Ionizing Radiation in Medical Exposure Benefits and/or Risks

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Radiation

- Mankind was born in an ocean of radiations
- From the first second of the Big Bang the whole world was flooded by the cosmic radiation, protons, helium ions, electrons, photons and neutrinos

Physical Radiation

Our planet is full of many radiation sources:

- building materials
- the soil and the underground minerals
- food we consume
- cigarettes which should not smoke
- the air we breath

Radiation

- Radiation and X rays have been stamped with bad name and bad fame
- H.Becqerel discovered the powerful radiation emitted by uranium in 1896
- Marie Curie and her husband Pierre Curie discovered polonium and radium in 1898

Radiation in human

- An average man, 70 kg, has inside him approximately 9 kBq radiation
- 4 kBq K-40
- 3 kBq C-14
- 2 kBq Th - Ra - U

Radiation in human

K-40

$1{,}3 \times 10^9$ y	0.0118	β , EC	1,31 MeV
		γ	1,46 MeV

Internal Dose 0,19 mSv/y

Radiation in human

If we could concentrate this 9 kBq to a point source, this source would produce

- 500.000 dpm
- 30.000.000 dph
- Billions of cells would be hit in one only day

Radiation in human

- Theoretically all human cells would be hit at least once during a year
- Is this dangerous ? is this harmful ?
- There is no evidence nor proof for this
- On the contrary, it looks that this is very beneficial and useful for life

Radiation - Medical Exposure

- Radiation is beneficial and useful
- Radiation gives - produces life and keeps life alive in our planet

- The increase of radiation due to medical exposure and technological /artificial sources is something to be considered
- Is any benefit from them?
- Or this damages and increases risk to human ?

Radiation Sources

1.1. Physical radiation

1.1.1. Cosmic radiation

1.1.2. Earth radiation

1.1.3. Radon

Radiation Sources

1.2. Radiation from technological activities

- **Carbon - electricity producing stations**
- **Phosphorous fertilizers**
- **Intercontinental air travel**
- **Old technology tv and monitors, airport x-ray scanners etc.**

Radiation Sources

Medical Exposure

1.3. Medical Exposure

- **Radiology - X-rays**
- **Nuclear medicine - Radiopharmaceuticals**
- **Dentistry – teeth x-rays**
- **Radiotherapy**

Radiation Accidents

The nuclear accidents
Chernobyl and Fukushima

GAEC - EEAE

• Cosmic Activity	0,3	0,3-1,0
• Earth activity	0,5	0,3-0,6
• Radon	1,7	0,2-10
• Radionuclides	0,2	0,2-0,8
	2,7 mSv	1,0-10
	GAEC (EEAE) 2015	
• Medical Exposure	1,8 mSv	

