



## **STAFF EYE LENS AND EXTREMITY EXPOSURE IN INTERVENTIONAL CARDIOLOGY: RESULTS OF THE ORAMED PROJECT**

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## ORAMED WP1 CAMPAIGN

### EXTREMITY AND EYE LENS DOSES IN IC

- ❑ 6 participating countries

- ❑ Belgium, SCK•CEN

- ❑ Greece, GAEC

- ❑ France, IRSN

- ❑ Poland, NIOM

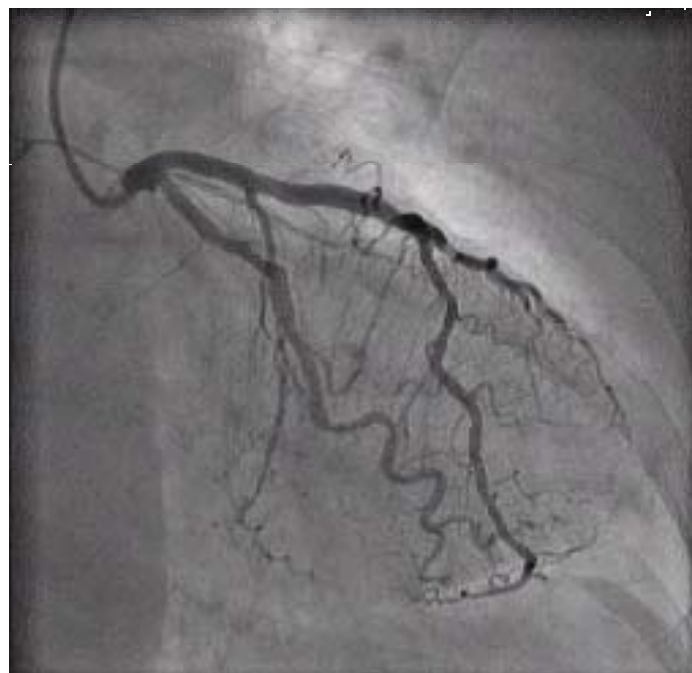
- ❑ Slovakia, SMU

- ❑ Switzerland, CHUV

- ❑ summary: 652 IC procedures

- ❑ measurements were performed in 22 hospitals

- ❑ IC procedures carried out by 146 physicians



## SELECTED IC PROCEDURES

- Cardiac angiographies (CA) and angioplasties (PTCA)

In total, 266 procedures were monitored in 22 hospitals



- Pacemaker and Cardiac Defibrillator implantations (PM/ICD)

In total, 183 procedures were monitored in 14 hospitals



- Radiofrequency ablations (RF)

