KSC 2015
The 59th Annual Scientific Meeting of The Korean Society of Cardiology
16(Fri.) ~17(Sat.), OCTOBER, 2015 / KINTEX, Goyang, Republic of Korea

Radiation exposure in the cath lab

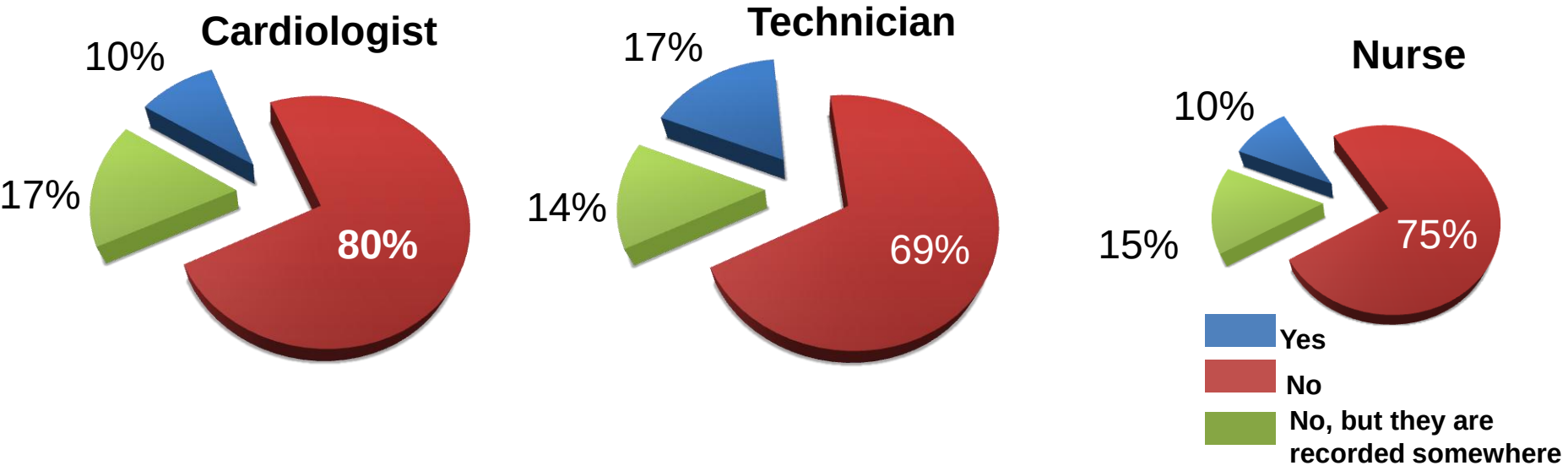
safety and *precautions*

Joon Won Kang, RT
Cardiovascular Center, Anam Hospital
Korea University Medical Center

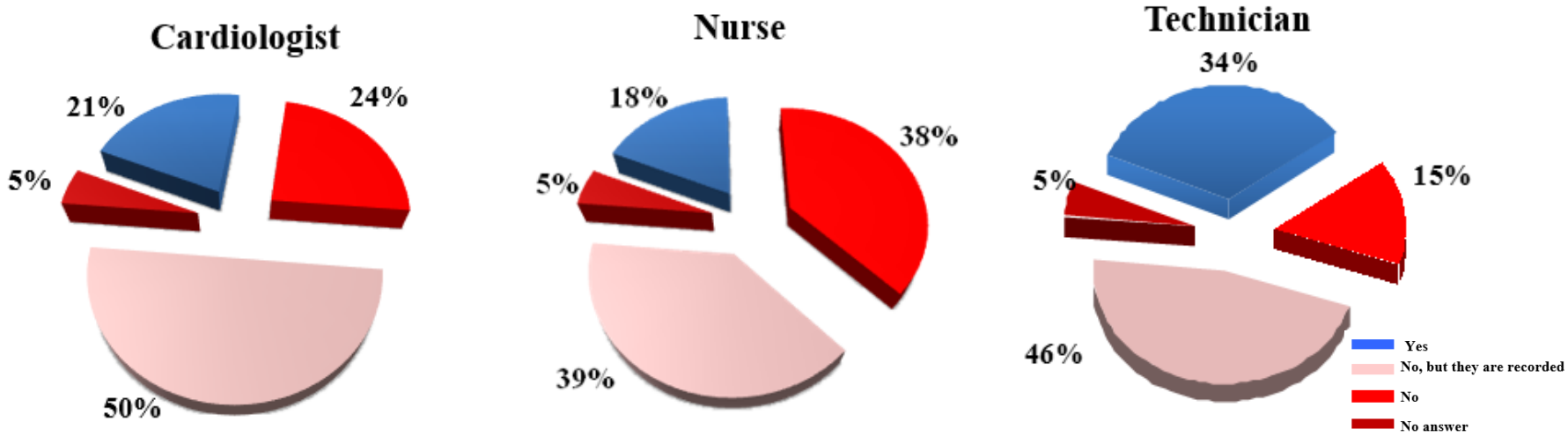
“Radiation is one of those things that people talk about but

Never really pay much attention to”

Do you know your doses in the last year?



Do you know DAP (KAP) doses to patient?



Italian Society of Invasive Cardiology, 2011 Radioprotection study

The NEW ENGLAND JOURNAL of MEDICINE

Review Article

Computed Tomography — An Increasing Source of Radiation Exposure

David J. Brenner, Ph.D., D.Sc., and Eric J. Hall, D.Phil., D.Sc.

