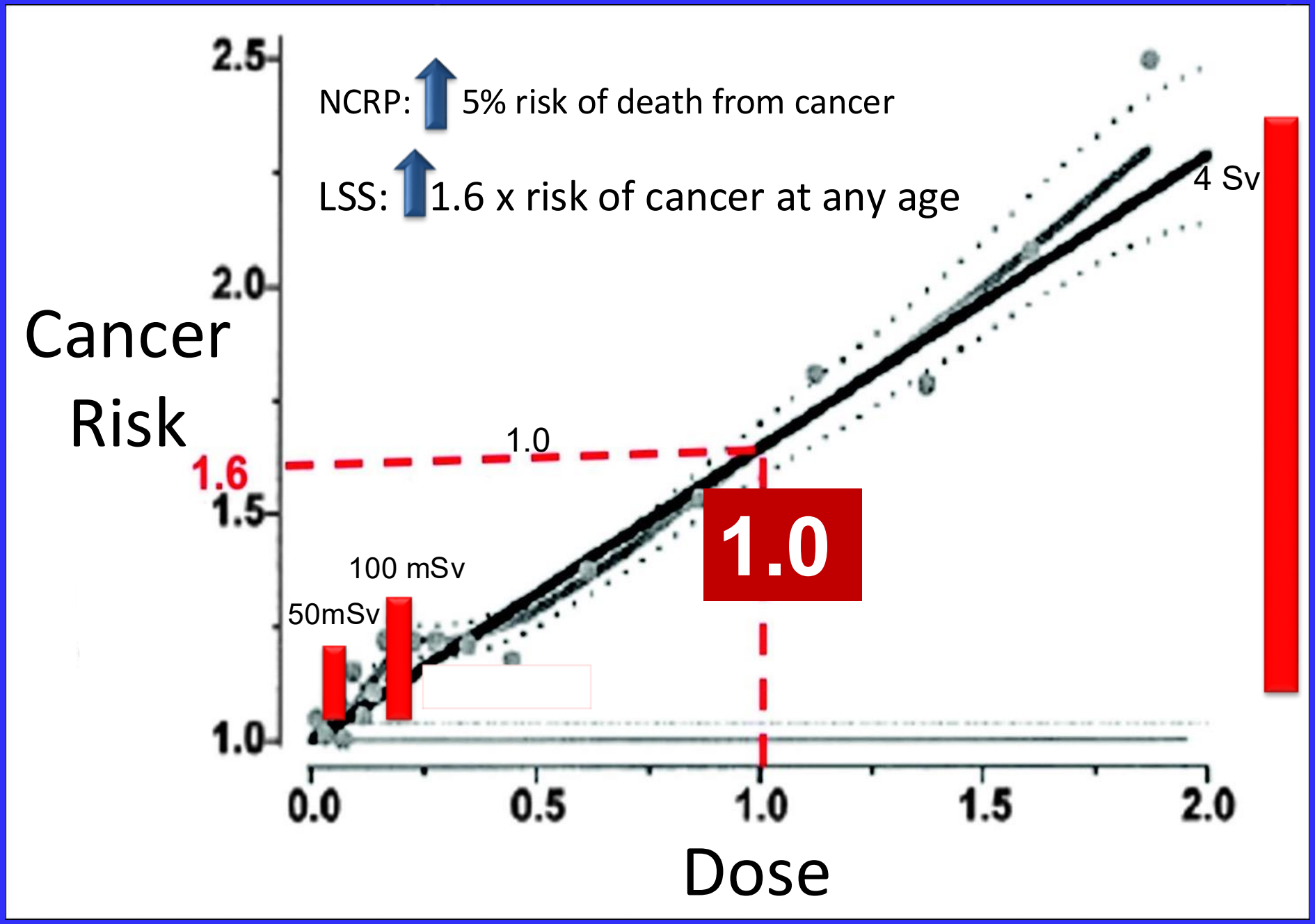
V radiatio





Ionizing Radiation




NCRP: 5% risk of death from cancer
LSS: 1.6 x risk of cancer at any age
Cancer Risk
2.5
2.0
1.6
1.5
1.0
1.0
1.0
100 mSv
50mSv
4 Sv
0.0
0.5
1.0
1.5
2.0
Dose

ALARA

(as low as reasonably achievable)