In total, 191 procedures were monitored in 14 hospitals



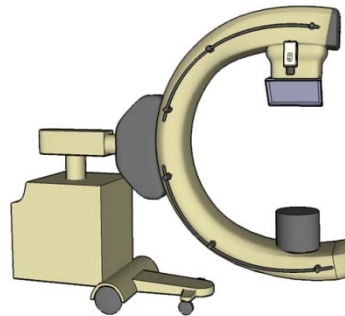
## PARAMETERS THAT WERE USED FOR THE ANALYSIS



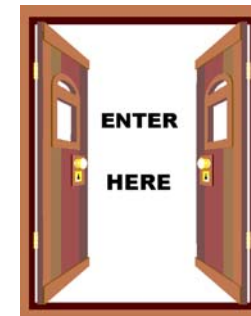
room  
protective  
equipment



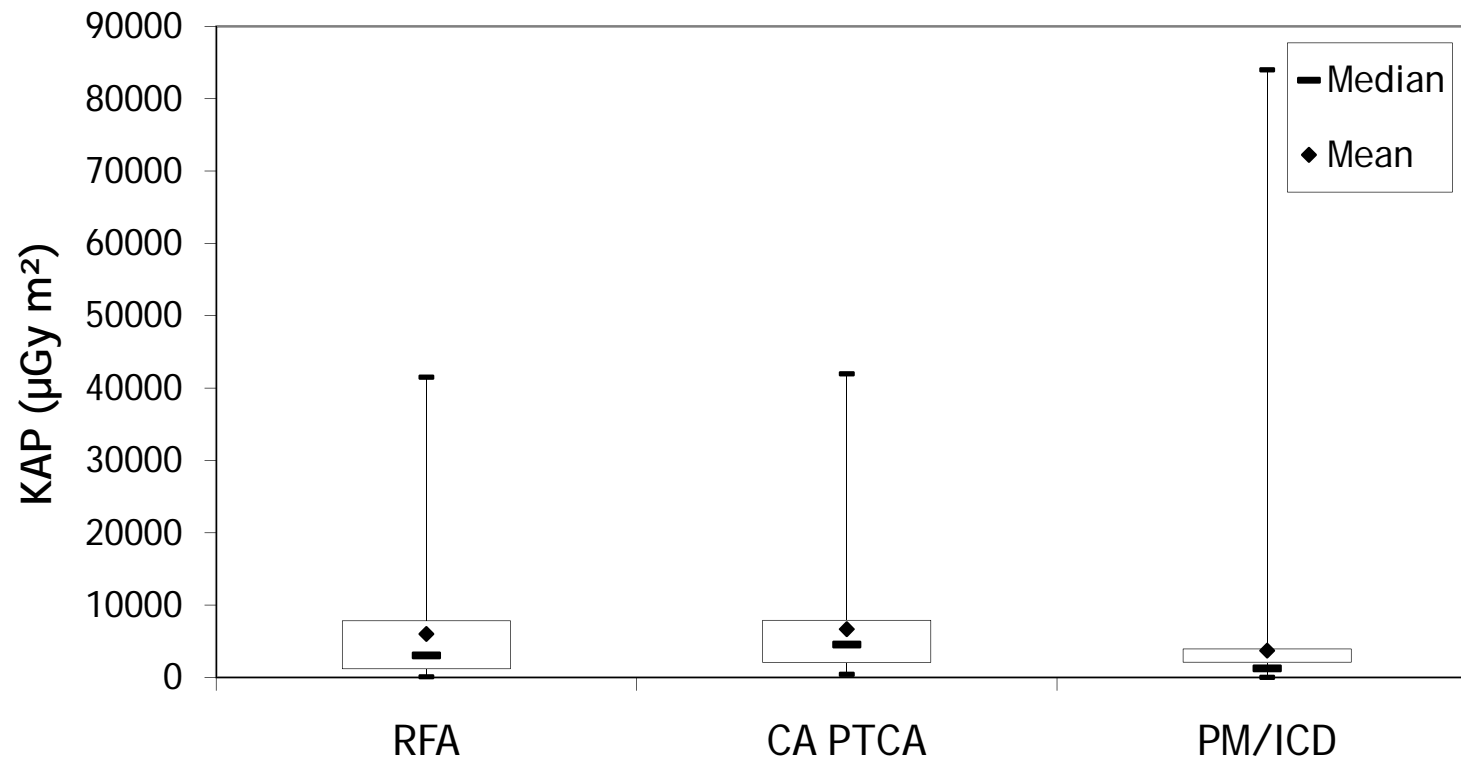
x-ray tube  
configuration  
(below, above or biplane)



access (radial or femoral)