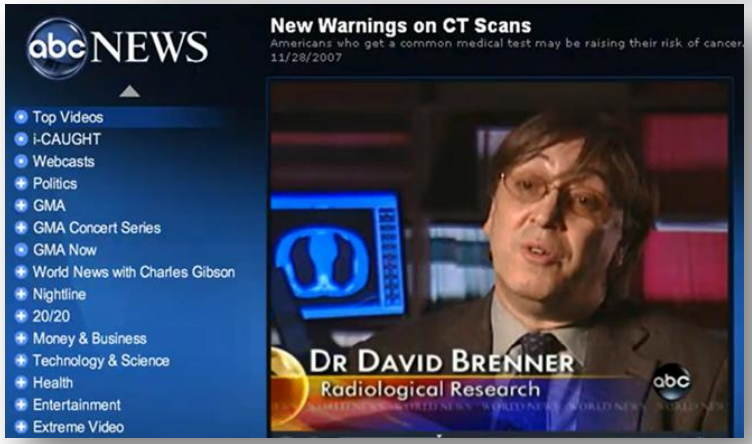
THE ADVENT OF COMPUTED TOMOGRAPHY (CT) HAS REVOLUTIONIZED DIagnostic radiology. Since the inception of CT in the 1970s, its use has increased rapidly. It is estimated that more than 62 million CT scans per year are currently obtained in the United States, including at least 4 million for children.[1]

By its nature, CT involves larger radiation doses than the more common, conventional x-ray imaging procedures (Table 1). We briefly review the nature of CT scanning and its main clinical applications, both in symptomatic patients and, in a more recent development, in the screening of asymptomatic patients. We focus on the increasing number of CT scans being obtained, the associated radiation doses, and the consequent cancer risks in adults and particularly in children. Although the risks for any one person are not large, the increasing exposure to radiation in the population may be a public health issue in the future.

From the Center for Radiological Research, Columbia University Medical Center, New York. Address reprint requests to Dr. Brenner at the Center for Radiological Research, Columbia University Medical Center, 630 W. 168th St., New York, NY 10032, or at djb3@columbia.edu.

N Engl J Med 2007;357:2277-84.

N Engl J Med Volume 357(22):2277-2284 November 29, 2007



진단 방사선 피폭량, 연간 한도 넘어

YTN 2014-01-22

CT 검사 등으로 방사선 피폭량은 늘어나는데 환자들에게는 피폭 기준조차 마련되지 않았다는 사실, YTN이 보도해드렸는데요.
연구해보니 우리 국민의 방사선 피폭량이 연간 한도를 넘어선 것으로 나타났습니다.

[인터뷰:석길칠, 심근경색 수술 환자 (80세)]
"병원에서 하라는 대로 하는 거죠. 시키는대로 하는 거지 뭐.
검사를 받아야 한다니까 하는 거죠. (CT 촬영) 2~3번 한 거죠."

최근 5년 동안 진단용 방사선 사용량을 분석했더니, 검사 건수가 35%나 늘었습니다.

엑스레이나 CT, 치과촬영 등을 합쳐 국민 한 사람이 1년에 4.6번이나 받았습니다.

1년 피폭량도 5년 전 0.9밀리시버트에서 1.4밀리시버트로 51%나 높아졌습니다.

일반인의 피폭량 한도인 1밀리시버트를 넘어선 것입니다.

특히 방사선을 가장 많이 발생하는 CT 촬영이 절반 이상을 차지합니다.