Re
Rad
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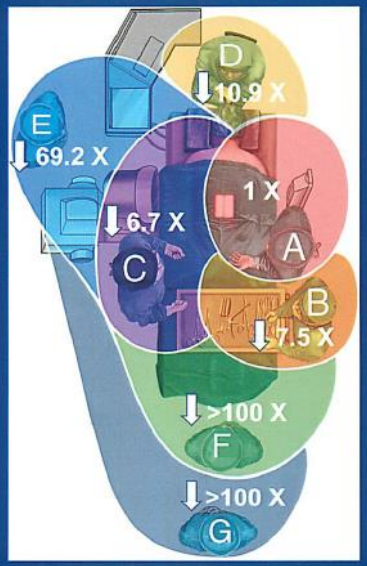
Timothy Kee
Ber
een MHP
AAOS
WOA
AC
HPS

VOL. 124, NO. 5, MAY 2023

HEALTH PHYSICS

THE RADIATION SAFETY JOURNAL

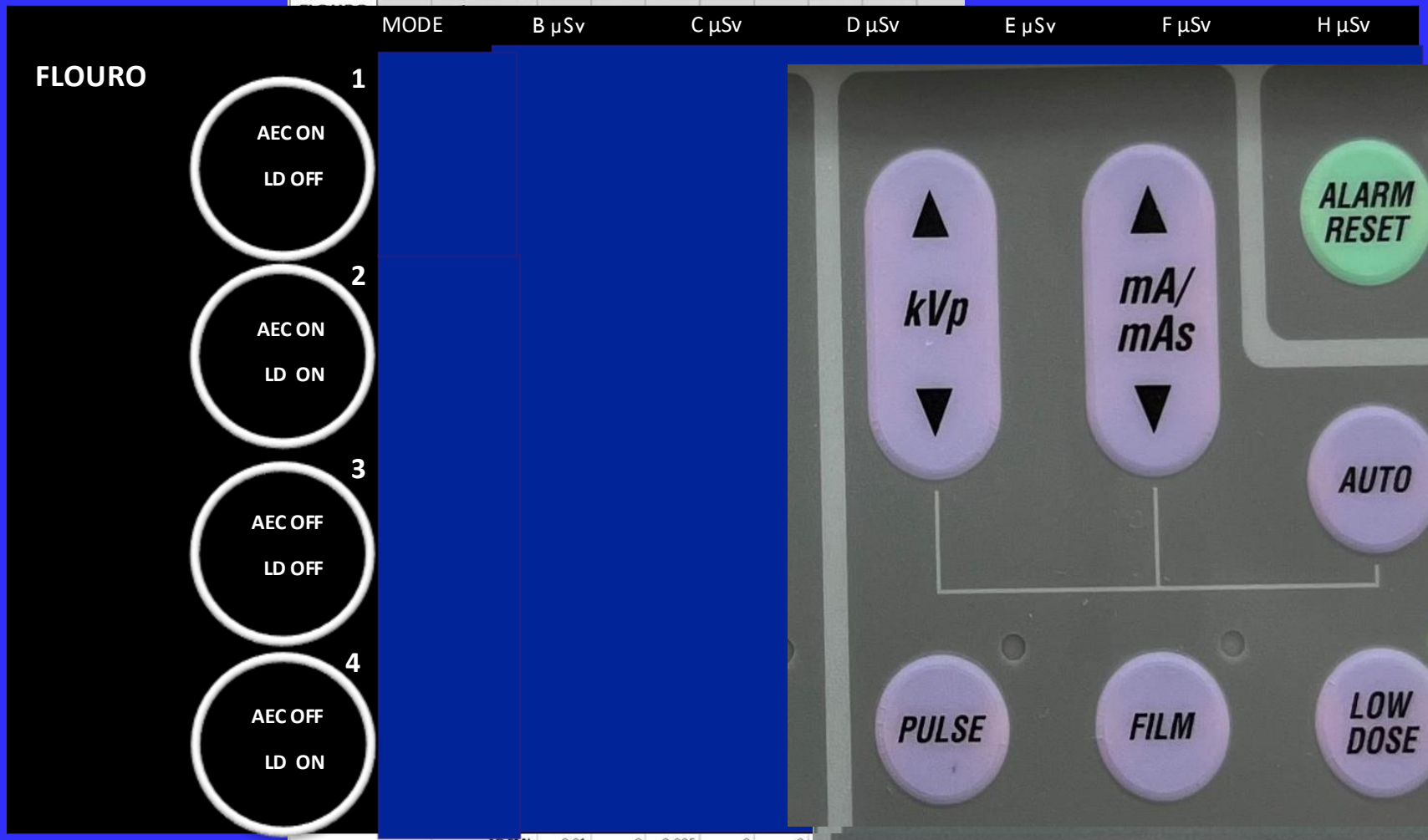
HPS The Official Journal of the Health Physics Society