## KAP VALUES FOR MONITORED PROCEDURES



# STATISTICS IN INTERVENTIONAL CARDIOLOGY

## USE OF PERSONAL PROTECTIVE EQUIPMENT



apron+thyroid  
collar+glasses  
+gloves  
2%

apron+thyroid  
collar+cabin  
1%

only  
apron  
9%

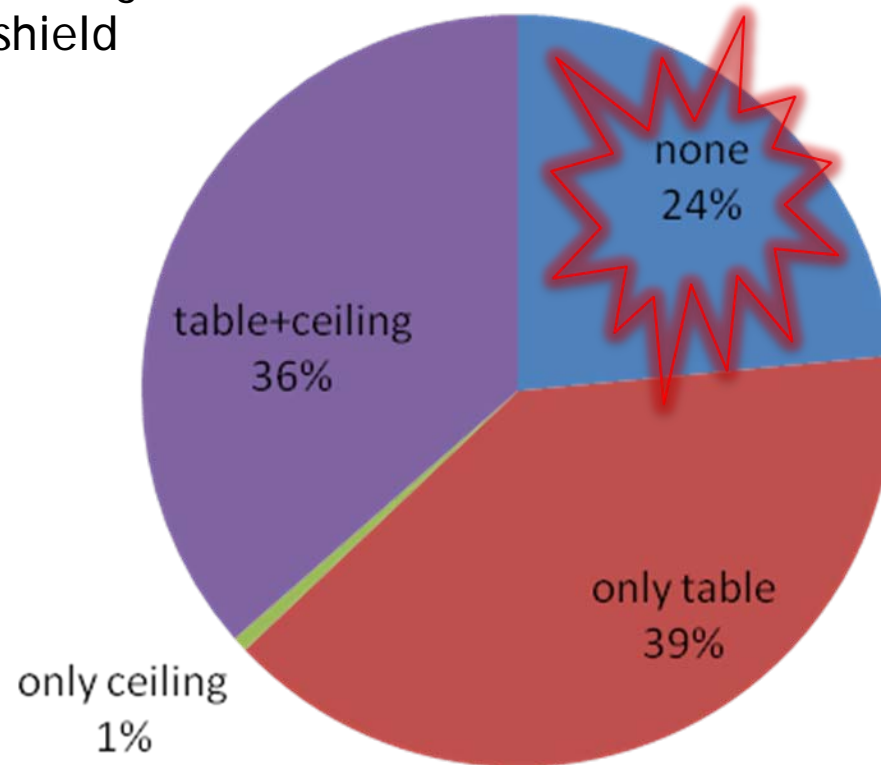
apron+thyroid  
collar+glasses  
34%

apron+thyroid  
collar  
54%

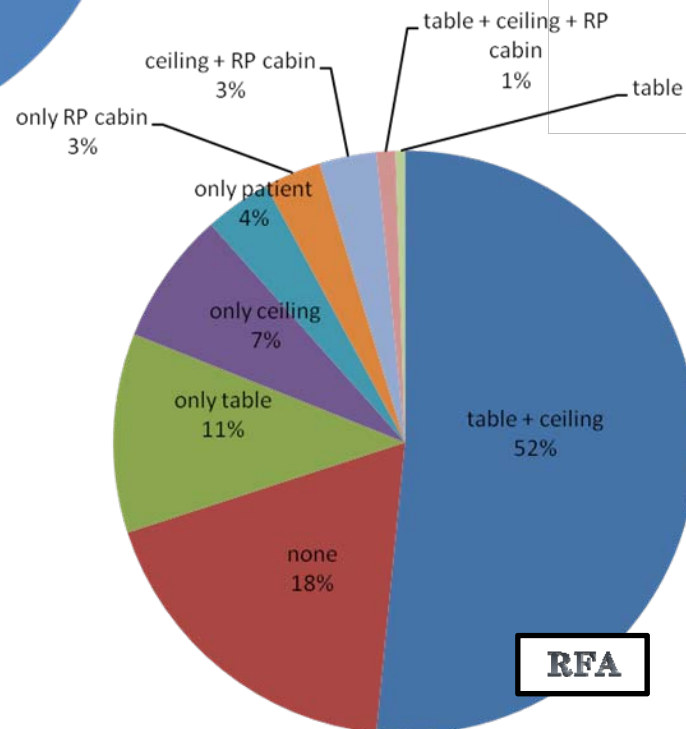
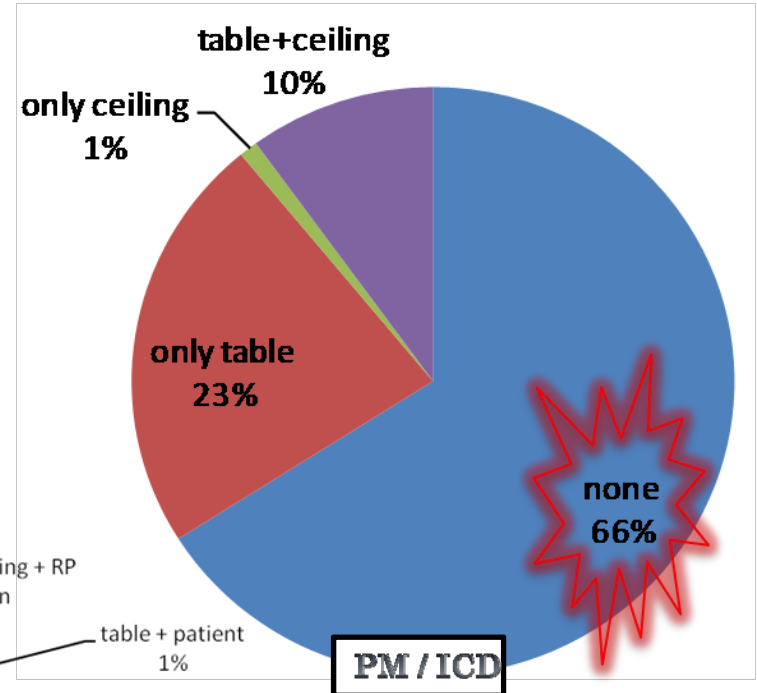
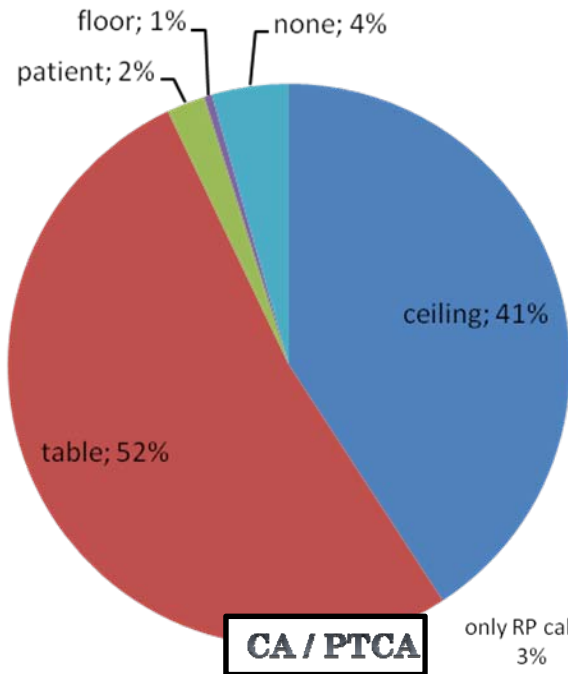
710 cases