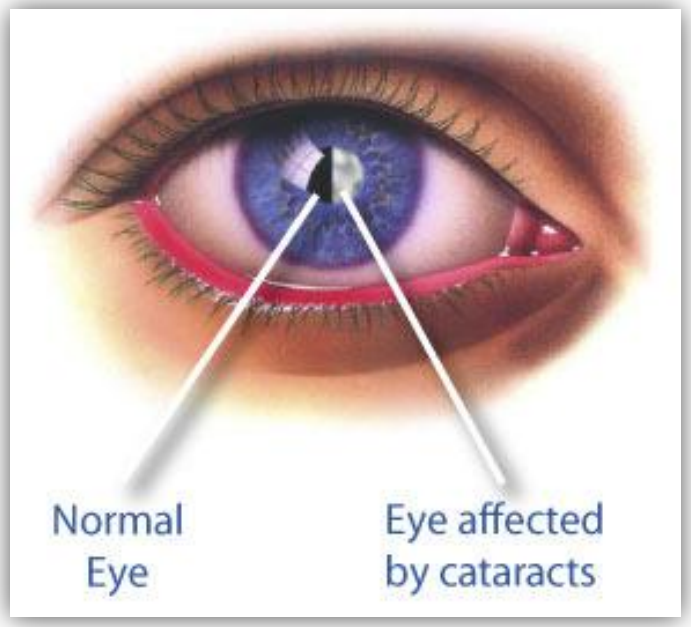
It’s a Serious Problem

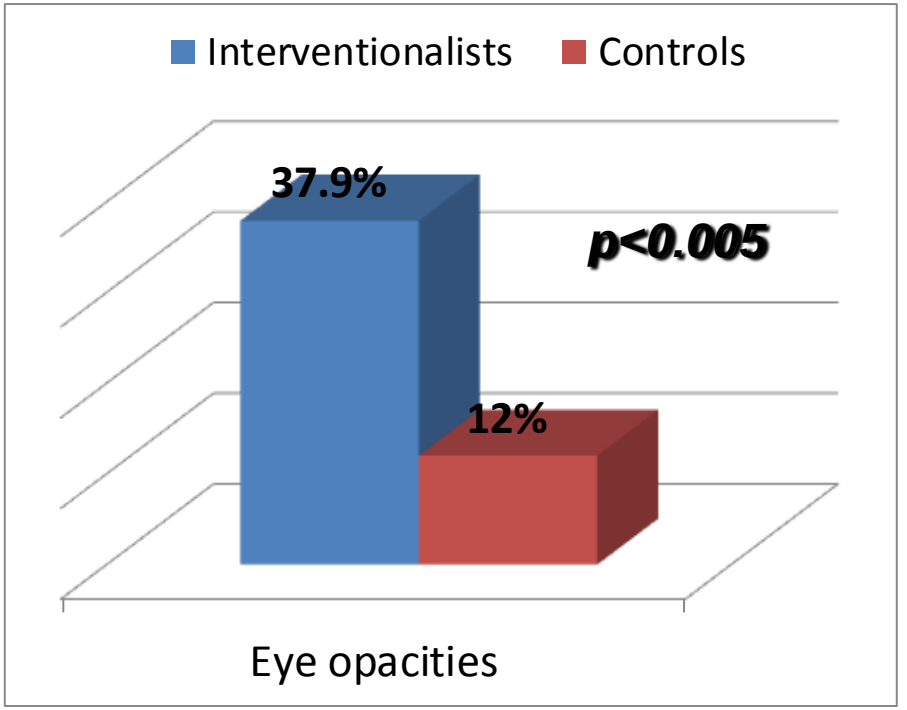
It’s a Negligible Problem

It's a Serious Problem

Radiation Induced
Cancer Risk

Lens opacity / Cataract





A dose dependent increased risk of posterior lens opacities

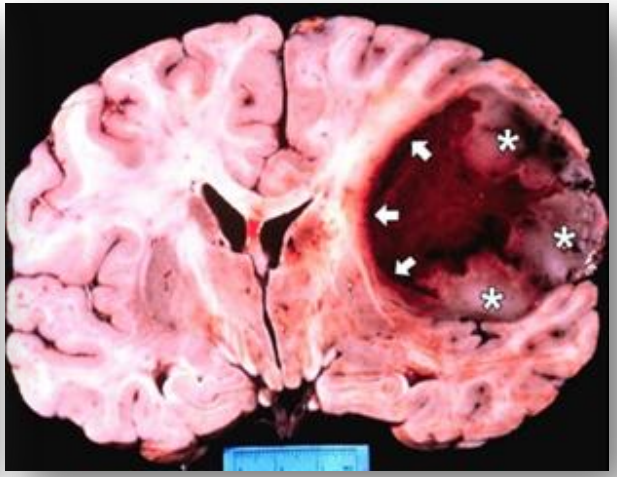
Kleiman NJ, CCI 2010

Rehani,M, Vano E, Radiat Prot Dosimetry, 2011

Brain tumours among interventional cardiologists: a cause for alarm?

Report of four new cases from two cities and a review of the literature

36 cases brain tumors in interventional cardiologists – 86% left sided



Conclusions: In interventional cardiologists and radiologists, the left side of the head is known to be more exposed to radiation than the right. A connection to occupational radiation exposure is biologically plausible, but risk assessment is difficult due to the small population of interventional cardiologists and the low incidence of these tumours. This may be a chance occurrence, but the cause may also be radiation exposure. Scientific study further delineating occupational risks is essential. Since interventional cardiologists have the highest radiation exposure among health professionals, major awareness of radiation safety and training in radiological protection are essential and imperative, and should be used in every procedure.

Roguin A et al. EuroIntervention 2012;7:1081-86

Biologic effect of radiation

Radiation ⟶ **Cancer**

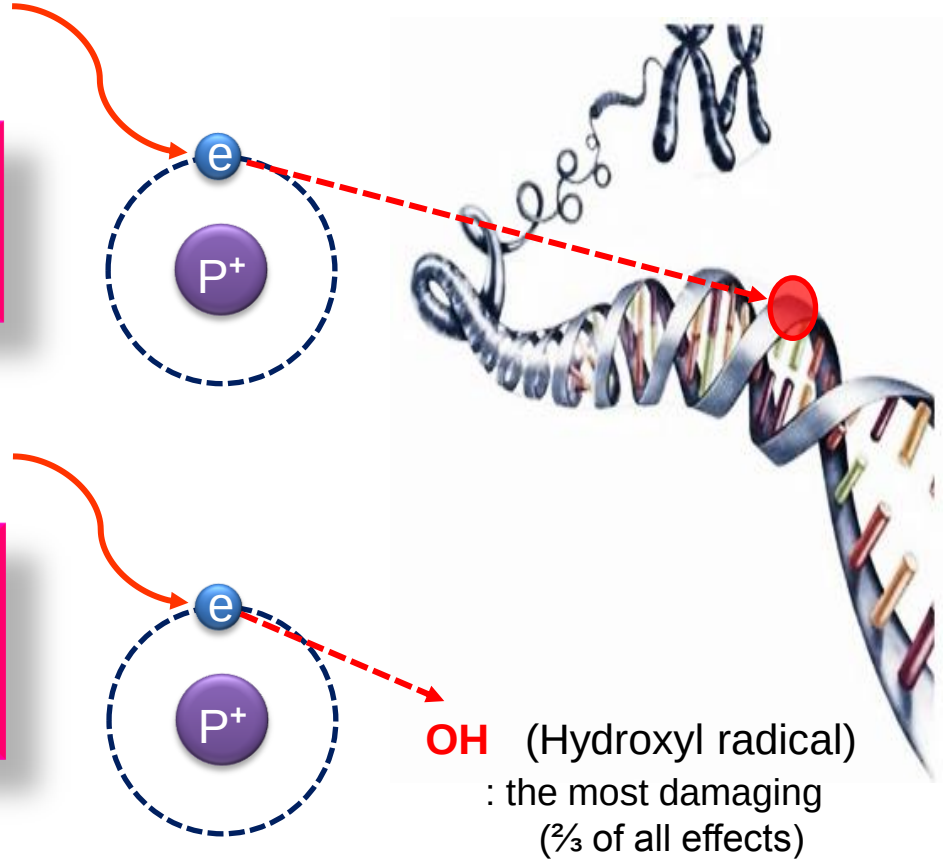
Radiation ⟶ **DNA damage(DSBs)** ⟶ **Cancer**

