



USE OF ACTIVE PERSONAL DOSEMETERS IN INTERVENTIONAL RADIOLOGY/CARDIOLOGY: TESTS IN HOSPITALS - ORAMED PROJECT

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TESTS IN HOSPITALS

1. Tests on phantoms

- Phantoms to represent patient and doctor
- Use of hospital X-ray system

OBJECTIVE: study the behavior of APDs in realistic conditions with the possibility to select specific field parameters

2. Tests on operators

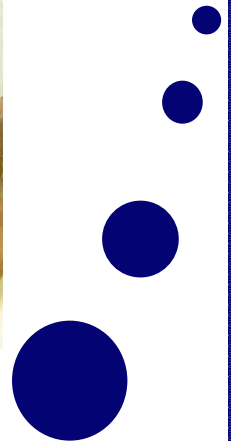
- APDs worn by operators during routine practice
- Use of interventional X-ray systems

OBJECTIVE: obtain an overview of differences between active and passive dosimetry in routine practice without an accurate knowledge of field parameters



TESTS ON PHANTOMS

- Patient = anthropomorphic Rando-Alderson phantom
Operator = ISO slab phantom
- X-ray system of EHSAL University School for Medical Imaging
(Brussels, Belgium)
PHILIPS BZR79 Optimus
40 to 150 kVp ; 0,5 to 850 mAs
inherent filtration : 3,5 mm Al_{eq} ; additional filtration possible
Pulsed radiation (single pulses)



TESTS ON PHANTOMS

- APDs tested

- RLD
- TL
- ed a
- det
- Total uncertainty of 20%

			
<p>MGPi DMC2000XB</p>	<p>Siemens EPD Mk2.3</p>	<p>Dosilab EDM III</p>	<p>Polimaster PM1621A</p>

- APDs were positioned on ISO slab together with passive TL dosemeter as “reference”

Uniformity
surface of
lower than



**Rados
DIS-100**



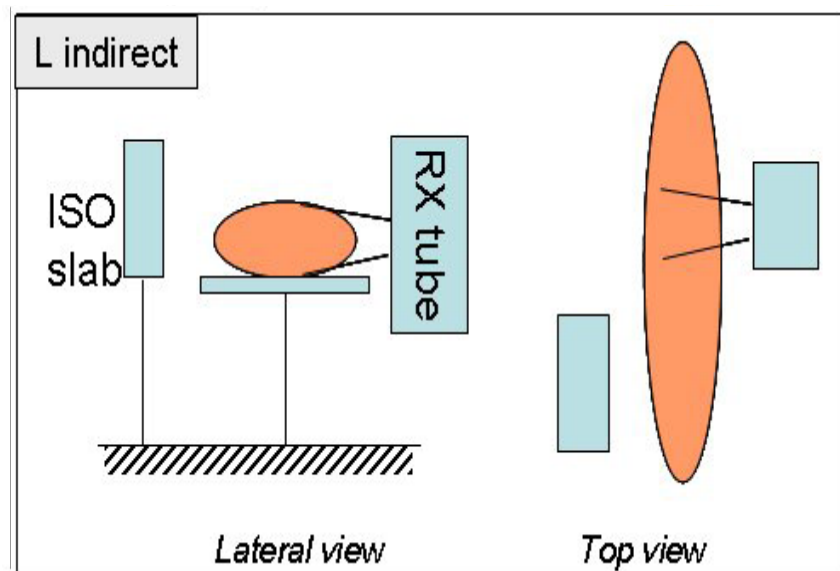
**Unfors
EDD 30**



- Atomtex AT3309C
DoseAware
not available

TESTS ON PHANTOMS

- Four realistic set-ups
 1. AP direct: Tube at 0°
slab at level of thorax of 'patient'
 2. L direct: Tube at 90°
slab at level of thorax of 'patient'
 3. AP indirect: Tube at 0°
slab at level of pelvis of 'patient'
 4. L indirect: Tube at 90°
slab at level of pelvis of 'patient'

