



Geneve
December 1th, 2015

AAAAA issues for Radiation Protection in Cardiovascular Imaging

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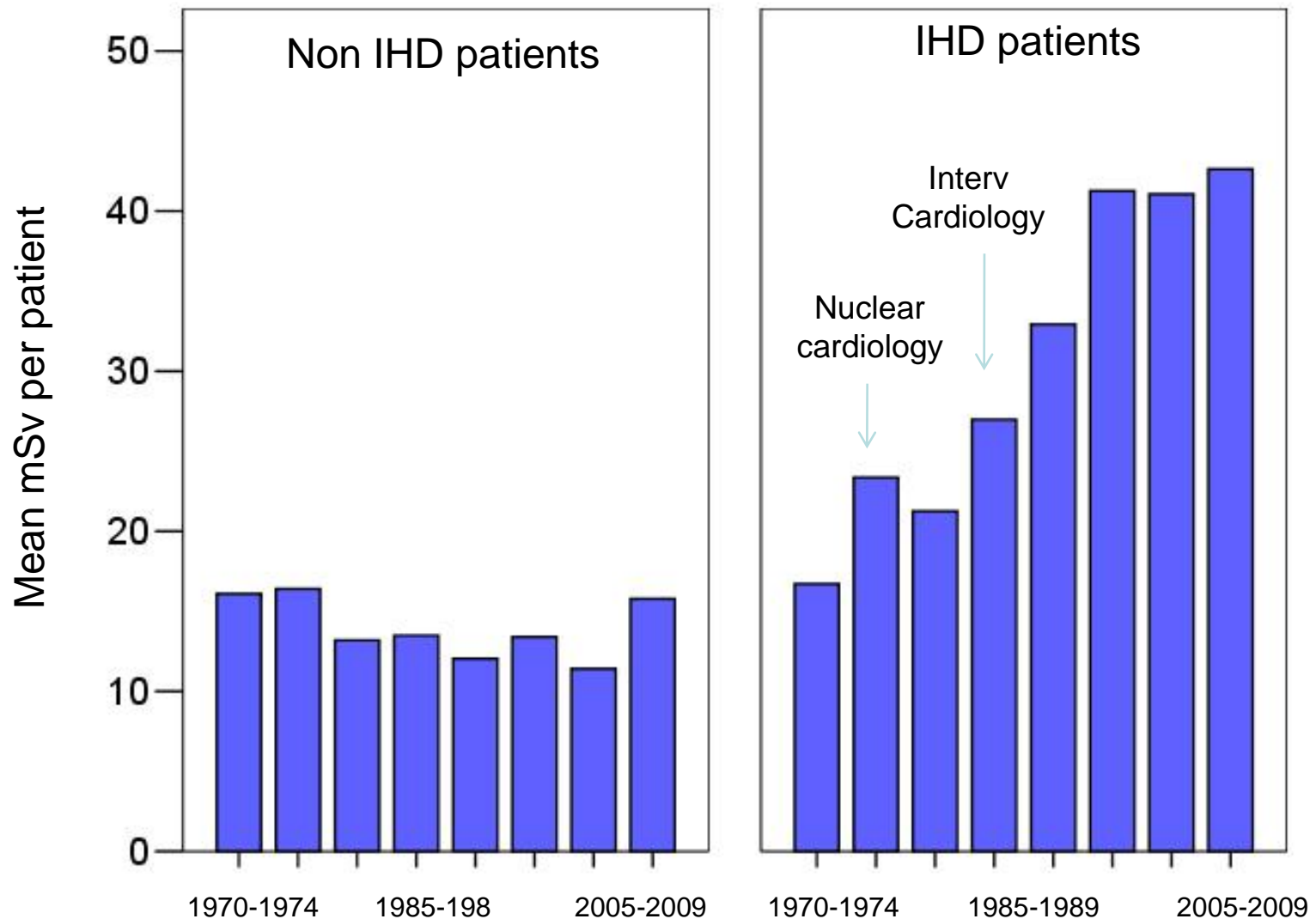
Competing interests: Nothing to declare

PLENARY SESSION IV

Cardiologist' 5 issues

5 Key issues for establishing and maintaining RPCM	Comments
1 Awareness	<ul style="list-style-type: none"> - Education on doses and risks; - Radiological informed consent ;
2 Appropriateness	Standardization of prescriptions following guidelines
3 Audit	Sistematic review of medical radiological prescriptions
4 Accountability	Changes of Governance – pay for quality not for quantity
5 Action	<p>Researchers studies on cancer and non-cancer effects</p> <p>Scientific societies statements and grants</p> <p>Personal standardized diary of medical radiation exposure</p> <p>Implementation of APP /software</p>

Cumulative radiation exposure per patient



Medical procedures - Adult

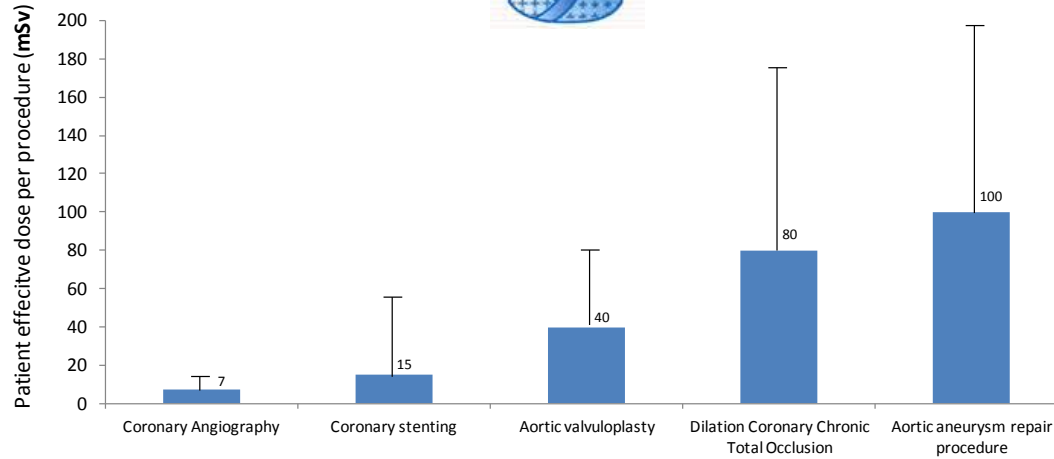
Diagnostic procedures	Effective dose (mSv)	Equivalent CXRs	Background radiation (years)
Diagnostic coronary angiography	7 (2-16)	350	2.9
Percutaneous coronary Intervention	15 (7-57)	750	6.3
Ablation procedure:	15.2 (1.6-59.6)	760	5.7
Atrial fibrillation	16.6 (6.6-59.2)	830	6.9
Pelvic vein embolization	60 (44-78)	3000	25.0
TIPS placement	70 (20-180)	3500	29.3
Aortic valvuloplasty	39	1950	16.2
Dilation chronic coronary occlusion	81 (17-194)	4050	33.7
ETAAAR procedure	76-119	3800-5950	31.6-49.5
Renal angioplasty	54	2700	22.5
Iliac angioplasty	58	2900	24.1
^{99m} Tc -Sestamibi (1100 MBq, 1 day) stress-rest	9.4	470	3.9