Direct action : 25%

- Direction interact with target
- High LET

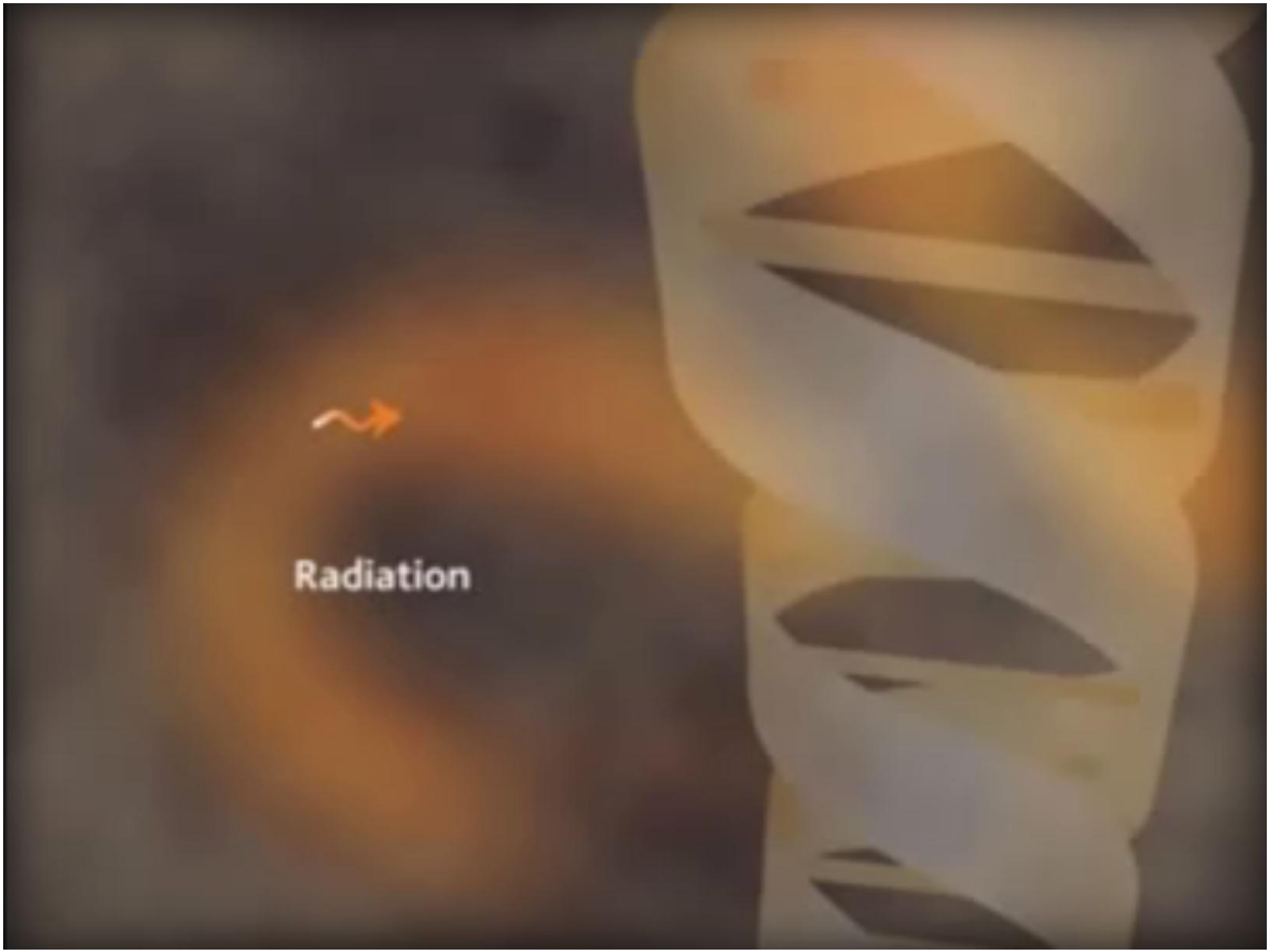
Indirect action: 75%

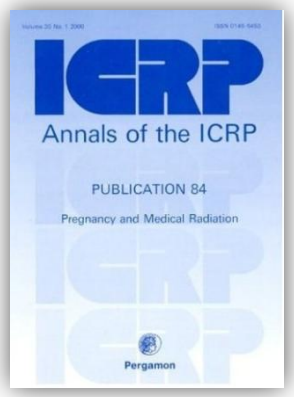
- Formation of reactive free radical-> DNA damage



Radiobiology for the Radiologist, 6nd (2006)

Low dose radiation cellular effects

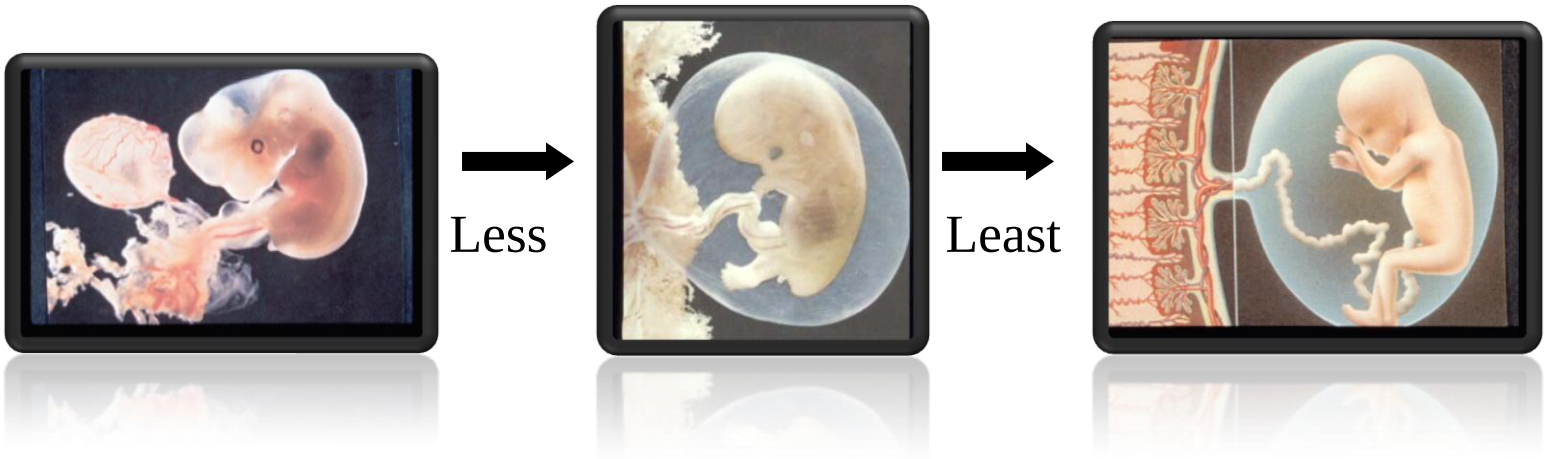




Fetal radiation risk

Radiation risks are most significant during organogenesis and in the **early fetal period**, somewhat less in the 2nd trimester, and least in the 3rd trimester