Medical Exposure

- Radiology 1,70
  (CT 1,50)
- Dentistry 0,01
- Nuclear Medicine 0,10

1,80 mSv

Doses

- Radiation workers 20 mSv/y
- Other 1 mSv/y

Radiation Rules

- Shielding
- Distance (inverse square law)
- Time

Legislation

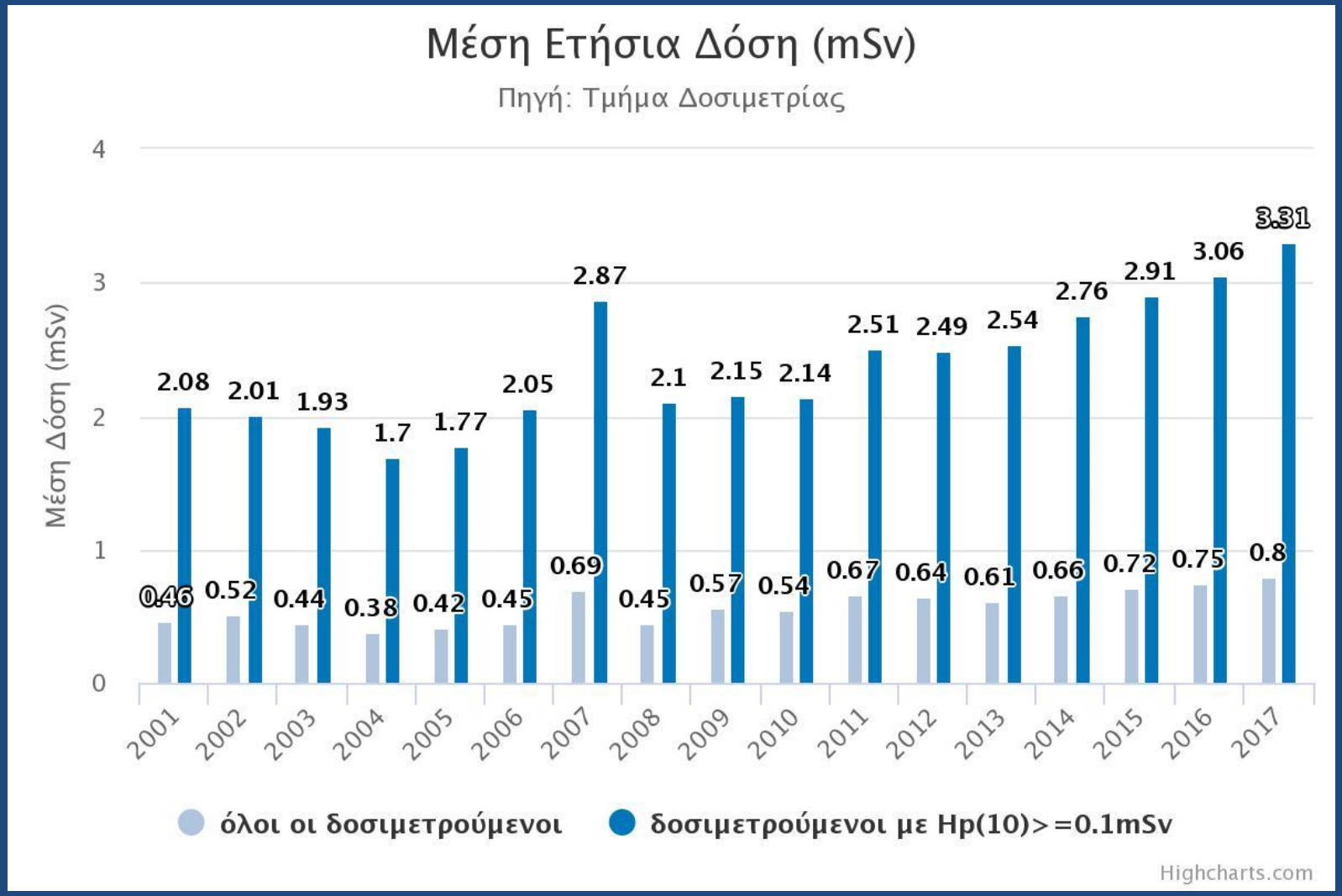
- Any human activity and any technological source is not innocent and it can cause risks to human life
- The existence of national legislation is obligatory and it should predict problems which may occur and the way they be solved
- The legislation should apply to anyone and at any time
- The existence of state and public mechanisms to ensure that the law is fulfilled
- The existence of a state agent, namely Greek Atomic Energy Commission GAEC-EEAE secures that all the above are done