ETAAAR = Endovascular Thoraco Abdominal Aortic Aneurysm Repair

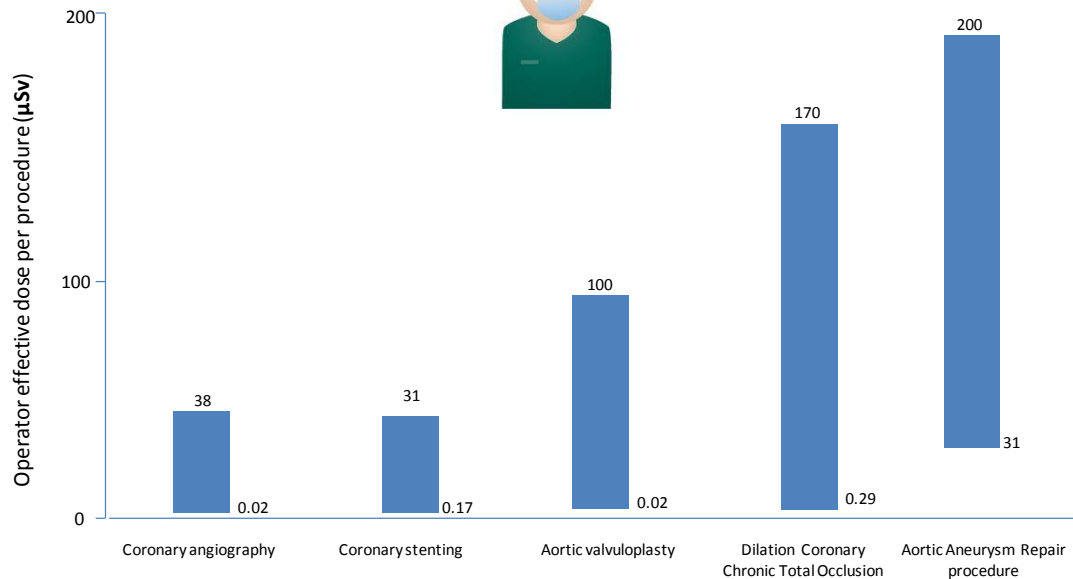
Doses in invasive radiology



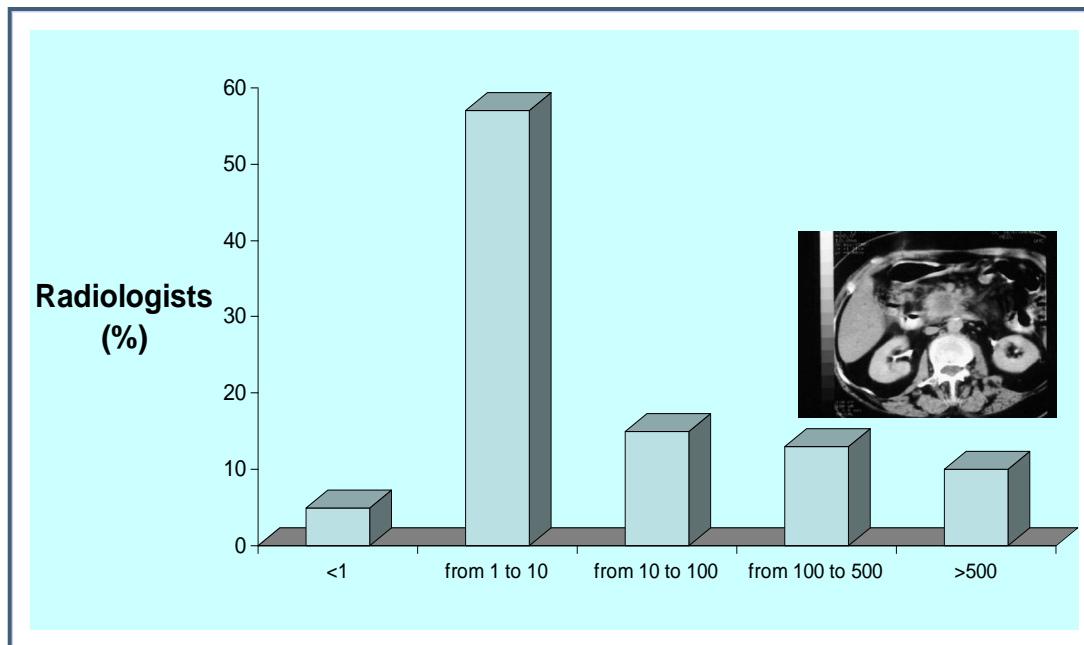
PATIENT DOSE



OPERATOR DOSE



Trust me, I'm the expert!