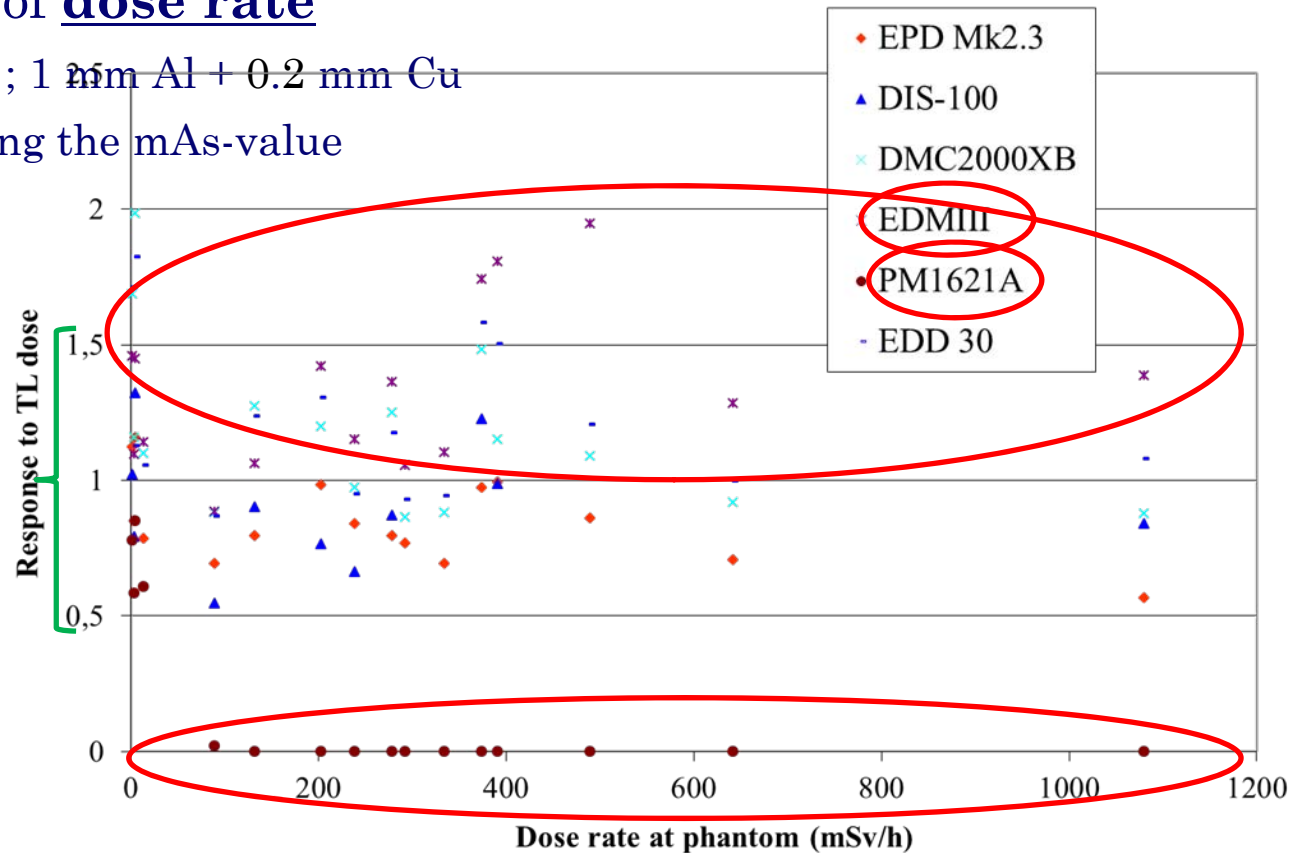


TESTS ON PHANTOMS - RESULTS

1. Influence of dose rate

- 80 kVp ; 1 mm Al + 0.2 mm Cu
- Changing the mAs-value

dose rate:
10 mSv/h
↓
1080 mSv/h



- PM1621A: no response → consistent with test in pulsed mode in laboratory conditions
- APD response globally within +/- 50%
- EDIII is in general higher than TLD dose