Legislation

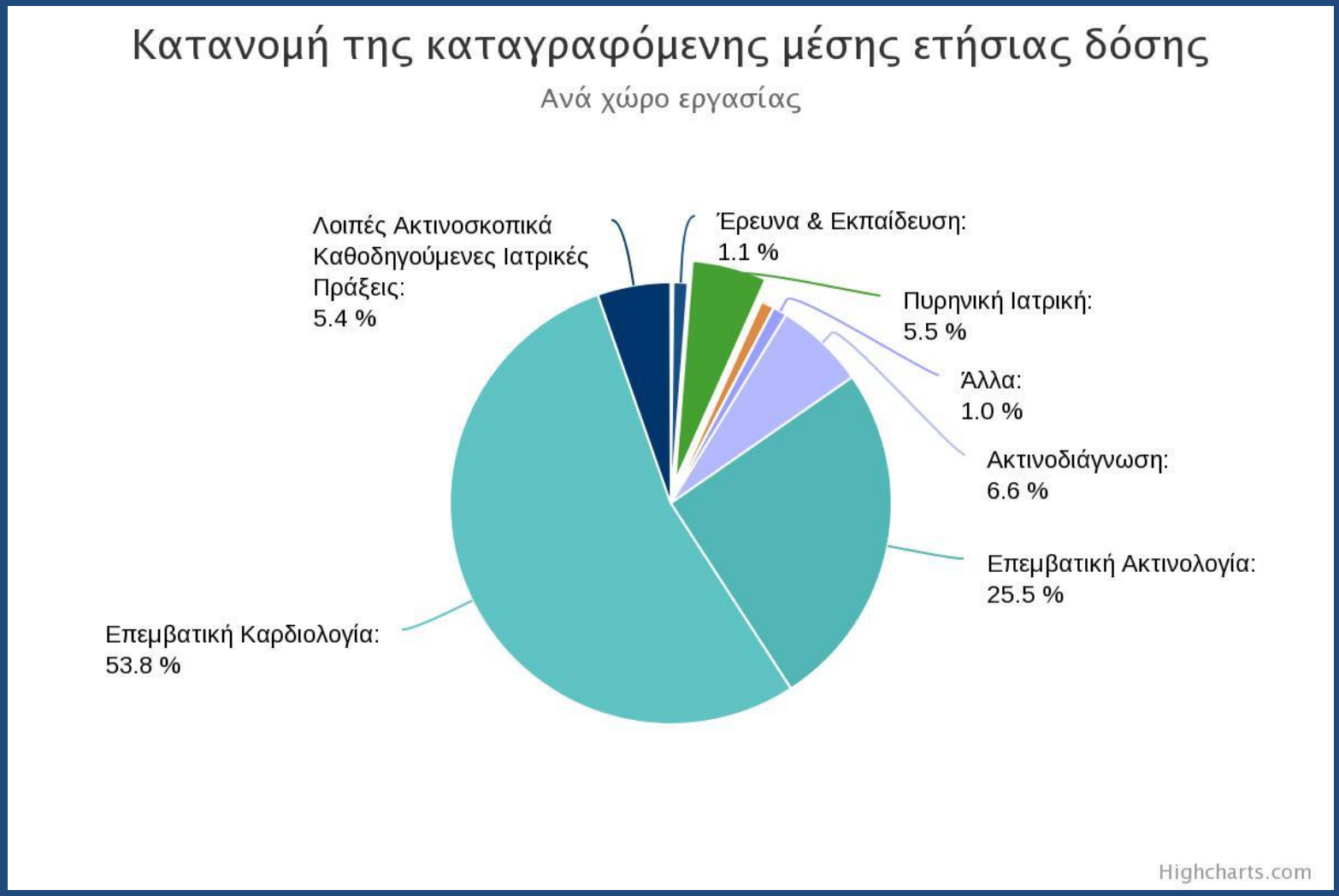
Radiation Protection aims the protection of humans, goods and environment from the dangerous effects of the ionizing radiation

FEK 216 / B / 2001

GAEA - EEAE


Μέση Ετήσια Δόση (mSv)
Πηγή: Τμήμα Δοσιμετρίας
Μέση Δόση (mSv)
0
1
2
3
4
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
0.46 0.52 0.44 0.38 0.42 0.45 0.69 0.45 0.57 0.54 0.67 0.64 0.61 0.66 0.72 0.75 0.8
2.08 2.01 1.93 1.7 1.77 2.05 2.87 2.1 2.15 2.14 2.51 2.49 2.54 2.76 2.91 3.06 3.31
όλοι οι δοσιμετρούμενοι
δοσιμετρούμενοι με Hp(10)>=0.1mSv
Highcharts.com