Lee TH et al. Radiology. 2004;231:393-8

Dose abdomen CT =500 CXR's

- 20% of internists believe MRI is ionizing (Shiralkar. BMJ 2004)
- 12% of pediatricians think scintigraphy is non-ionizing (Thomas et al. Pediatr Radiol, 2006)
- 60% of cardiologists underestimate of 500 times the dose of a scintigraphy (Correia et al. Int J Cardiol, 2005)
- 22% of interventional radiologists do not wear dosimeter (Kottou et al. Radiat Prot Dosimetry, 2001)
- 81% of the interventional cardiology fellows did not know their radiation exposure (Kim C, Am J Cardiol 2010)
- Inverse relationship between experience and dose awareness, consistently poor (Brown N, J Med Im Rad Oncol, 2013)

Radiomachismo

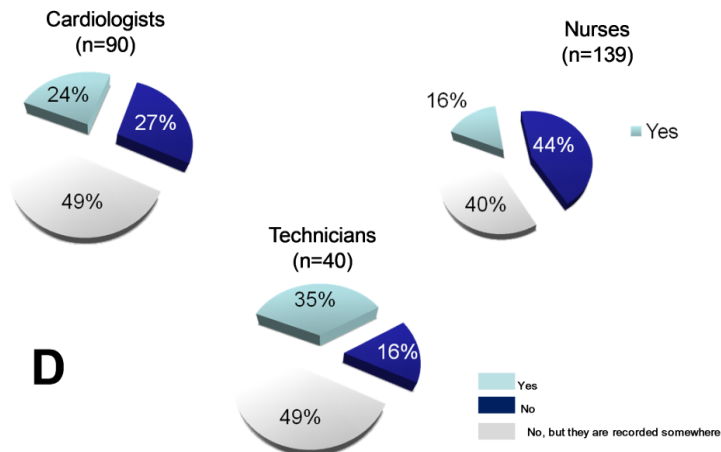
“Increasingly, we have become casual regarding our exposure. We forget to wear the dosimeters. Not infrequently, there is a machismo disregard for radiation protection”



Rita Watson, Sayonara ALARA, Cath Cardio Diagn, 1997





Healthy Cath Lab, 2013

HCL – Do you know DAP (KAP) doses to patient?



Education: patient (and doctor!) must know what they are doing

Table 6 Terminology that should be used

Investigation (example)	Effective dose range	Additional lifetime risk of fatal and non-fatal cancer	RCR symbolic representation	Proposed risk term
CXR	<0.1 mSv	1:1 million		Negligible
Abdominal X-ray	0.1–1 mSv	1 in 100 000 to 1 in 1 million		Minimal
Chest CT	1–10 mSv	1 in 10 000 to 1 in 1000		Very low
PCI	10–100 mSv	1 in 1000 to 1 in 100		Low

These examples relate to a healthy 50-year-old man. Multiply by 1.38 for women, by 4 for children, and by 0.5 (reduced by 50%) in an 80-year-old man. Adapted from references 18,48, and 49.

CXRs, chest X-rays; RCR, Royal College of Radiology; PCI, percutaneous coronary intervention.

 <0.1 mSv; , 0.1–1 mSv; , 1–10 mSv; , > 10 mSv.

Patient Radiation Informed Consent



**Strategy number one:
DON'T SAY A WORD**

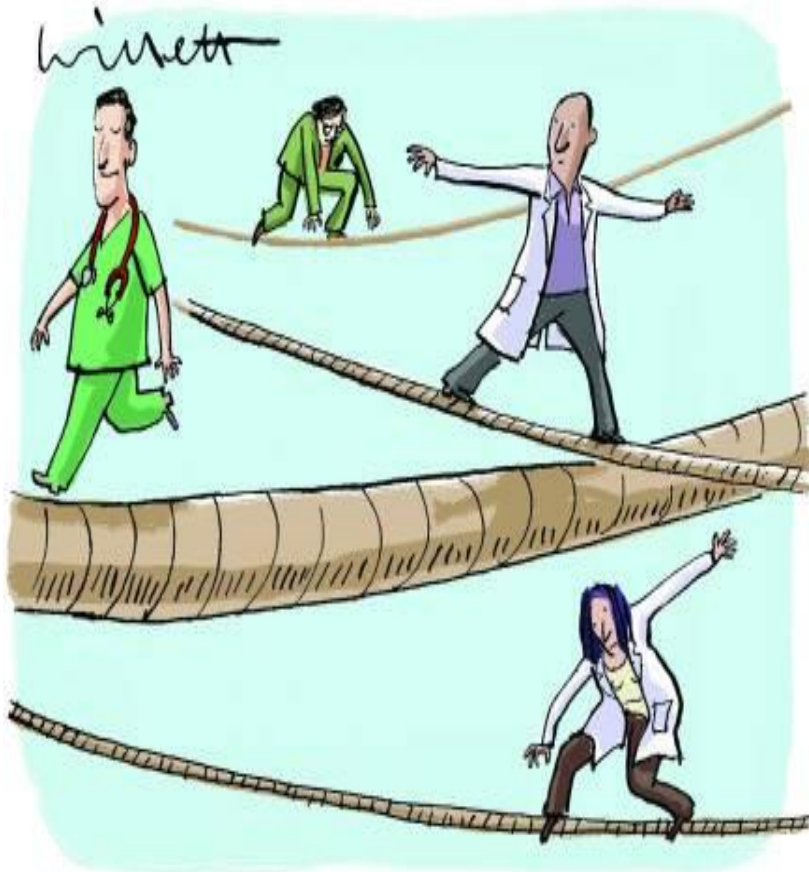


**Strategy number two: Understatement
PCI/MP dose corresponding to a
common radiography**

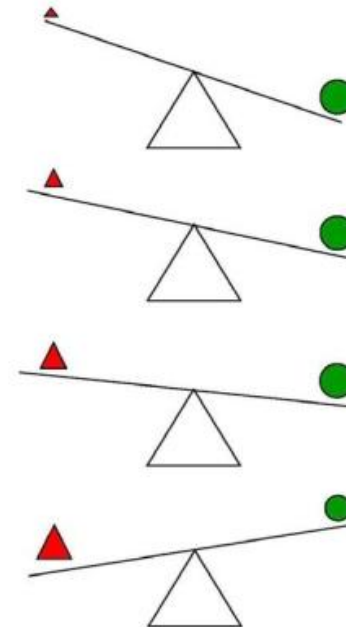
Your scan in Nuclear Medicine involves exposure to radiation.your whole body radiation exposure during each scan will be about 15 milliSieverts.. Harmful effects could include the development of cancer and genetic changes”

**Strategy n. 3:
Full disclosure (NIH.gov)**
The dose in informed consent forces the doctor to know what he/she should already know

Appropriateness Balance



Risk vs Benefit: The code of appropriateness



$B \gg \gg R$
I (appropriate indication)