Most risk → Less → Least



ICRP 84, Pregnancy and radiation

It’s a Negligible Problem

Medical Exposure

Typical patient radiation doses for common procedures

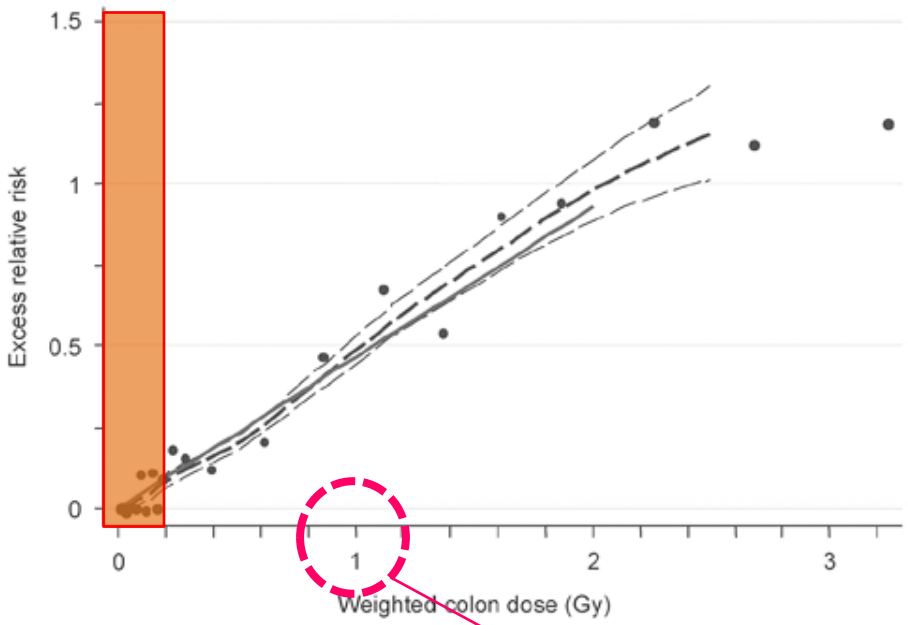
Type of study	Dose to patient mSv median and range
Coronary angiography	7 2.0–16
Percutaneous coronary intervention	15 7–57

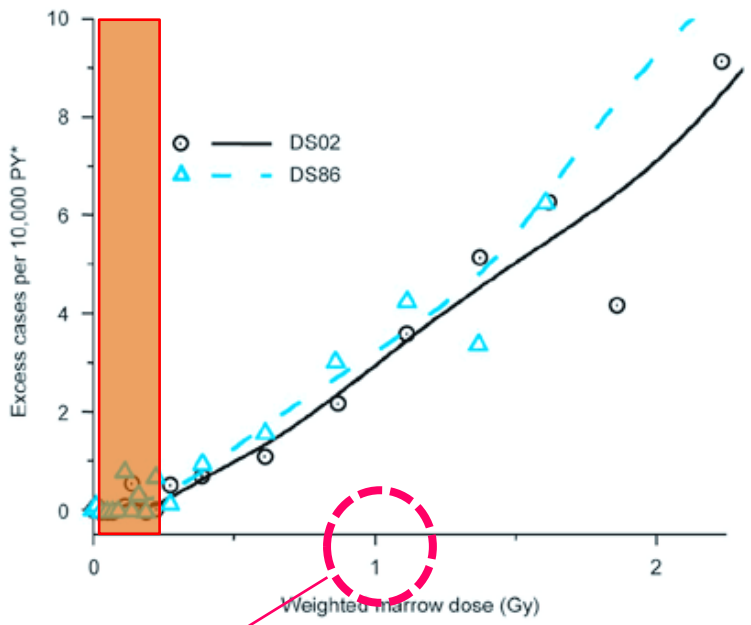
Type of study	Dose to patient mSv median and range
Diagnostic EP study	3.2 1.3–23.9
Ablation procedure	15.2 1.6–59.6
AF	16.6 6.6–59.6
AT – AVNRT – AVRT	4.4 1.6–25
VT	12.5 3–≥45
VVI/DDD PM or ICD implant	4 1.4–17
CRT implant	22 2.2–95