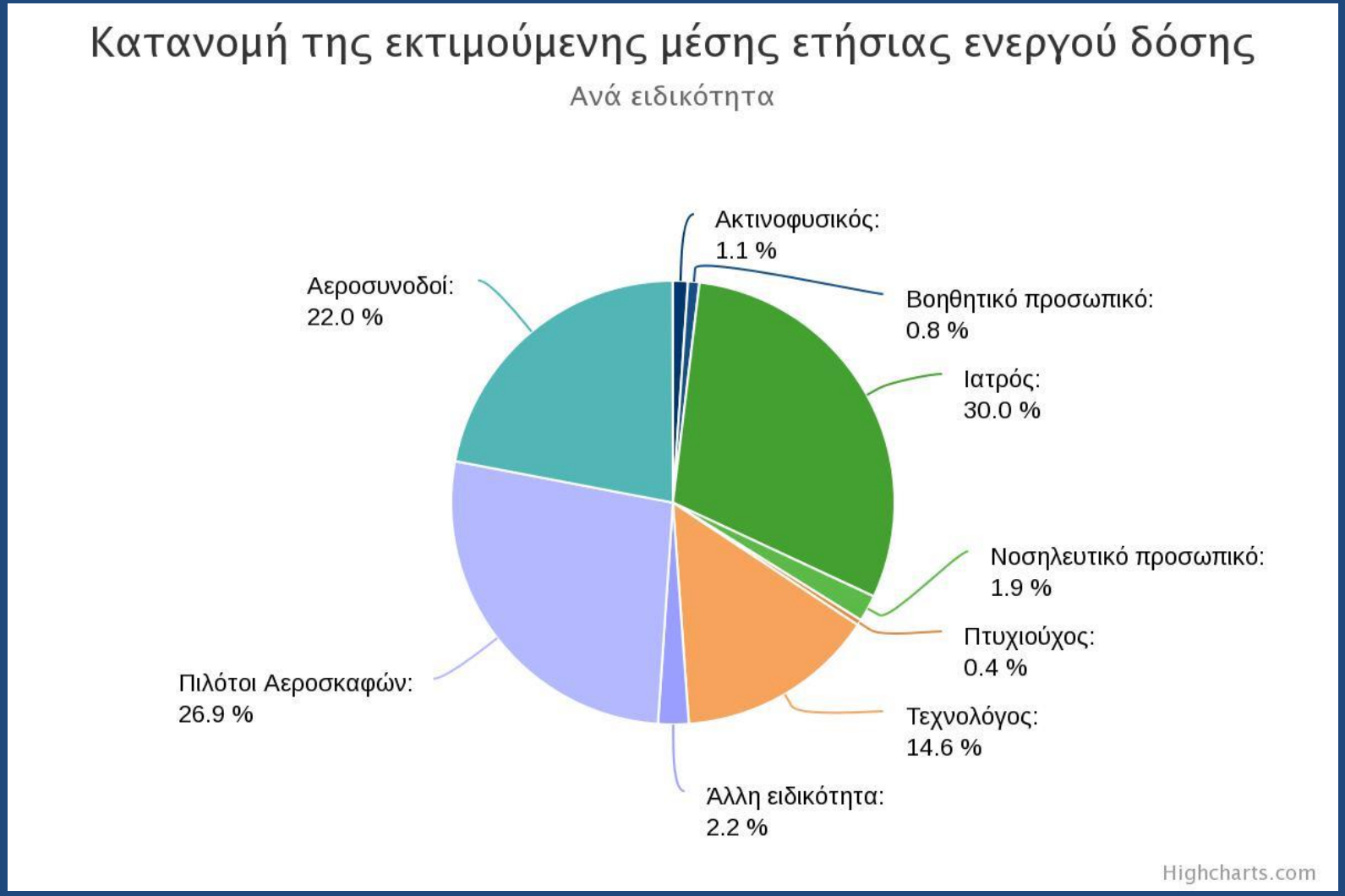
GAEA - EEAE


Κατανομή της καταγραφόμενης μέσης ετήσιας δόσης
Ανά χώρο εργασίας
Λοιπές Ακτινοσκοπικά Καθοδηγούμενες Ιατρικές Πράξεις: 5.4 %
Έρευνα & Εκπαίδευση: 1.1 %
Πυρηνική Ιατρική: 5.5 %
Άλλα: 1.0 %
Ακτινοδιάγνωση: 6.6 %
Επεμβατική Ακτινολογία: 25.5 %
Επεμβατική Καρδιολογία: 53.8 %
Highcharts.com