$B \gg R$
IIa (probably appropriate)

$B \geq R$
IIb (possibly appropriate)

$R \geq B$
III (inappropriate)

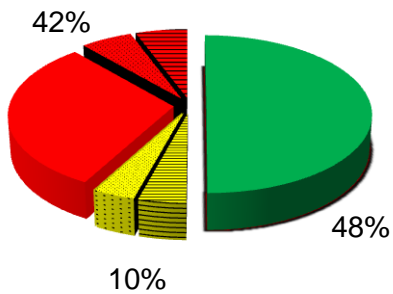
Carpeggiani C et al, PLOSOne, November 27, 2013

■ Appropriate

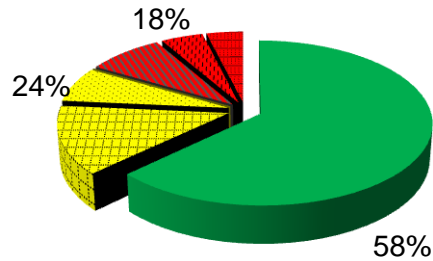
■ Partially inappropriate

■ Inappropriate

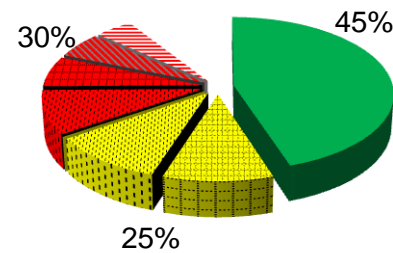
Chest X-Ray



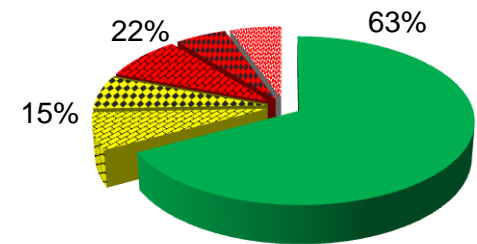
Coronary Computed Tomography



Coronary Angiography



Percutaneous Coronary Intervention



■ Routine at admission

■ Suspected or proven pulmonary pathology

■ Suspected or proven heart failure

■ Asymptomatic, low risk patients

■ Arrhythmias no prior non-invasive test

■ Post revascularization, asymptomatic

■ Recent imaging tests, asymptomatic/stable

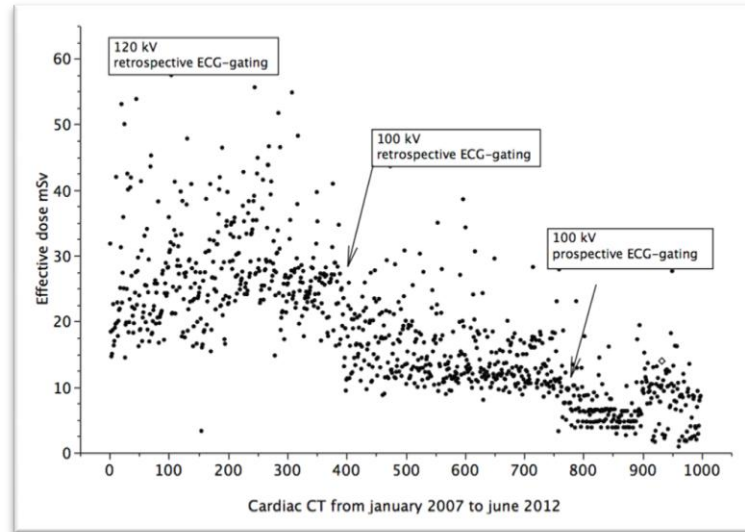
■ STEMI >12 h stable

■ No CABG, no non-invasive testing, asymptomatic

■ With CABG, intermediate findings on non-invasive testing, asymptomatic/stable


AUDIT on prescription/justification/ Optimization of Radiation Dose

SAME TECHNOLOGY



*Marraccini P et al. Acta Radiol.
2014;54:42-7*

**NEW
TECHNOLOGY**

 European Heart Journal (2014) 35, 1131–1136
doi:10.1093/eurheartj/ehu053

CLINICAL RESEARCH
Imaging

Coronary computed tomography angiography with model-based iterative reconstruction using a radiation exposure similar to chest X-ray examination

Tobias A. Fuchs[†], Julia Stehli[†], Sacha Bull, Svetlana Dougoud, Olivier F. Clerc, Bernhard A. Herzog, Ronny R. Buechel, Oliver Gaemperli, and Philipp A. Kaufmann*

Division of Nuclear Medicine and Cardiac Imaging, University Hospital Zurich, Ramistrasse 100, NUK C 42, CH-8091 Zurich, Switzerland

Government Accountability



“Le proiezioni di crescita e invecchiamento della popolazione mostrano che la sostenibilità futura dei sistemi sanitari, incluso il nostro Servizio sanitario nazionale di cui andiamo fieri, potrebbe non essere garantita se non si individueranno nuove modalità di finanziamento e organizzazione dei servizi e prestazioni”.
Repubblica, 28 Nov 2012

Per fronteggiare questa situazione di particolare emergenza occorre non solo operare interventi forti di riorganizzazione e di innovazione del sistema, ma anche rafforzare il monitoraggio dell'appropriatezza delle prestazioni sanitarie». ..ritengo fondamentale promuovere azioni dirette a garantire la trasparenza - quale strumento per il potenziamento della comunicazione con il cittadino..
Ansa, FIRENZE, 13 OTT 2014



**Appropriatezza prescrittiva.
Individuate 208 prestazioni specialistiche a prescrizione limitata.**
Lorenzin illustra il Decreto ai sindacati medici che dicono no alle sanzioni
September 2015

ACTION



Main funding	NIH and NCI	Italian CNR National Research Council – IFC, Institute of Clinical Physiology
Scientific Societies endorsement	Multispecialty Occupational Health Group	Italian Society of Invasive Cardiology (GISE)
Enrolled population	<ul style="list-style-type: none"> 44,000 fluoroscopists (interventional cardiologists, radiologists, neuroradiologists) 49,000 non-interventional radiologists 100,000 non-exposed physicians 	<ul style="list-style-type: none"> 500 exposed interventional cardiologists (nurses, technicians) 500 non exposed clinical cardiologists (nurses, technicians)
Endpoint	Epidemiological clinical endpoints (cancer, cataract, vascular events)	Surrogate biomarkers of genetic, vascular, reproductive, neurocognitive effect