# STATISTICS IN INTERVENTIONAL CARDIOLOGY

## USE OF THE ROOM PROTECTIVE EQUIPMENT



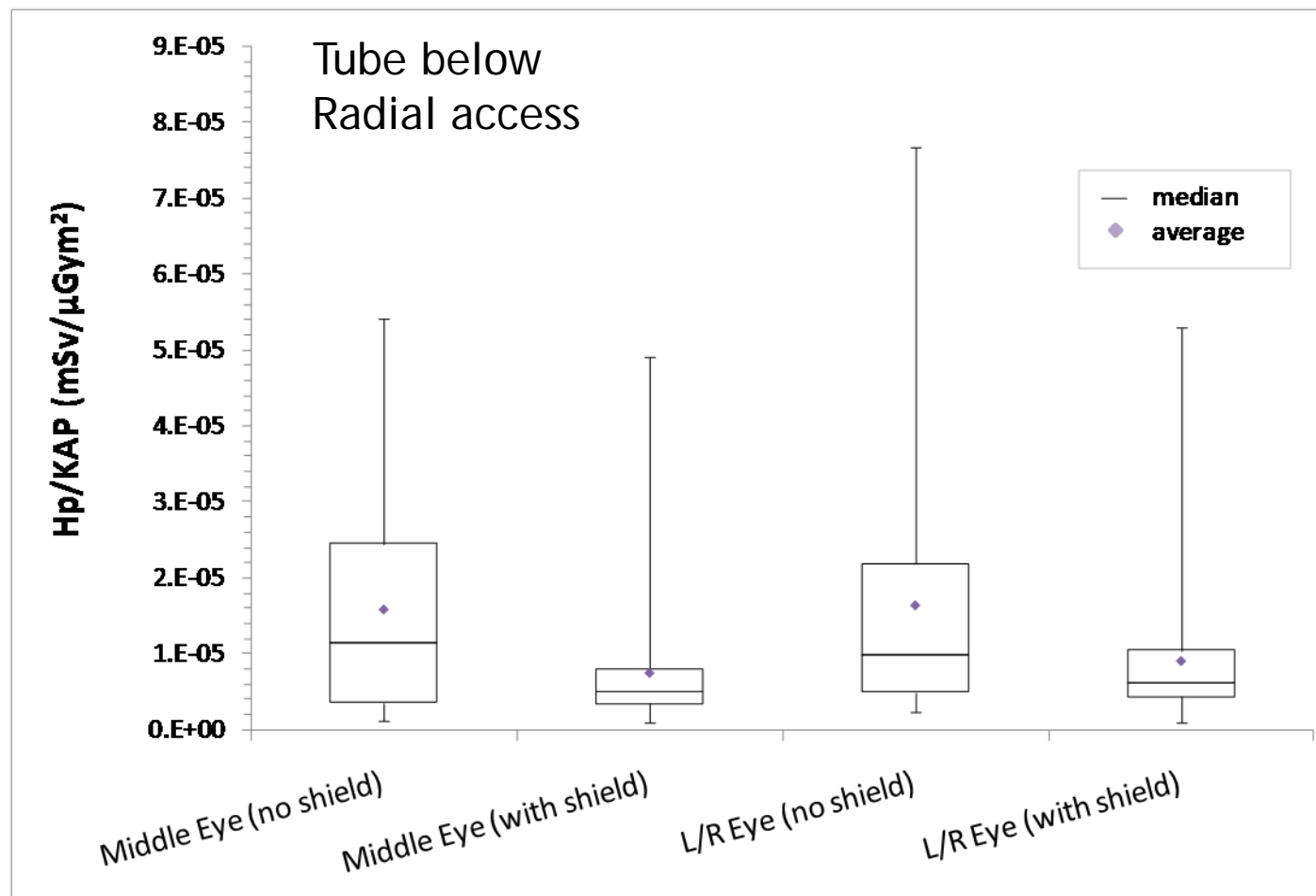
# USE OF ROOM PROTECTIVE EQUIPMENT





# EFFECT OF ROOM PROTECTIVE EQUIPMENT [CA PTCA]

## Effect of ceiling suspended shield on the eyes and hands

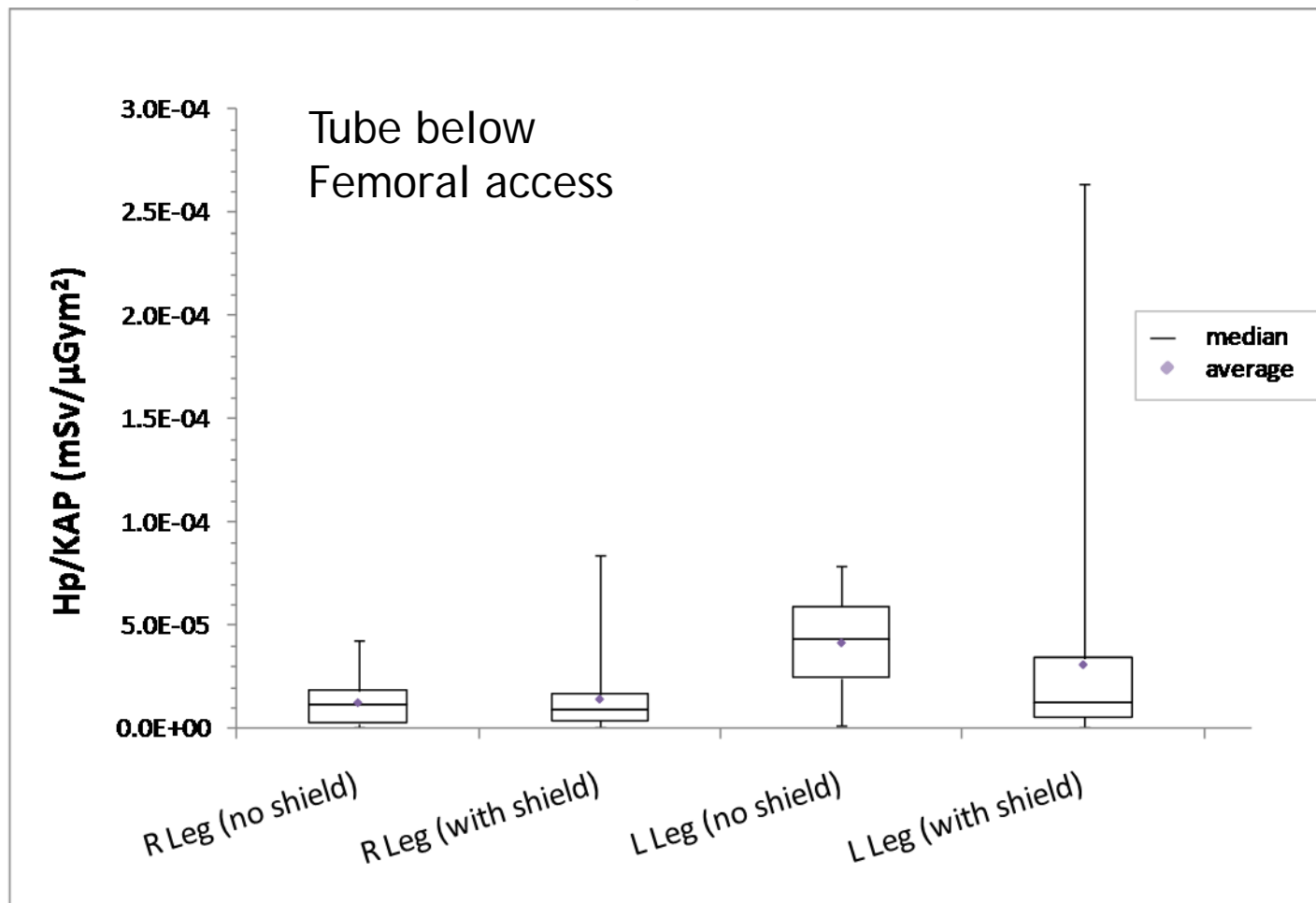