GAEA - EEAE


Κατανομή της καταγραφόμενης μέσης ετήσιας δόσης
Ανά ειδικότητα
Άλλη ειδικότητα:
1.1 %
Ακτινοφυσικός:
0.5 %
Τεχνολόγος:
9.4 %
Βοηθητικό προσωπικό:
0.4 %
Πτυχιούχος:
0.2 %
Νοσηλευτικό προσωπικό:
9.6 %
Ιατρός:
78.8 %
Highcharts.com

GAEA - EEAE


Κατανομή της εκτιμούμενης μέσης ετήσιας ενεργού δόσης
Ανά ειδικότητα
Ακτινοφυσικός:
1.1 %
Βοηθητικό προσωπικό:
0.8 %
Ιατρός:
30.0 %
Νοσηλευτικό προσωπικό:
1.9 %
Πτυχιούχος:
0.4 %
Τεχνολόγος:
14.6 %
Άλλη ειδικότητα:
2.2 %
Πιλότοι Αεροσκαφών:
26.9 %
Αεροσυνοδοί:
22.0 %
Highcharts.com

Radiological Effects

- Physical stage
- Chemical stage
- Biological stage

Biological Effects from Radiation

Deterministic effects

Stochastic effects

Stochastic effects

- Stochastic effects occur by chance
- They show up years after exposure
- There is no threshold dose below which it is certain that an adverse effect can not occur

  (linear – non – threshold, LNT, dose response)
- But as the dose to an individual increases the probability increases
- Severity is independent of the dose

Stochastic effects

The International Commission of Radiological Protection, ICRP, estimates the excessive risk of cancer mortality

5 % per Sv

15 % per Sv for a young girl

1 % per Sv for a 70 year old man

Stochastic effects

- Cell death
- Radiation induced cancer
- Hereditary diseases
- Shortening life span

Radiology, Radiation Dose , mSv

• CT head	2
• CT abdomen and pelvis	18
• CT abdomen	9
• X – ray chest	0,1
• X – ray extremity	0,001
• Mammography	0,3
• Dental X – ray	0,005
• Bone densitometry	0,001
• PET/CT	25

Nuclear Medicine Radiation Dose (mSv)

• Thyroid, Tc-99m	1
• Bone	3
• Kidney DTPA	2
• Kidney DMSA	3
• MIBG, I-123	5
• Myocardial perfusion, Tc	20
• Myocardial perfusion, Tl	15 - 20
• PET/CT F-18	25