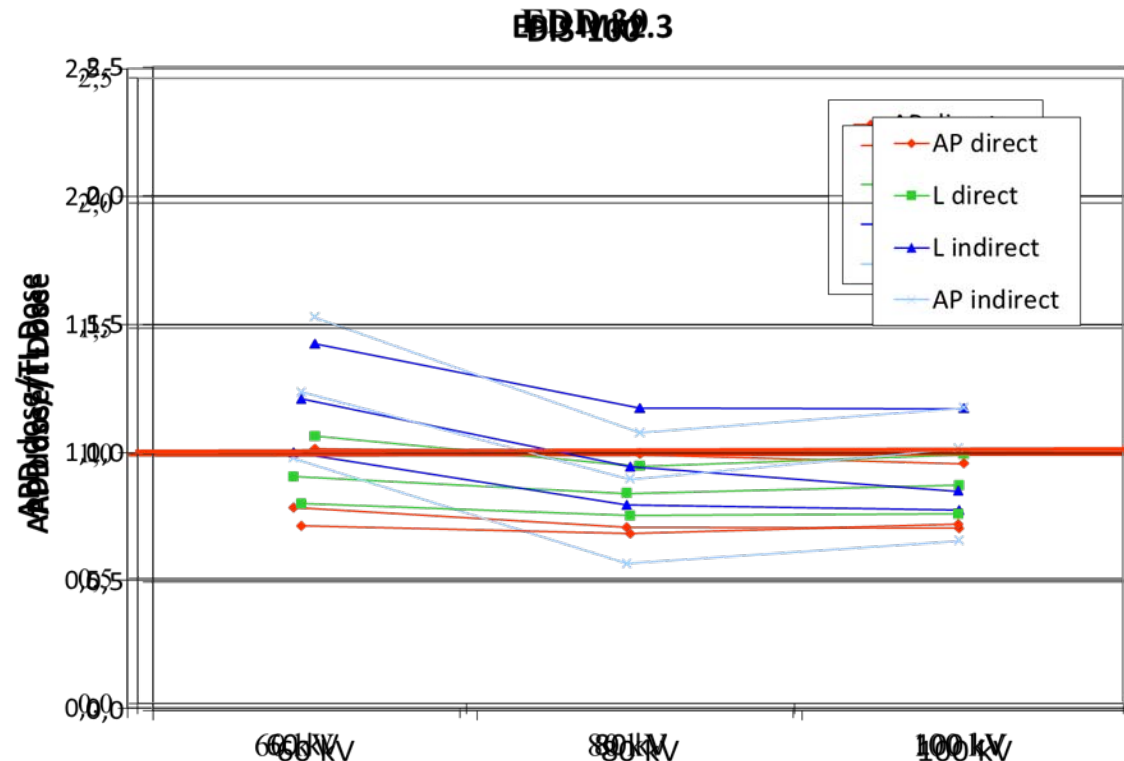
TESTS ON PHANTOMS - RESULTS

2. Influence of kilo-voltage compared to TLD

- 625 mA ; 20 ms ; 1 mm Al + 0.2 mm Cu

tube voltage:
60 kVp
↓
100 kVp

Doserate:
100 mSv/h
↓
1500 mSv/h



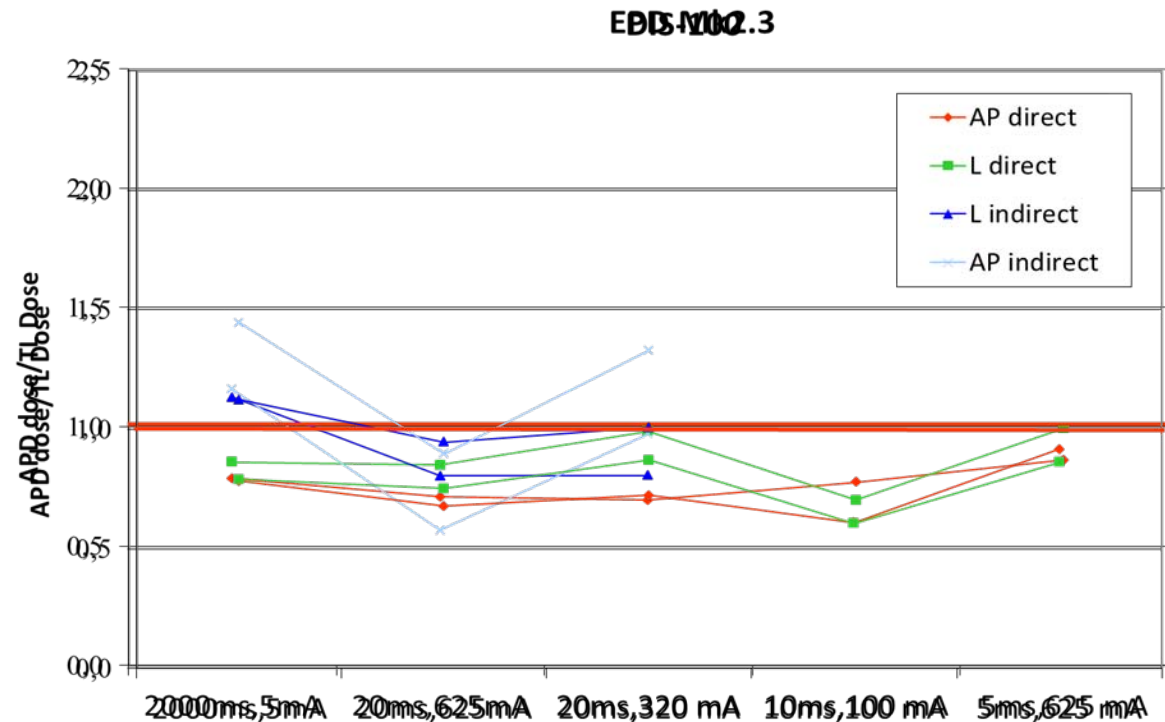
- No important influence of kVp was observed for all APDs (no response for PM1621A)

TESTS ON PHANTOMS - RESULTS

3. Influence of pulse width compared to TLD

- 80 kVp ; 1 mm Al + 0.2 mm Cu
- mA not constant (mA and ms cannot be chosen independently)

pulse width:
5 ms
↓
2000 ms



- No important influence of pulse width was observed for all APDs (no response for PM1621A)
Dose rate: 1-13 mSv/h, 240-1080 mSv/h, 130-375 mSv/h, 100-300 mSv/h, 400-500 mSv/h

TESTS ON PHANTOMS - CONCLUSIONS

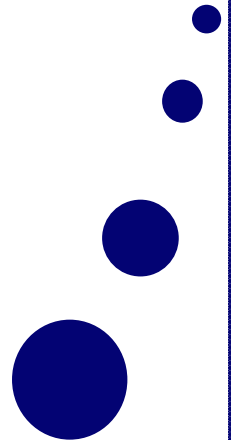
APDs tested in scattered fields (no direct beams)

For several realistic setups with different kVp and pulse width, compared to the TL dosimeter as reference:

- Response of most APDs is roughly within +/- 30%
- EDMIII gives higher responses within +/- 50%
- DMC 2000XB and EDD30: slightly higher than TLD
- EPD Mk2.3 and DIS-100: slightly lower than TLD
- PM1621A did not respond