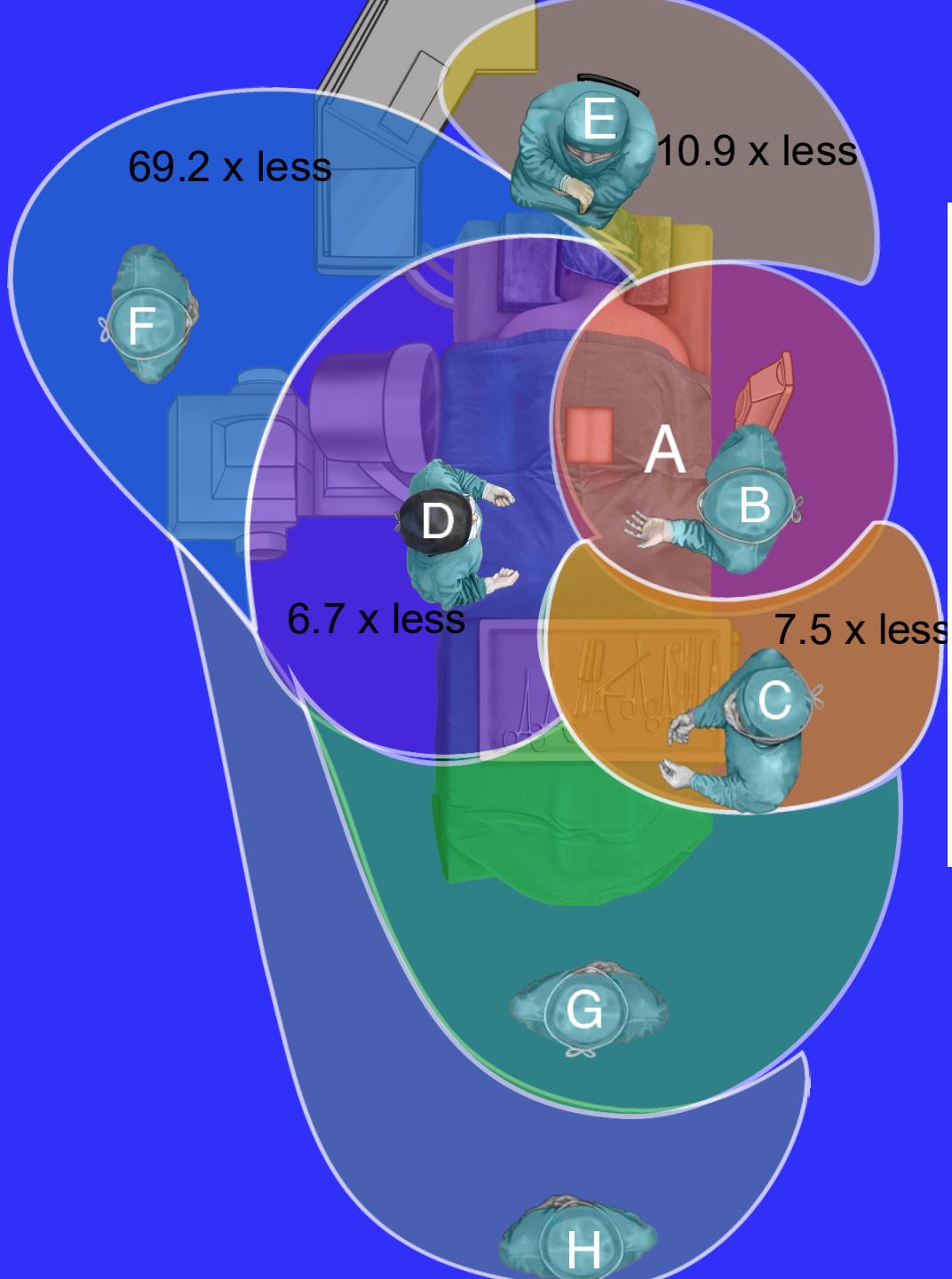
Full Text
OVID
www.health-physics.com
Wolters Kluwer