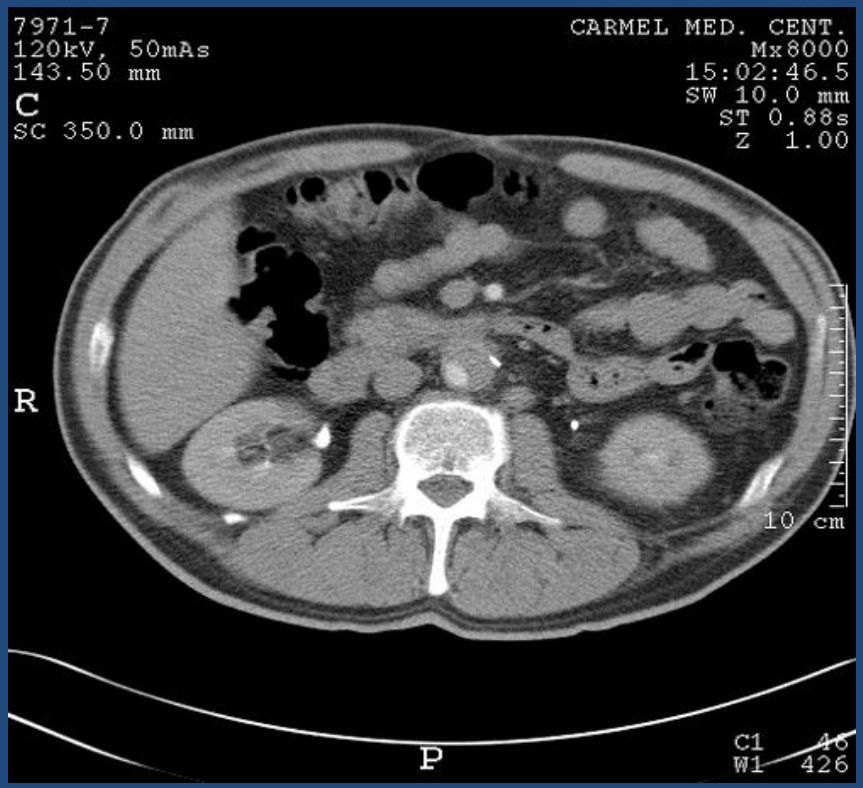
Medical Doses

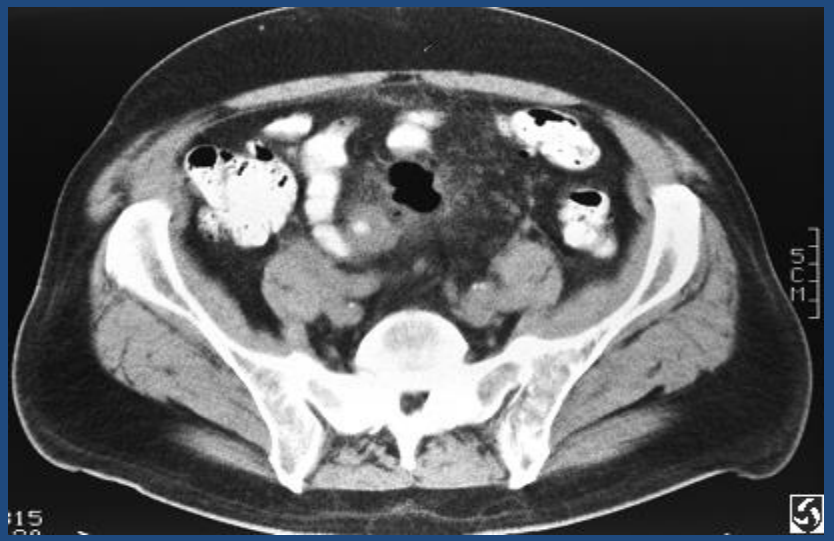
- The conventional X-rays
- Fluoroscopy
- The CT scans
- The nuclear medicine scintigraphy scans
- Interventional radiology procedures
- Other Medical exposure

- Result in organ doses in the range of 1 – 20 mGy

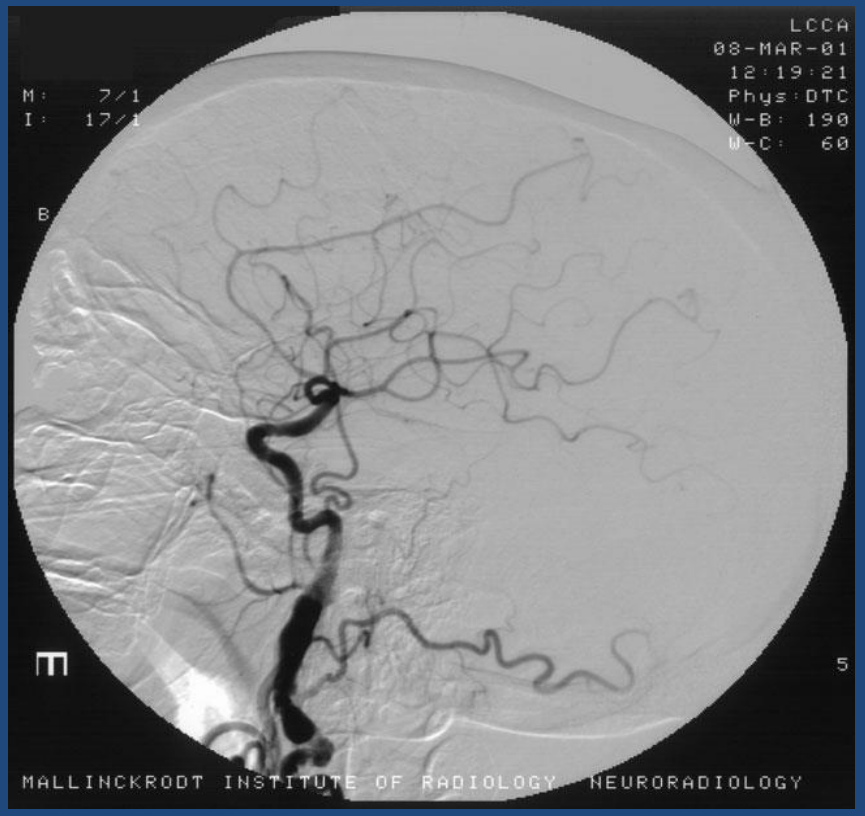
- One big problem is the increasing large number of X ray examinations performed every year
- More than 360 examinations per 1000 individuals worldwide
- Three quarters of all examinations occur in countries accorded health care level I, which account for only one quarter of the world population