Baysson et al. BMC Public Health 2013, 13:266
<http://www.biomedcentral.com/1471-2458/13/266>



STUDY PROTOCOL

Open Access

Risk of cancer associated with cardiac catheterization procedures during childhood: a cohort study in France

Helene Baysson^{1*}, Jean Luc Réhel¹, Younes Boudjemline², Jérôme Petit³, Brigitte Girodon², Bernard Aubert¹, Dominique Laurier¹, Damien Bonnet² and Marie-Odile Bernier¹

Andreassi, MG, Piccaluga E, et al:
JACC Cardio Int, 2015 :
Subclinical atherosclerosis and early vascular aging :a genetic, telomere and vascular ultrasound study iin interventional cardiologists



International Journal of Cardiology,

Volume 195, 15 September 2015, Pages 30–36

Long-term outcome and medical radiation exposure in patients hospitalized for cardiovascular disease. [Clara Carpeggiani](#), [Giuseppe Rossi](#), [Patrizia Landi](#), [Claudio Michelassi](#), [Marco Brambilla](#), [Lauro Cortigiani](#), [Eugenio Picano](#). doi:10.1016/j.ijcard.2015.05.080

[Eisenberg MJ](#), [Afilalo J](#), [Lawler PR](#), [Abrahamowicz M](#), [Richard H](#), [Pilote L](#). Cancer risk related to low-dose ionizing radiation from cardiac imaging in patients after acute myocardial infarction. CMAJ 183 (2011) 430–436.

[Hung MC](#) and [Hwang JJ](#). Cancer risk from medical radiation procedures for coronary artery disease: a nationwide population-based cohort study. Asian Pacific J Cancer Prev 14 (2013) 2783-2787.

RadioRisk software a Clinical Decision Making Support

Personal data

Summary and specific kind of exposure

DATI PERSONALI

Nome: Mario Rossi
Data nascita: 01/01/1975
Luogo nascita: Arezzo
Sesso: M

EVENTI

Data	Evento	Dose	Note
01/01/1975	Residenza Arezzo	2,175	
10/10/1985	Thoracic spine	4,4	
11/12/1985	Napoli	4,539	
10/10/1999	Viaggio Aereo	0,14	
01/01/2000	Dual isotope (3.0 mCi Th-201+30 mCi Tl-201)	27	
10/10/2000	Ascoli Piceno	1,85	
10/02/2001	Esposizione professionale	7	
01/01/2002	Esposizione professionale	4	
10/10/2002	Residenza Aosta	1,889	
10/10/2003	Esposizione professionale	6	
10/10/2004	Esposizione professionale	5	
11/11/2006	Esposizione professionale	2	
10/10/2008	Perfusion cardiac rest/stress thallium	21	

RIEPILOGO

Esposizione: **NATURALE** 110,54 mSv (59,13 %)
DIAGNOSTICA 52,40 mSv (28,03 %)
PROFESSIONALE 24,00 mSv (12,84 %)
TOTALE 186,94 mSv

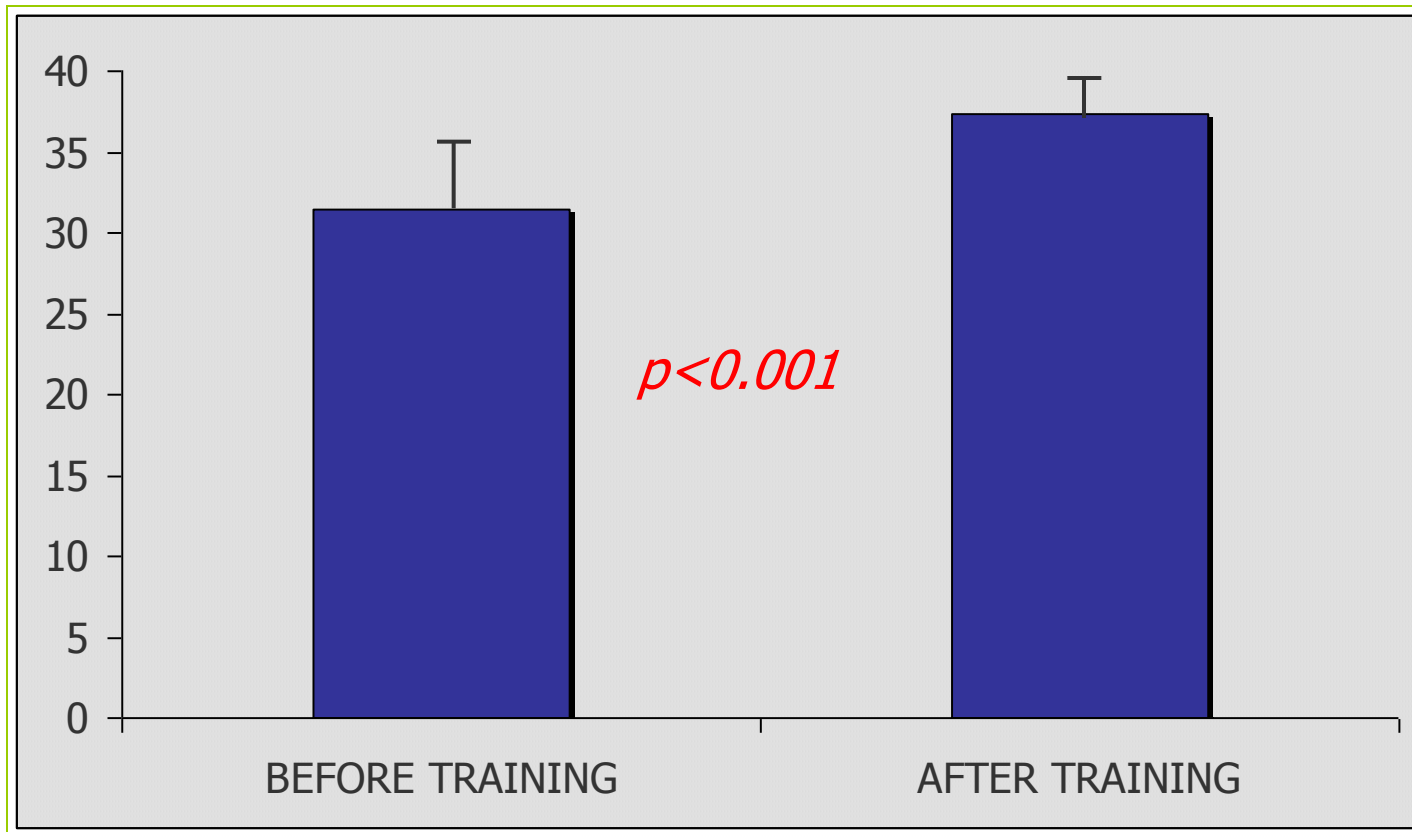
Equivalenza Simulazione Stampa Informazioni Uscita