without/with ceiling	
L Eye	M Eye
radial access	
1,6	2,3

without/with ceiling			
L Wrist	R Wrist	L Finger	R Finger
radial access			
1,7	1,3	1,3	1,6

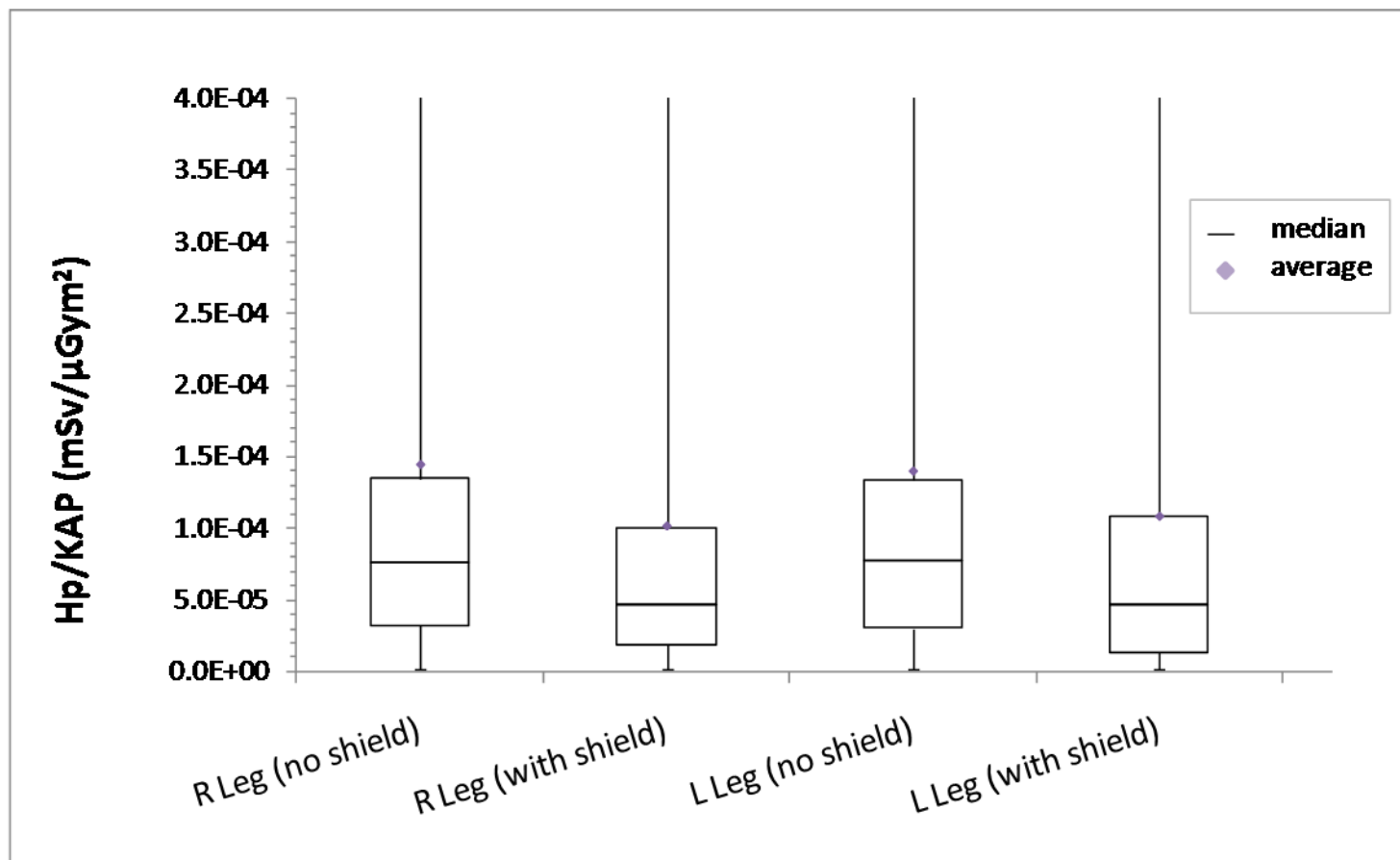
# EFFECT OF ROOM PROTECTIVE EQUIPMENT [CA PTCA]