CT


7971-7
120kV, 50mAs
143.50 mm
C
SC 350.0 mm
CARMEL MED. CENT.
Mx8000
15:02:46.5
SW 10.0 mm
ST 0.88s
Z 1.00
R
10 cm
P
C1 46
W1 426

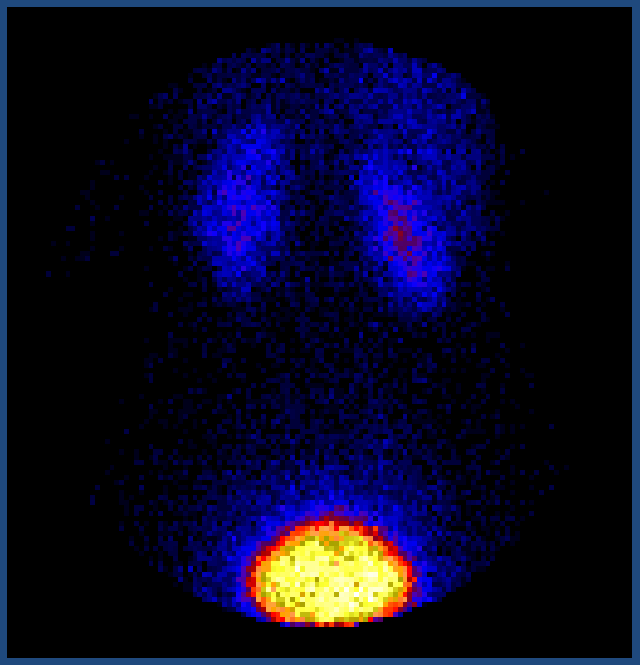


Inventive Radiology



Nuclear Medicine

Nuclear Medicine



Nuclear Medicine

WHO

UV

Radon

X - rays

Non - Ionising

- New methods
- New procedures

Interventional Radiology

Diagnostic Procedures

- Angiography
- Cholangiography
- Biopsy

Interventional Radiology

Therapeutic Procedures

- Balloon angioplasty – stent
- Embolization
- Thrombolysis
- Endovascular aneurysm repair
- Dialysis related interventions

Interventional Radiology

Therapeutic Procedures

- Cholecystostomy
- Drainage catheter placement
- Chemoembolization
- Radioembolization

Interventional Radiology

Therapeutic Procedures

- Radiofrequency ablation
- Cryoablation
- Microwave ablation
- Percutaneous nephrostomy
- Vertebroplasty

- Can we ignore all these new techniques and examinations ?
- Can we ignore that a better diagnosis is obtained which leads patients to better quality of life ?
- Can we ignore that many people's lives are saved ?

Closing Remarks

- The medical examinations will increase every year
- New equipment and medical devices will be produced
- More individuals will be examined and exposed to radiation

Aim - Goal

Taking into account the two basic principles of

Justification and Optimization

It is in our hands to handle all the above wisely so that we obtain

better differential diagnosis and therapeutic result with the same or reduced radiation dose

THANK YOU FOR YOUR ATTENTION