Personal medical imaging history

Tools

Radiological Awareness

403 attendees



We Are Giving Ourselves Cancer

By RITA F. REDBERG and REBECCA SMITH-BINDMAN **JAN. 30, 2014**

Neither doctors nor patients want to return to the days before CT scans. But we need to find ways to use them without killing people in the process.



The appropriate and justified use of medical radiation in cardiovascular imaging: a position document of the ESC Associations of Cardiovascular Imaging, Percutaneous Cardiovascular Interventions and Electrophysiology

Eugenio Picano¹, Eliseo Vañó^{2,3}, Madan M. Rehani⁴, Alberto Cuocolo⁵, Lluís Mont⁶, Vicente Bodi⁷, Olivier Bar⁸, Carlo Maccia⁹, Luc Pierard¹⁰, Rosa Sicari¹, Sven Plein¹¹, Heiko Mahrholdt¹², Patrizio Lancellotti¹³, Juhani Knuuti¹⁴, Hein Heidbuchel¹⁵, Carlo Di Mario¹⁶, and Luigi P. Badano^{17*}

¹Institute of Clinical Physiology, CNR, Pisa, Italy; ²Department of Radiology, School of Medicine, Complutense University, Madrid, Spain; ³Medical Physics Service, San Carlos University Hospital, Madrid, Spain; ⁴International Atomic Energy Agency, Vienna, Austria; ⁵Department of Advanced Biomedical Sciences, University Federico II, Napoli, Italy; ⁶Arrhythmia Section, Thorax Institute (ICT), Hospital Clinic, University of Barcelona, Catalonia, Spain; ⁷Cardiology Department, Hospital Clínico Universitario-INCLIVA, Universidad de Valencia, Valencia, Spain; ⁸EAPCI, French Society of Cardiology, Clinique Saint-Gatien, Tours, France; ⁹Centre d'Assurance de qualité des Applications Technologiques dans le domaine de la Santé (CAATS), Bourg-La-Reine 92340, France; ¹⁰Department of Cardiology, University of Liège, University Hospital Sart Tilman, Liège, Belgium; ¹¹Multidisciplinary Cardiovascular Research Centre and Leeds Institute of Genetics, Health and Therapeutics, University of Leeds, Leeds LS2 9JT, UK; ¹²Cardiac Magnetic Resonance Group, Robert-Bosch-Hospital, Stuttgart, Germany; ¹³Department of Cardiology, University of Liege, Hospital GIGA Cardiovascular Sciences, CHU Sart Tilman, Liege, Belgium; ¹⁴Turku PET Centre, University of Turku and Turku University Hospital, Turku, Finland; ¹⁵Department of Cardiovascular Medicine, University Hospital Gasthuisberg, University of Leuven, Leuven, Belgium; ¹⁶Cardiology, Royal Brompton Hospital, Sydney Street, London SW3 6NP, UK; and ¹⁷Department of Cardiac, Thoracic and Vascular Sciences, School of Medicine, University of Padua, Padua, Italy

Take-home message

- All other considerations being equal, it is not recommended to perform tests involving ionizing radiation when the desired information can be obtained with a non-ionizing test with comparable accuracy.
- If you perform a test that utilizes ionizing radiation, choose the one with the lowest dose and be aware of the many factors modulating dose.
- The actual delivered dose should always be recorded and included in patients' records. Because of the numerous sources of variability, there is no clear threshold between acceptable and unacceptable exposure for any given examination, but the dose that is not even considered is certainly unacceptable.