## Effect of table shield on the legs



# EFFECT OF ROOM PROTECTIVE EQUIPMENT [PM/ICD]

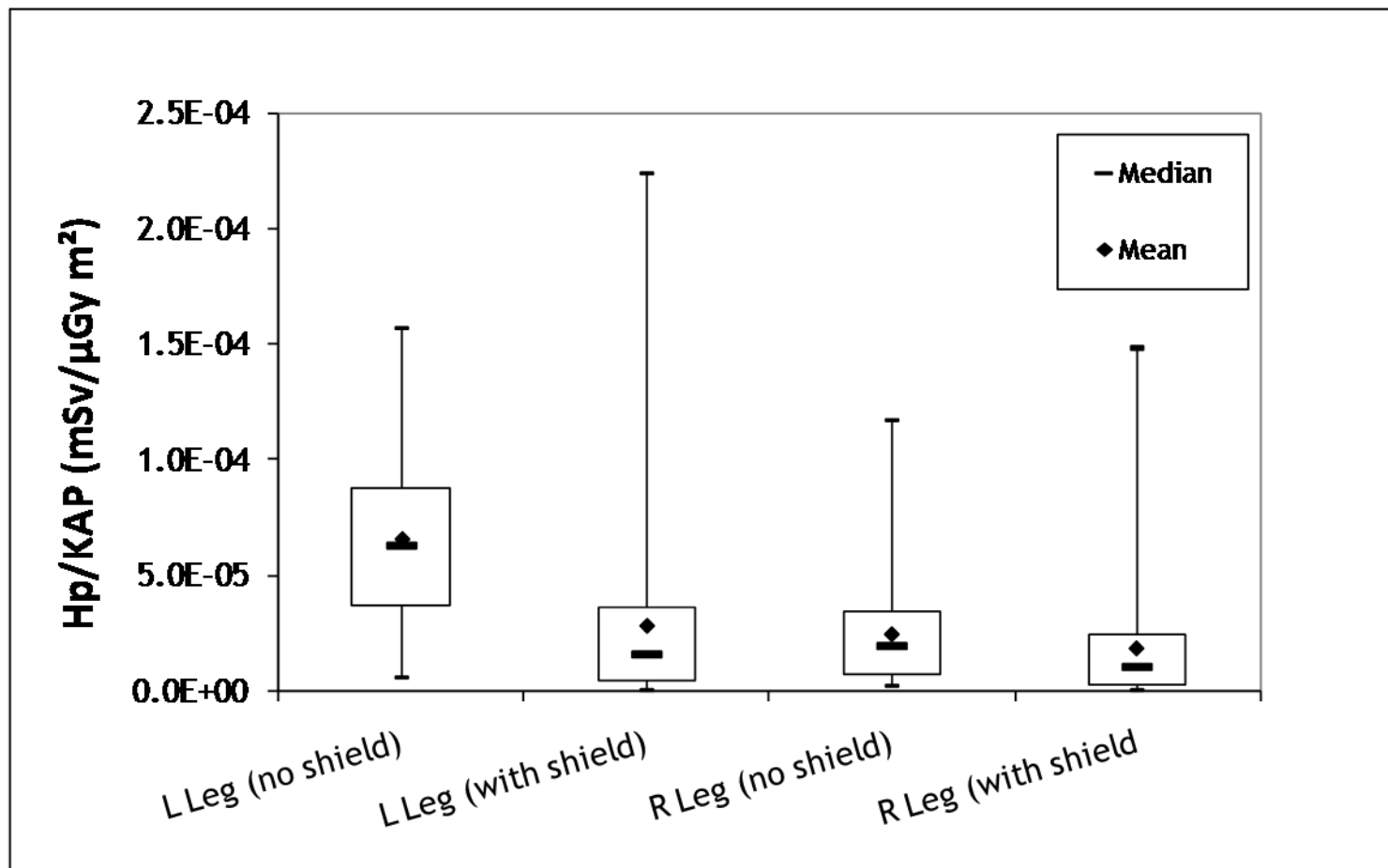
## Effect of table shield on the legs



without/with table shield	
L Leg	R Leg