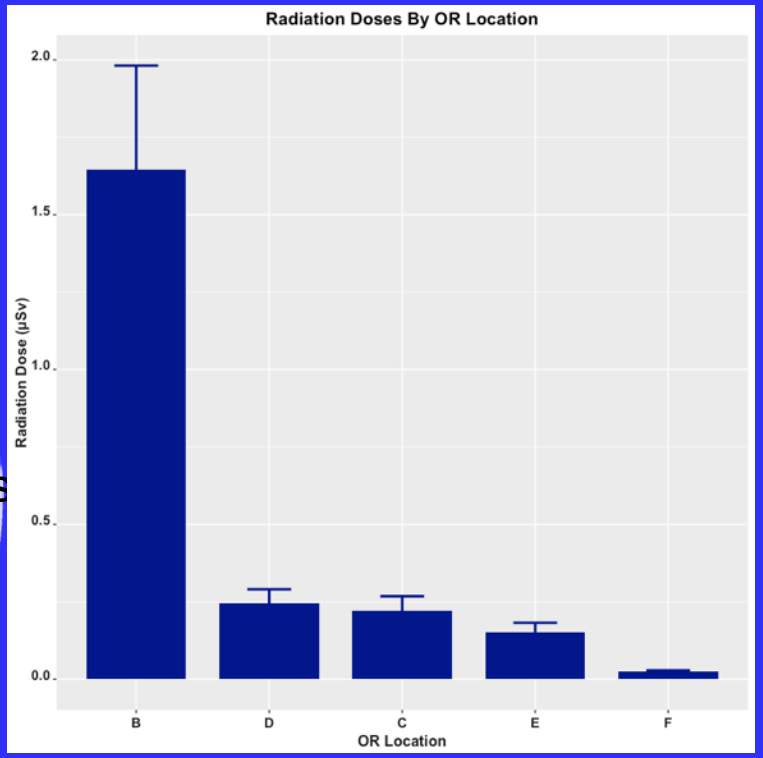
Protocol

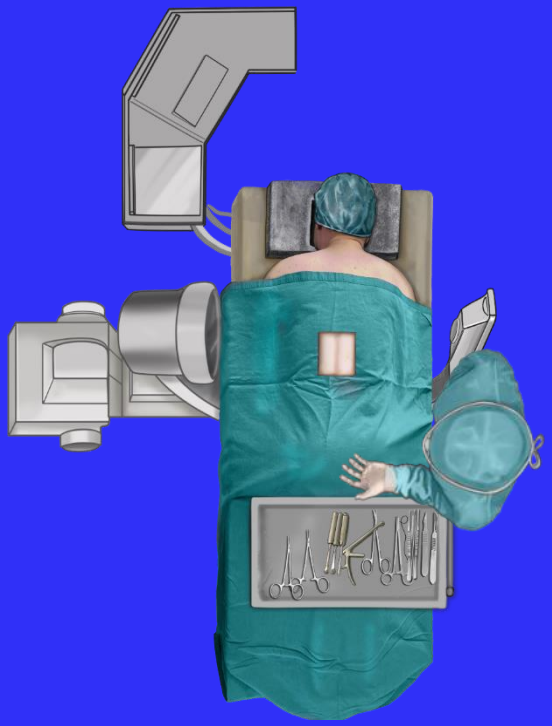

2



			MODE	B µSv	C µSv	D µSv	E µSv	F µSv	G µSv	H µSv
			AP SML	0.01	0	0.005	0	0		
DS		13	LAT LRG	9.64	1.33	0.995	0.595	0.055	0.215	0.025
	AEC ON		LAT SML	7.395	1.17	1.61	1.135	0.125	0.195	0.035
	LD OFF		AP LRG	0.35	0.06	0.29	0.065	0.12	0	0
			AP SML	0.175	0.005	0.125	0.02	0.005	0	0
		14	LAT LRG	9.44	1.315	0.915	0.635	0.05	0.235	0.015
	AEC ON		LAT SML	7.39	1.1	1.575	1.155	0.125	0.135	0.03
	LD ON		AP LRG	0.28	0.06	0.24	0.07	0.1	0	0.005
			AP SML	0.175	0.005	0.11	0.025	0.01	0	0
		15	LAT LRG	9.475	1.32	0.855	0.6	0.045	0.235	0.015
	AEC OFF		LAT SML	2.52	0.35	0.535	0.39	0.04	0.05	0
	LD OFF		AP LRG	0.075	0.005	0.065	0.005	0.02	0	0
			AP SML	0.15	0.005	0.11	0.01	0.005	0	0
		16	LAT LRG	9.66	1.345	0.97	0.715	0.05	0.18	0.025
	AEC OFF		LAT SML	2.685	0.355	0.495	0.385	0.045	0.06	0
	LD ON		AP LRG	0.135	0.005	0.12	0.01	0.04	0	0
			AP SML	0.17	0.005	0.11	0.015	0.01	0	0