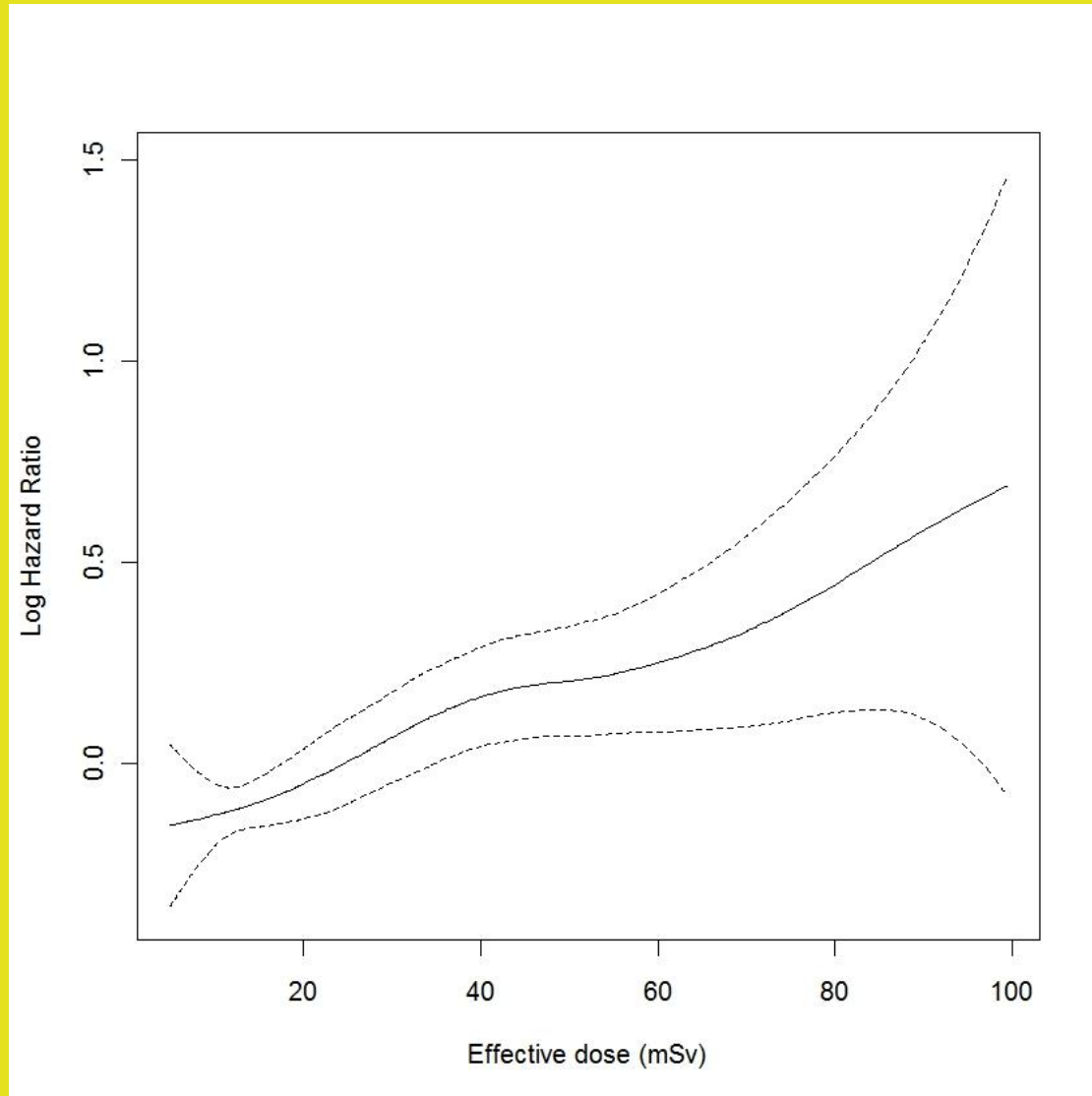
Take-home message

- X-rays and gamma-rays used in radiology and nuclear medicine are proven (class 1) carcinogens, and cardiologists should make every effort to give *'the right imaging exam, with the right dose, to the right patient'*.
- The priority given to radioprotection in every cardiology department is an effective strategy for primary prevention of cancer, a strong indicator of the quality of the cardiology division, and the most effective shielding to enhance the safety of patients, doctors, and staff.
- A smart cardiologist cannot be afraid of the essential and often life-saving use of medical radiation, but must be very afraid of radiation unawareness.



	How we were	How we will be
Flow-chart	More is More	Less is More
Philosophy	Moral suasion	“Carrot and stick”
Authorization	Specialist self-referral	Radiology manager
Evidence	Guidelines + judgement	Appropriateness on App
Payment	Pay per volume	Penalty and bonus
Report appropriateness	“Jeopardizes reputation”	Mandatory by law

Log Hazard ratio for Cancer Onset plotted against effective dose below 100 mSv



Common Language

Israel MOH Policy

- **Monitor the use and evaluate the clinical impact**
- utilization patterns of CT exams over time
- identify populations at risk
- high dose imaging history as part of the E-medical files
- update recommendations according to the evidence and other imaging modalities
- **implement the following principles** -
 - Justification
 - Optimization (ALARA)
 - Quality Control
 - Record of radiation exposure
- **Focus on high radiation dose examinations** – CT, Nuclear medicine, Interventional procedures
- **Attention to populations at risk:** children, pregnant women.

Dies IRAE Policy

- Identificare la popolazione a rischio
- Costruire la carta radiologica del paziente con la dose di esposizione
- Implementare linee guida
- Nell'eseguire esami radiologici Implementare i principi di ALARA
- Identificare procedure ad alta dose di esposizione (CT, esami di medicina nucleare, interventistica)
- Attenzione alla popolazione a rischio: donne, bambini