1,6	1,4

# EFFECT OF ROOM PROTECTIVE EQUIPMENT [RF ABLATION]

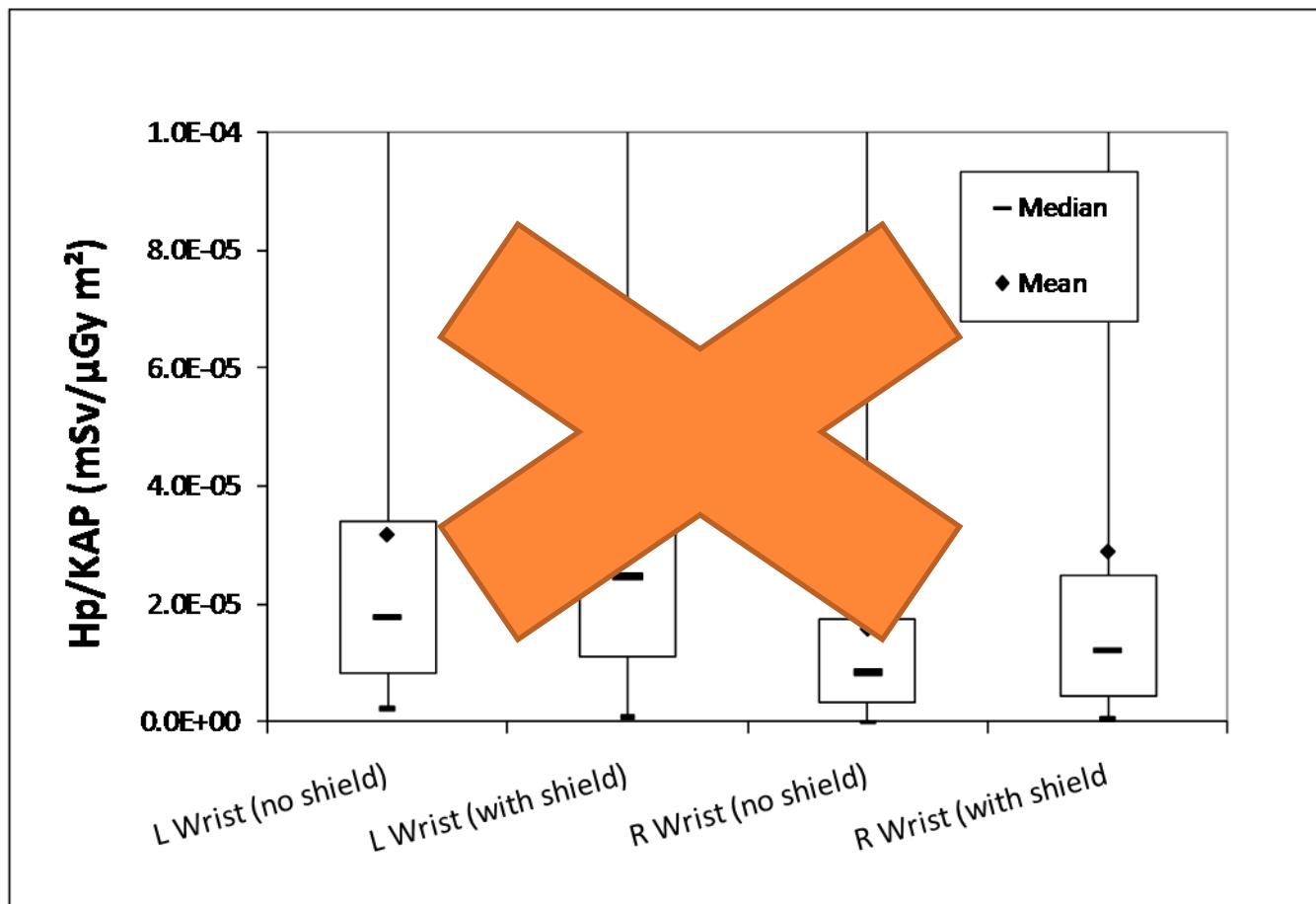
## Effect of table shield on the legs



without/with table shield	
L Leg	R Leg
3.8	1,6