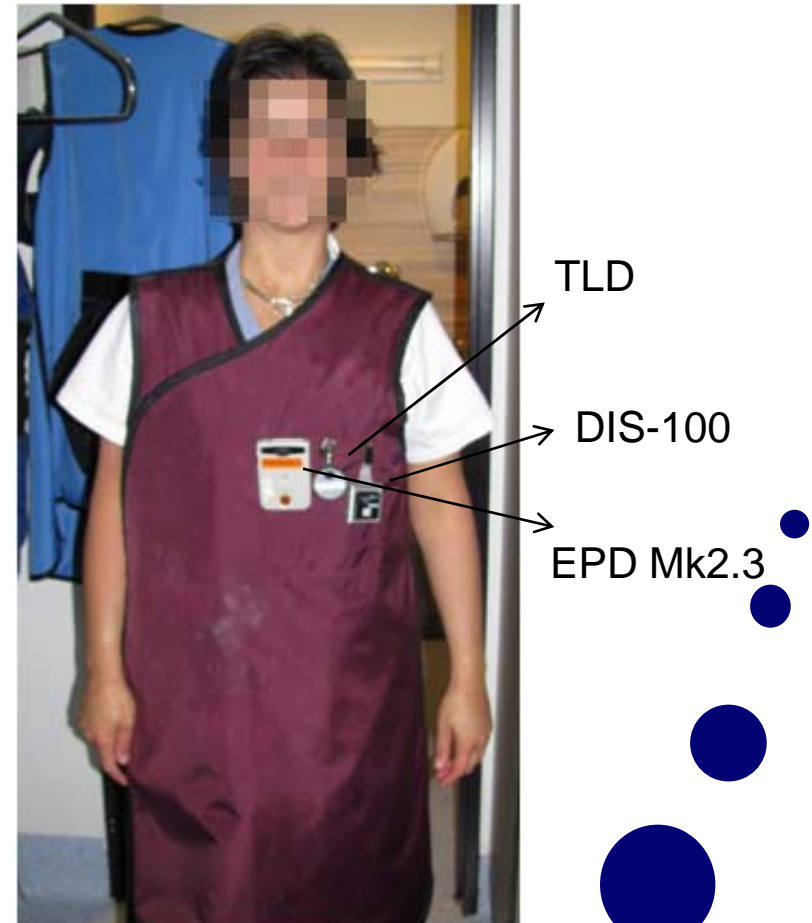
Problems encountered in pulsed mode (lab tests) do not occur

- probably because dose rate $< 1 \text{ Sv.h}^{-1}$



TESTS ON OPERATORS

- Operators wear side by side one or two APD and one additional passive dosimeter **above the lead apron**
- Tests were performed in parallel in different hospitals from different European countries
- At least 300 μSv were integrated by TLD
- The same dosimeters were worn for different IR/IC procedures
Unknown field characteristics



TESTS ON OPERATORS

- APDs tested



**MGPi
DMC2000XB**



**Siemens
EPD Mk2.3**



**Dosilab
EDM III**



**Rados
DIS-100**



**Philips
DoseAware**

- Passive dosimeter: TLDs
 - Dose provided by TLD according to the routine measurement protocol by ORAMED partner (background removed)
- In total 102 measurements were performed in 7 hospitals
 - * DMC2000XB: 45 measurements in 3 hospitals
 - * EDMIII: 14 measurements in 1 hospital
 - * DoseAware: 5 measurements in 1 hospital
 - * EPD Mk2.3: 24 measurements in 2 hospitals
 - * DIS-100: 14 measurements in 2 hospitals

TESTS ON OPERATORS - RESULTS

A distribution of APD response related to passive TL dosemeter

Mean
Hp(10) APD/TLD:

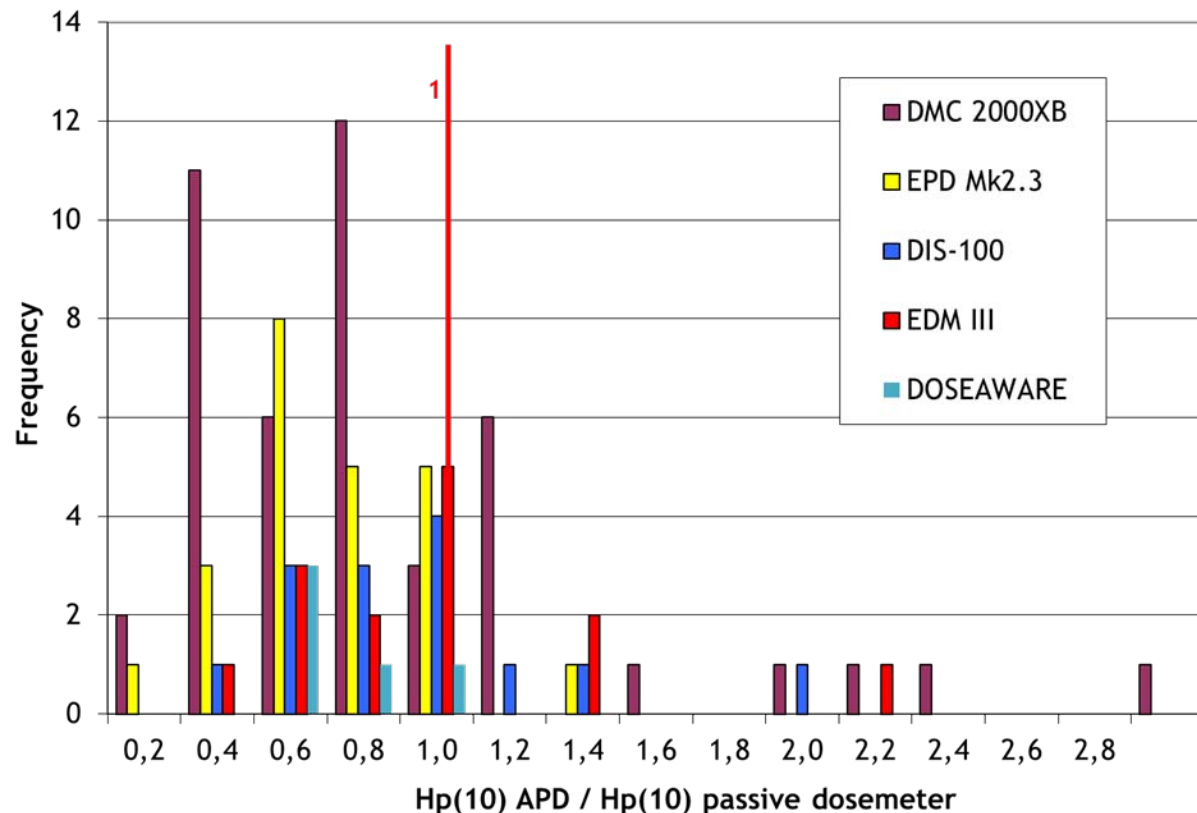
-DMC 2000XB: 0,77

-EPD Mk2.3: 0,77

-DIS-100: 0,86

-EDMIII: 0,88

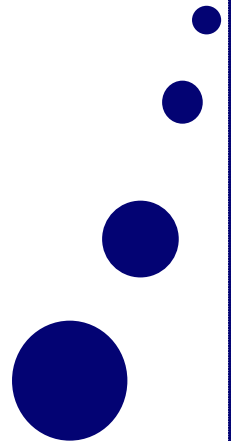
-DoseAware: 0,61



- A large spread in the results
(non-uniform irradiation, shielding of one dosimeter by the other)
- All dosimeters slight under-response compared to passive dosemeter

TESTS IN HOSPITALS - CONCLUSIONS

- The behavior of the APDs in the laboratories for low dose rates were confirmed with tests in real conditions in hospitals
- The behavior of the APDs is even more satisfactory in hospitals than in laboratories (effect of kVp and pulse width)
 - because they are exposed to scattered fields with dose rates $< 1 \text{ Sv}\cdot\text{h}^{-1}$
- 5 APDs were tested in daily routine practice
 - All dosimeters have a slight under-response compared to the passive dosimeter





THANK YOU FOR YOUR ATTENTION