E
10.9 x less
69.2 x less
F
A
B
D
6.7 x less
7.5 x less
C
G
H


Radiation Doses By OR Location
Radiation Dose (μSv)
2.0
1.5
1.0
0.5
0.0
B
D
C
E
F
OR Location



200 images

34 cases to reach .05 Sv

14 cases to reach .02 Sv

What can you do next time in the OR to reduce radiation exposure?

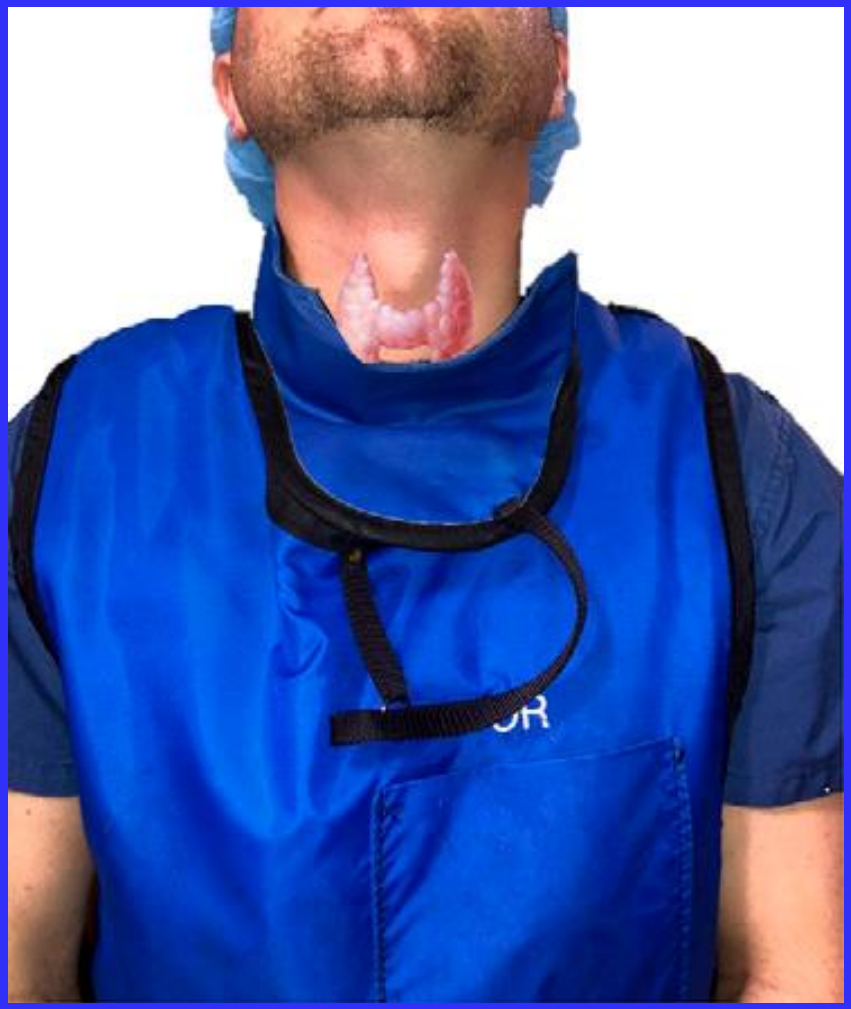
Is the Auto button still on?

Who is next to the emitter?

How many images have I taken?