Europace (2014) 16, 946–964 doi:10.1093

Excess risk of developing *solid cancer* in LSS

Solid cancer risks among atomic-bomb survivors 1958-1998



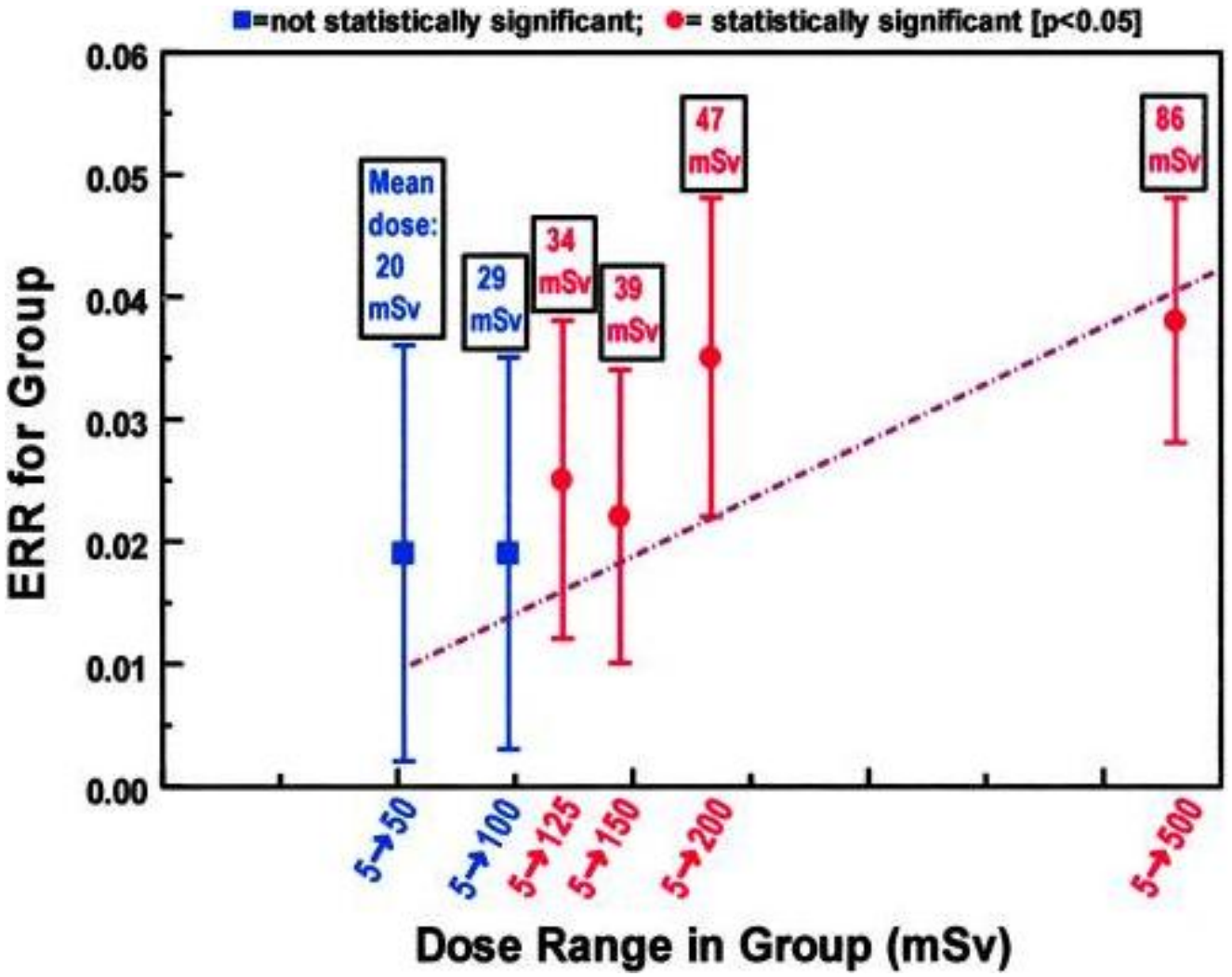


Solid cancer

Leukemia

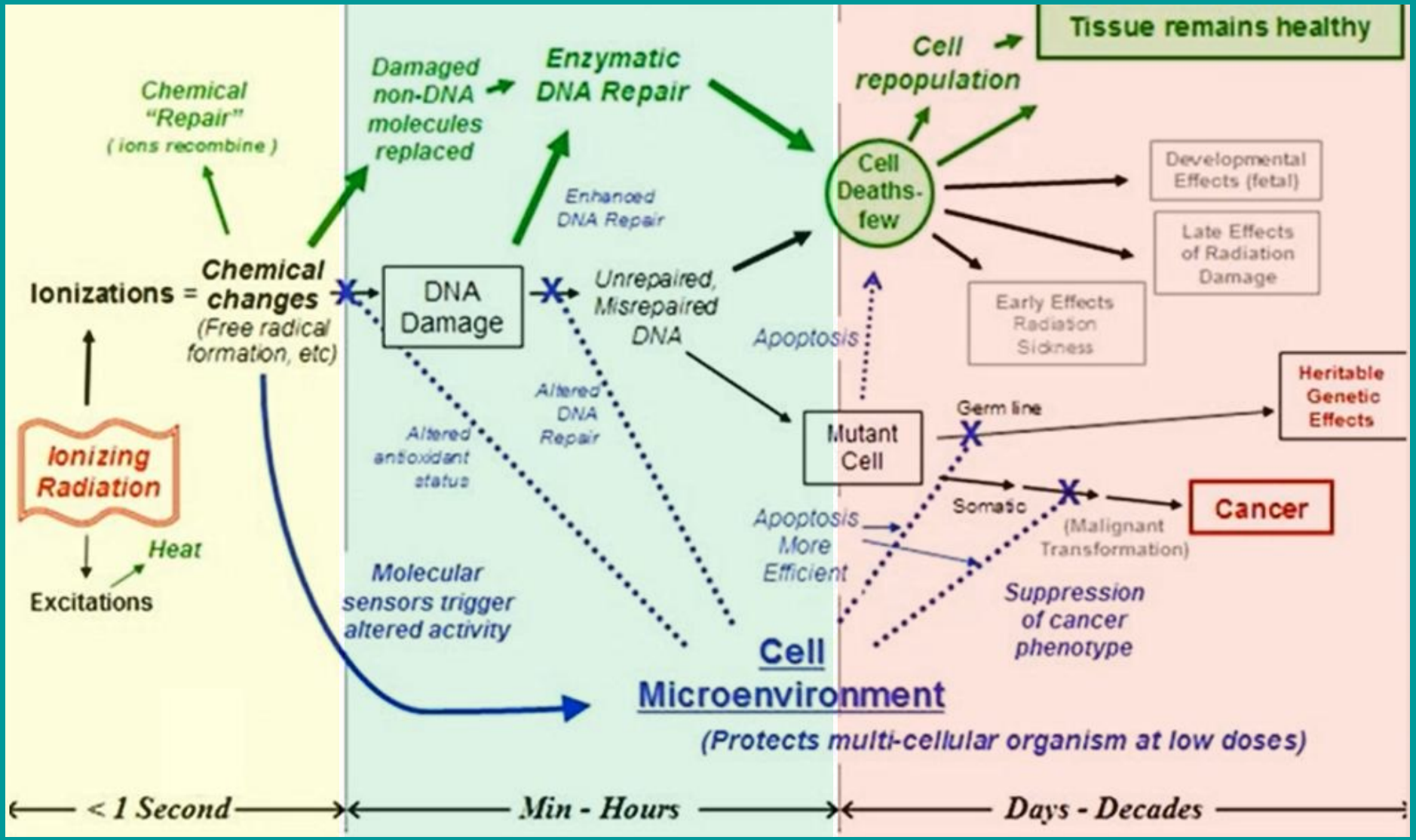
1 Gy = 1000 mGy

Estimated excess relative risk of mortality from ***solid cancer*** in A-bomb survivor (< 500 mSv)

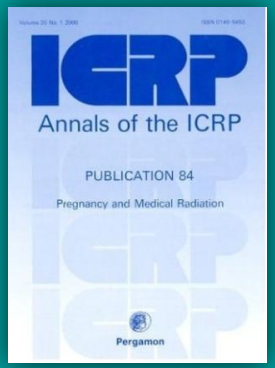


Brenner et al.(2003) PNAS 100(24) :13761-13766

Classic Paradigm of Radiation Injury



U.S. Department of Energy



Risks in a pregnant population *Not exposed* to radiation

Risks:

- Spontaneous abortion	> 15%
- Incidence of genetic abnormalities	4-10%
- Intrauterine growth retardation	4%
- Incidence of major malformation	2-4%