The technology of tomorrow with the awareness of yesterday



1981

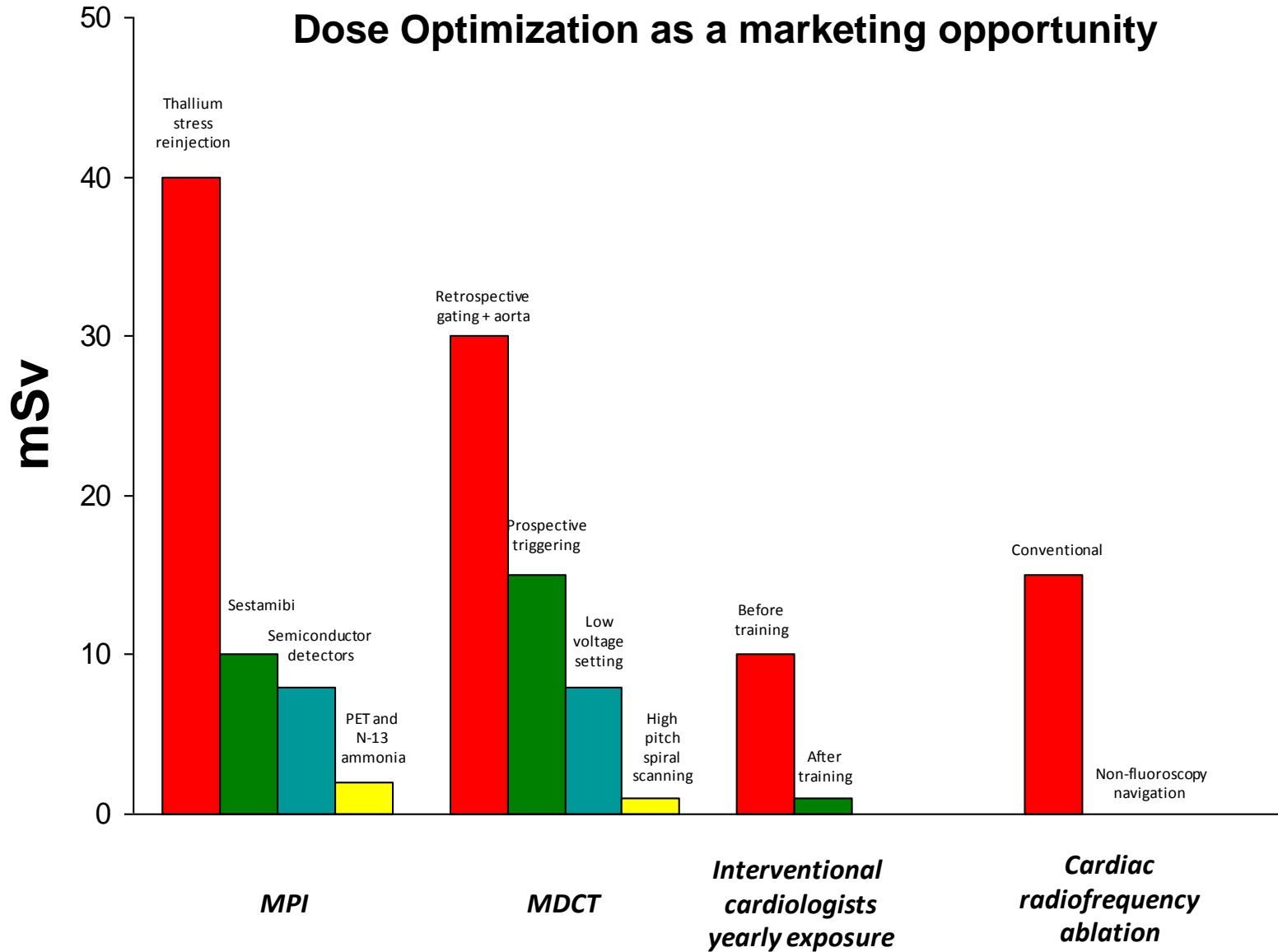


2013



From radiological go-kart to Ferrari

Dose Optimization as a marketing opportunity



The Information Imperative: Is It Time for Informed Consent Explaining the Risks of Medical Radiation?

Semelka RC, Armao DM, Elias J Jr, Picano E.






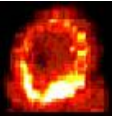

The danger to the field of Radiology in not regulating itself and requiring informed consent for medical procedures using ionizing radiation is that we stand the very real chance of having regulations imposed upon us by government, as is already in process in Europe. The prospects of facing both poor public perception and imposed regulations is disturbing.

January 2012

Radiology

Radiology is a monthly journal devoted to clinical radiology and allied sciences, owned and published by the Radiological Society of North America, Inc.

Imaging and extra-risk

		Effective dose around (milliSievert)	Extra-risk of cancer	Natural background radiation	Lost life expectation
	Chest x-ray 	<0.1	Negligible 1 in 1.000.000	A few days	2 min
	Skull x-ray 	0.1-1.0	Minimum From 1 in 1.000.000 to 1 in 100.000	A few weeks	20 min
	Thyroid scintigraphy 	1.0-10	Very Low From 1 in 100.000 to 1 in 1.000	A few months	hours
	Cardiac scintigraphy 	10-100	Low From 1 in 1.000 to 1 in 100	A few years	days

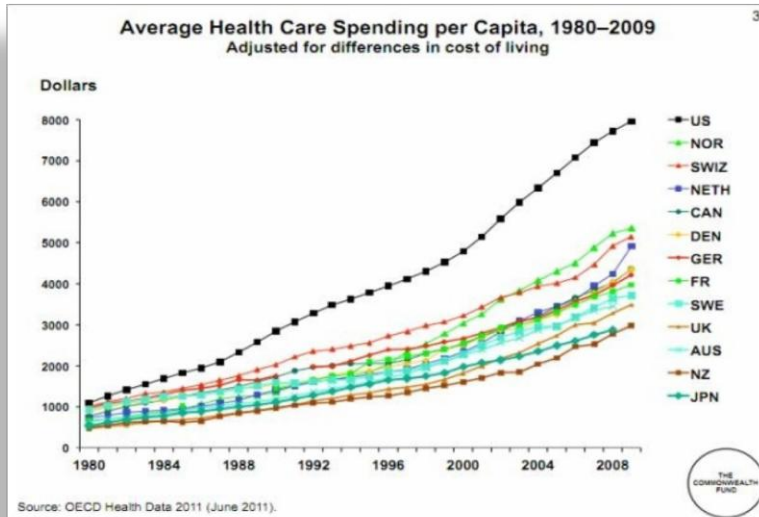
Radiation and your patient: a web module produced by the Committee 3 of the International Committee on Radiation Protection (2002)

No more blind date with radiation

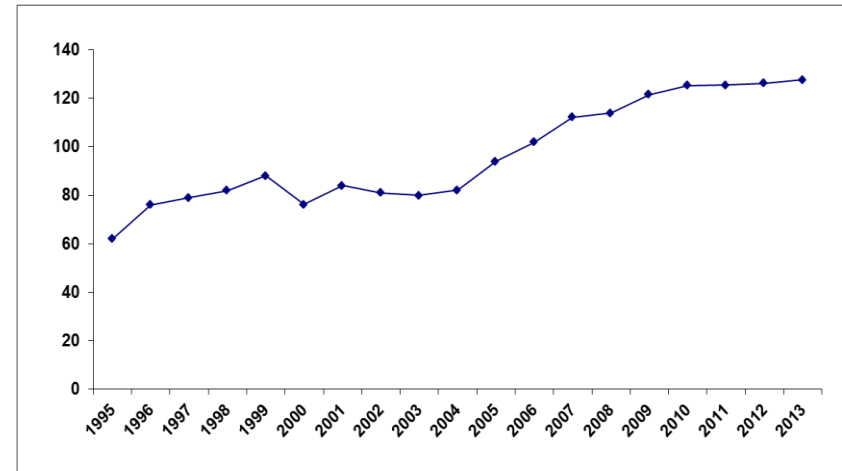


- The dose in informed consent forces the doctor to know what he/she should already know (*you know what you are going to do*)
- The truly given dose in mSv should be spelled-out in the written report (*you know what you did*)
- There is no cut-off value between high or low dose: **but the certainly wrong dose is the one we ignore**
- To reduce radiation overexposure and overuse without dose audit is like to treat fever without a thermometer

Background



CT rate (per 1,000 people) in Israel 1995 -2013



Cardiac CT has experienced the greatest growth

Redberg RF, N Engl J Med 2008

Cardiovascular imaging amounts of at least 50% of all imaging test

Shaw LJ, JACC 2010