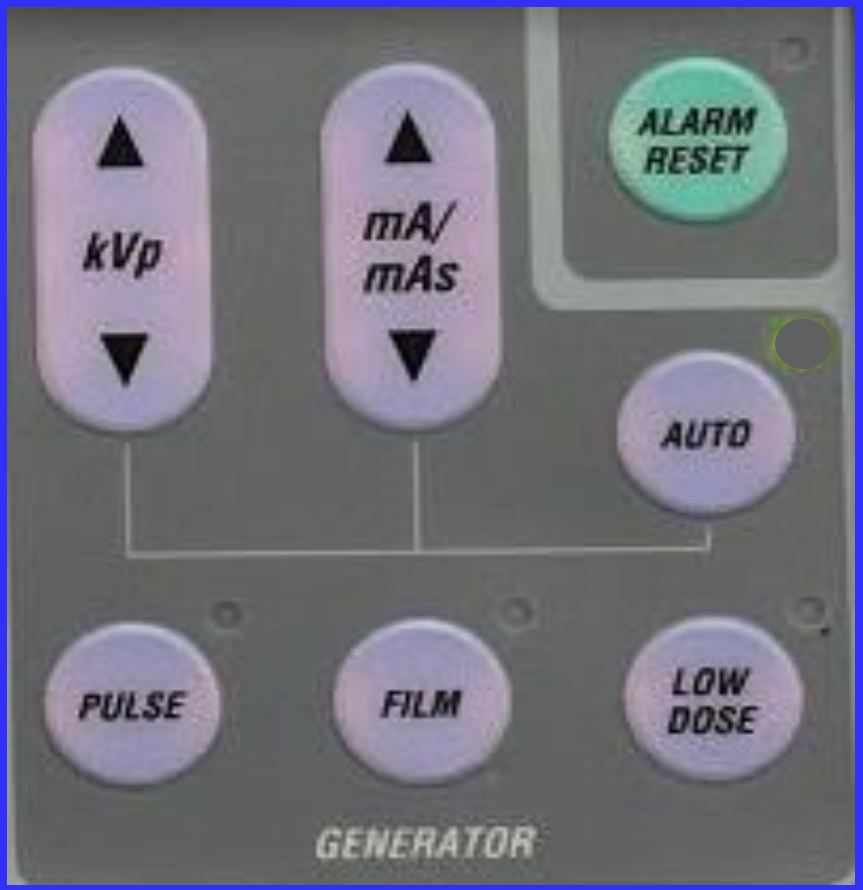
Do I need this image?

What is CAK?