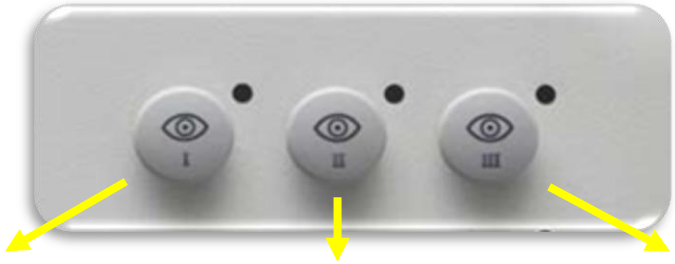
ICRP 84, Pregnancy and radiation

Probability of bearing healthy children as a function of radiation dose

Dose to conceptus (mGy) above natural background	Probability of no malformation	Probability of no cancer (0-19 years)
0	97	99.7
1	97	99.7
5	97	99.7
10	97	99.6
50	97	99.4
100	97	99.1
>100	Possible	Higher

from ICRP 84, Pregnancy and radiation

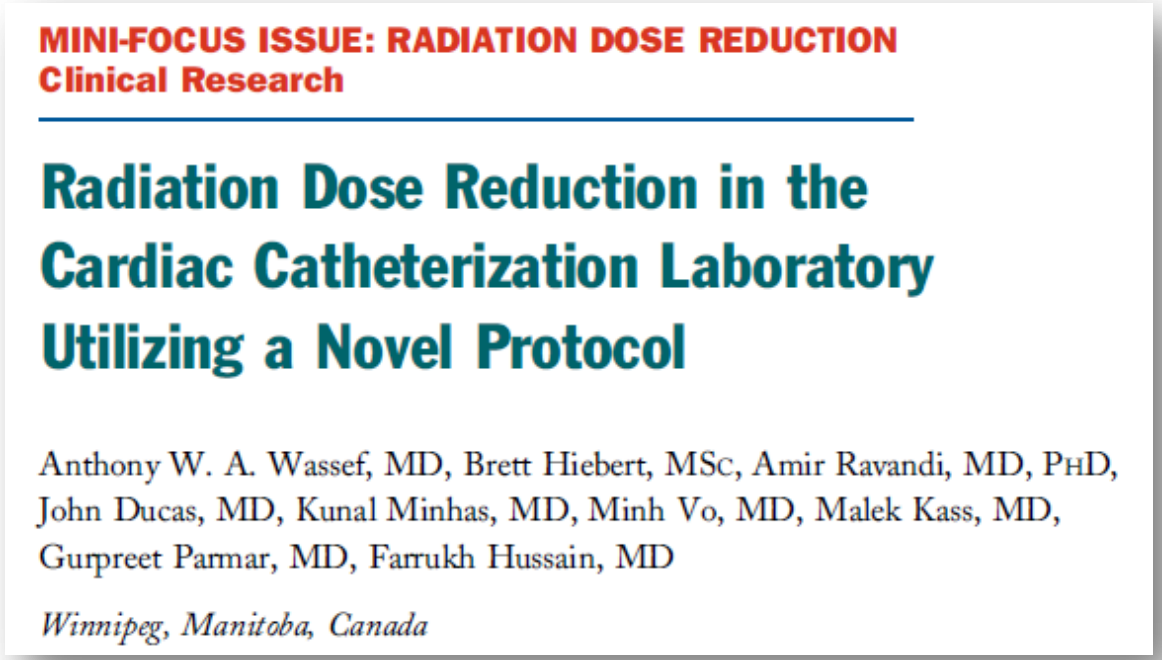
It’s a Negligible Problem



Philips FD 10 Default Setting	Fluoro flavor 1(Low)	Fluoro flavor 2 (Normal)	Fluoro flavor 3 (High)
Pulsed Fluoro Frame speed	15	15	30
Dose rate limitation (microGy/s)	697	1395	1395
Focus	Smalllest	Smalllest	Smalllest
Spectral Filter CU	0.4	0.1	0.1
Spectral Filter Al	1	1	1

FD 10 (#1) Setting **CAG**	Fluoro flavor 1(Low)	Fluoro flavor 2(Normal)	Fluoro flavor 3(High)
Frame speed	7.5	15	15
Dose rate limitation (microGy/s)	349	697	1395
Focus	Smalllest	Smalllest	Smalllest
Spectral Filter CU	0.9	0.4	0.1
Spectral Filter Al	1	1	1

(#3 EP) Setting = Philips FD 10 EP Default **EP**	Fluoro flavor 1(Low)	Fluoro flavor 2(Normal)	Fluoro flavor 3(High)
Frame speed	7.5	15	15
Dose rate limitation (microGy/s)	140	349	697
Focus	Smalllest	Smalllest	Smalllest
Spectral Filter CU	0.9	0.9	0.4
Spectral Filter Al	1	1	1



MINI-FOCUS ISSUE: RADIATION DOSE REDUCTION
Clinical Research

Radiation Dose Reduction in the Cardiac Catheterization Laboratory Utilizing a Novel Protocol

Anthony W. A. Wassef, MD, Brett Hiebert, MSc, Amir Ravandi, MD, PhD, John Ducas, MD, Kunal Minhas, MD, Minh Vo, MD, Malek Kass, MD, Gurpreet Parmar, MD, Farrukh Hussain, MD

Winnipeg, Manitoba, Canada

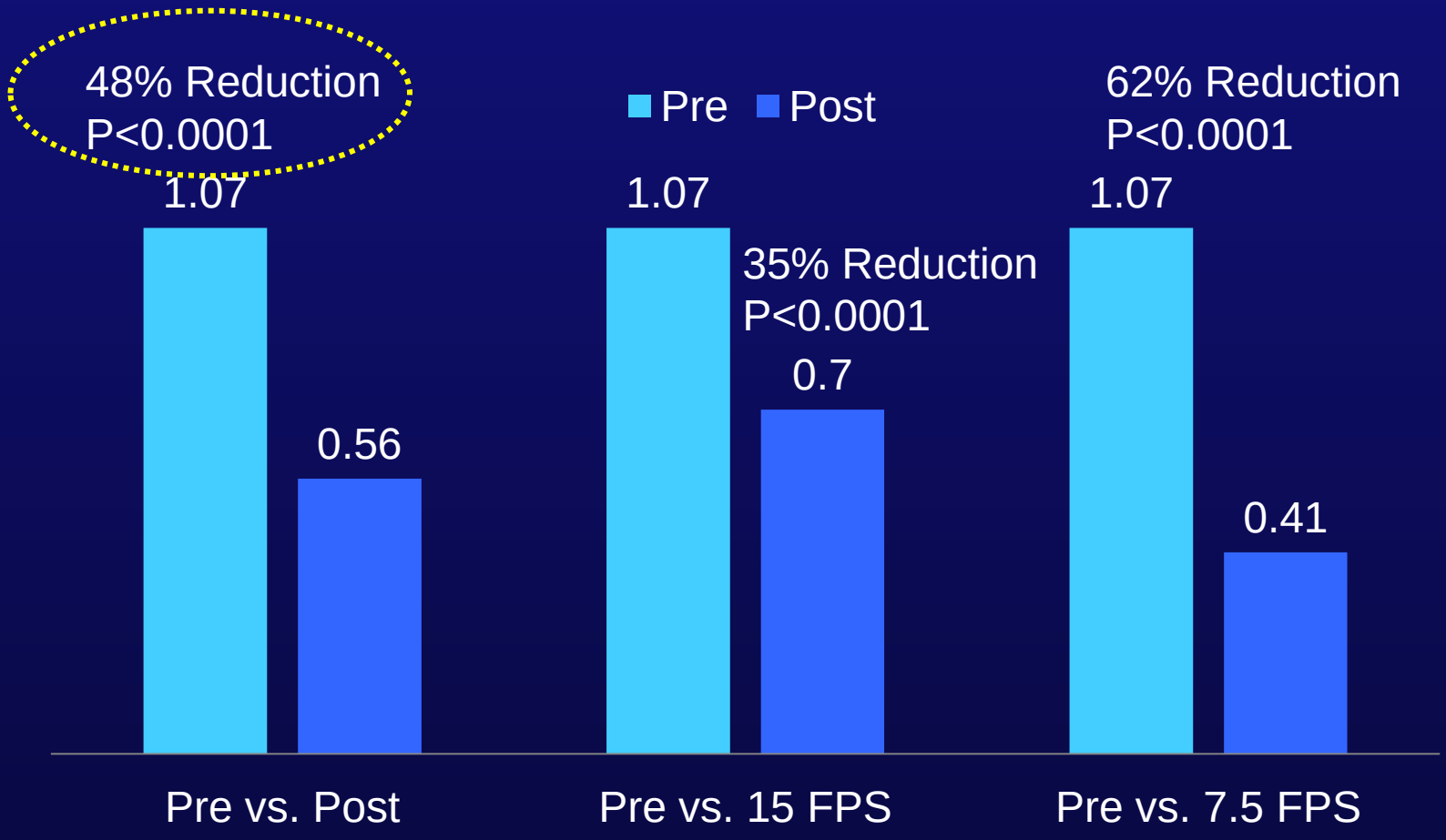
Before and after study, Phillips Allura (n=605)

Algorithms to reduce dose include:

- ✓ Reduces *Detector dose* rate
- ✓ Increased *thickness of filters*
- ✓ Automatically uses *lowest dose* possible based on patient
- ✓ Reduce FPS from 15 to *7.5 FPS*

Wassef AW, et al. JACC Interv. 2014;7:550-7.

Radiation Dose Reduction in the Cardiac Cath Lab Utilizing a Novel Protocol



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Benefit versus Risk

Benefit

Remember

Controlling dose to ***patient*** will help control dose to ***staff***

Thank you for your time!

KU MC

The Korean Society of Cardiology