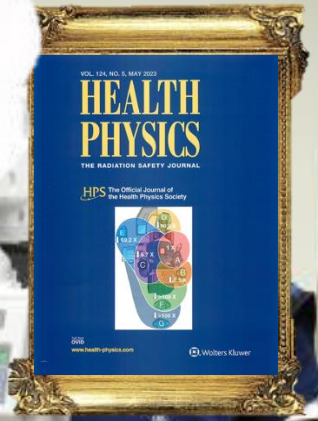

OR

FedEx

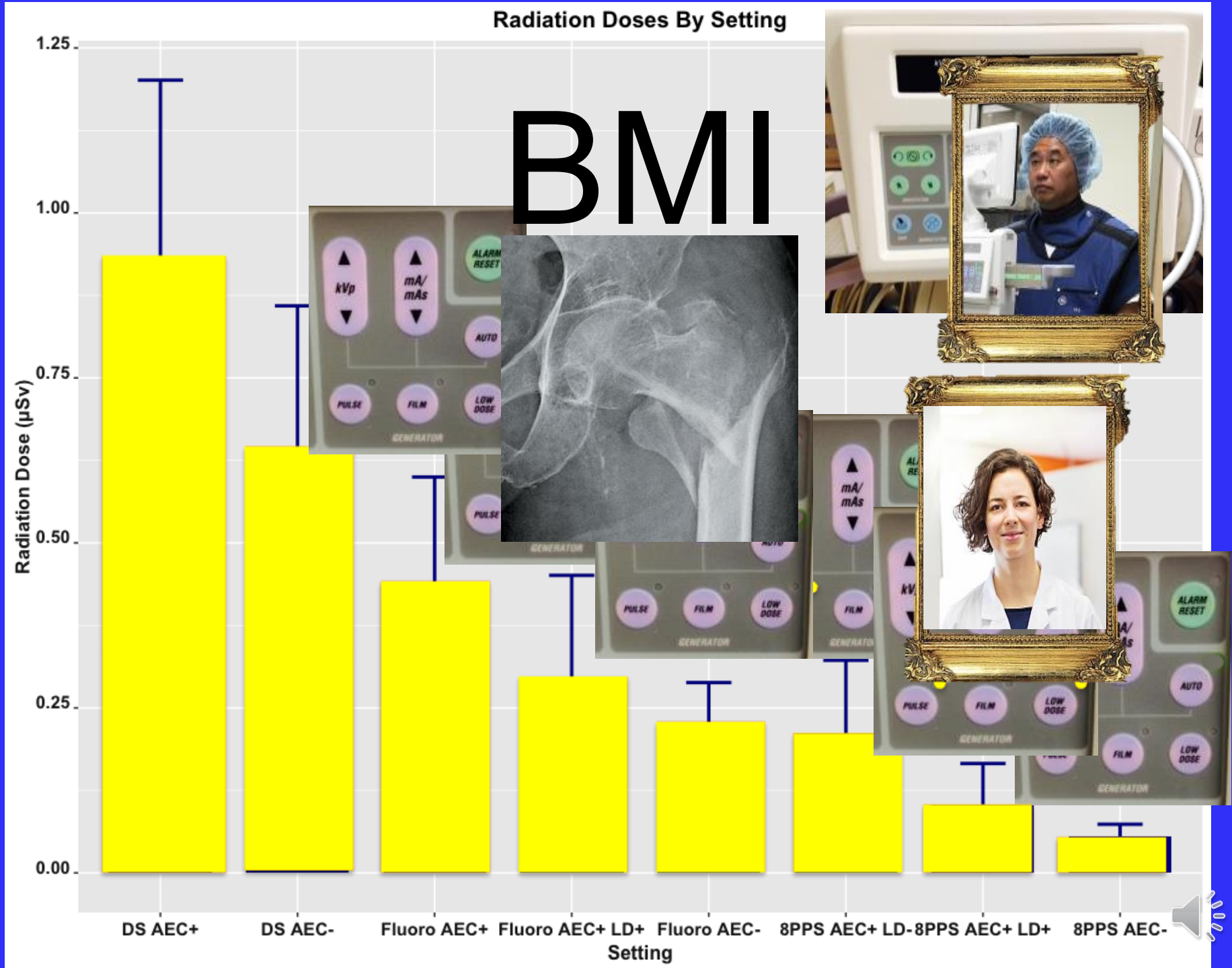

kVp
mA/
mAs
ALARM
RESET
AUTO
PULSE
FILM
LOW
DOSE
GENERATOR

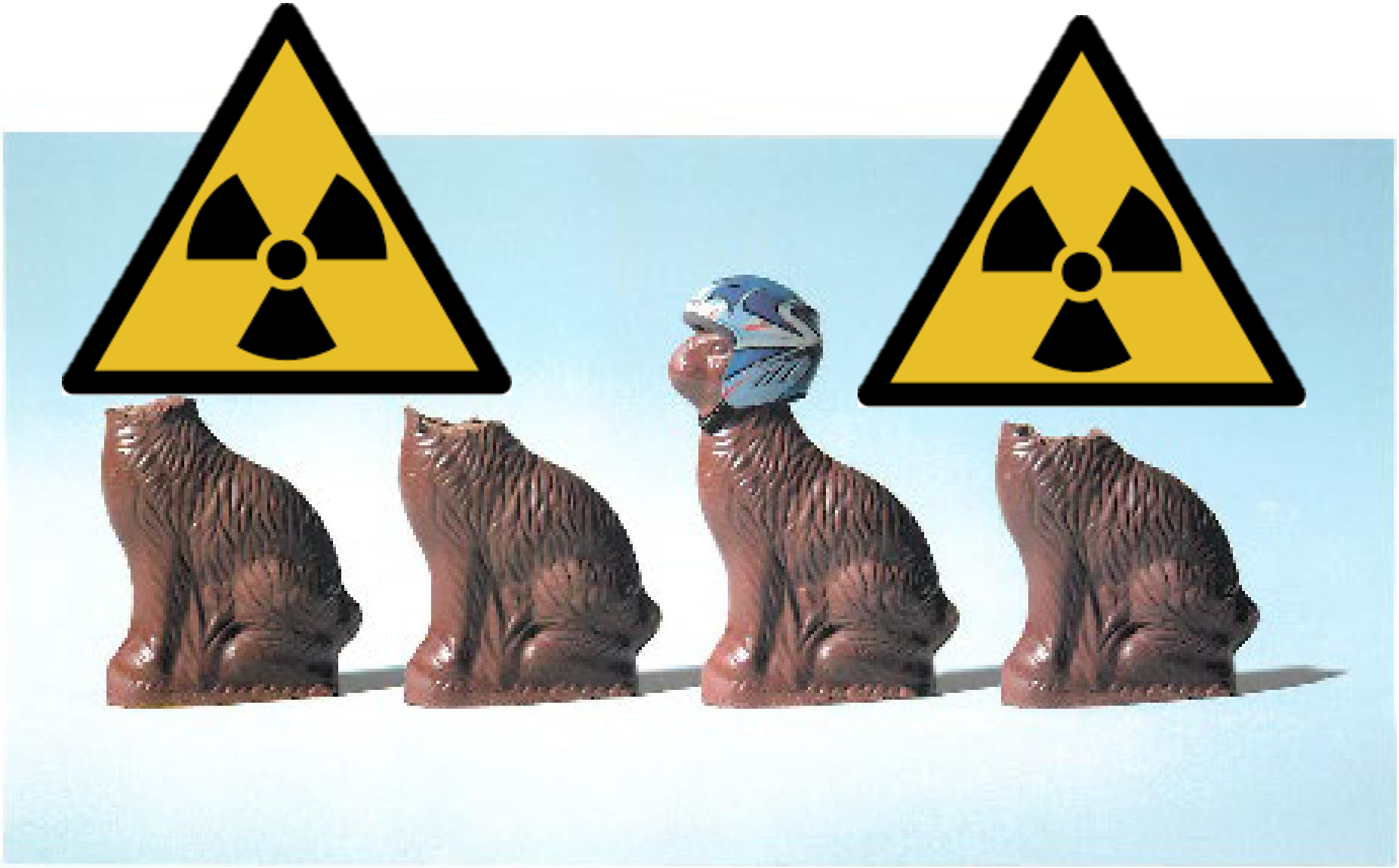

kVp
mA/
mAs
ALARM
RESET
AUTO
PULSE
FILM
GENERATOR

Bill



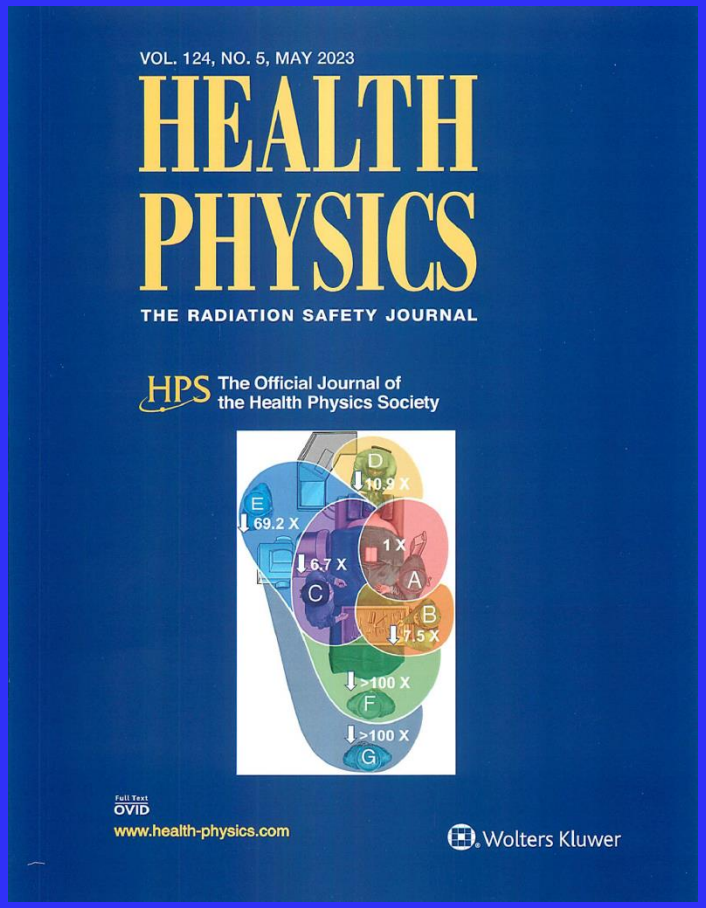
	A	Count	CAK
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			


Radiation Doses By Setting
BMI
1.25
1.00
0.75
0.50
0.25
0.00
Radiation Dose (µSv)
DS AEC+
DS AEC-
Fluoro AEC+
Fluoro AEC+ LD+
Fluoro AEC-
8PPS AEC+ LD-
8PPS AEC+ LD+
8PPS AEC-
Setting



Thank you

keenent@ohsu.edu



Discussion