# EFFECT OF ROOM PROTECTIVE EQUIPMENT [RF ABLATION]

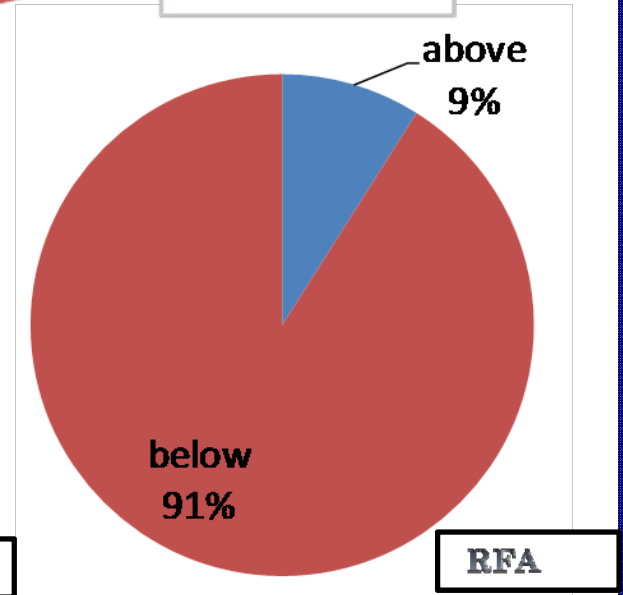
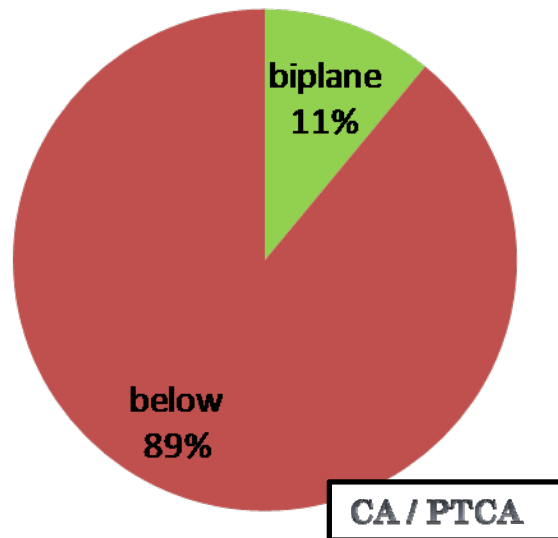
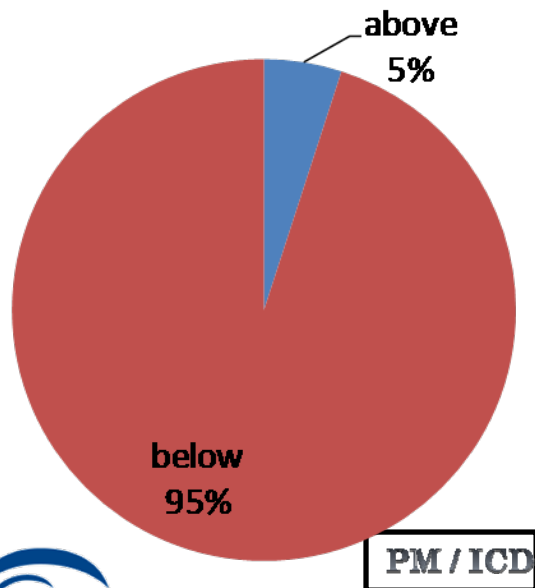
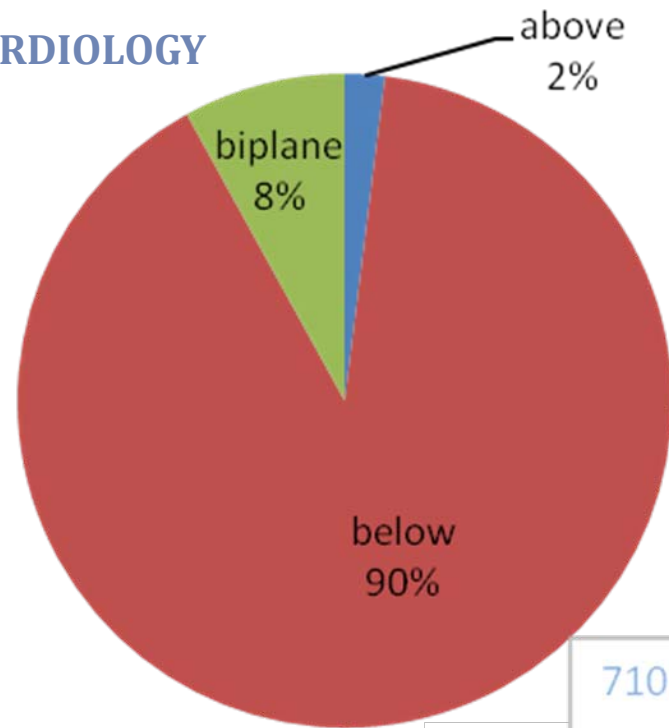
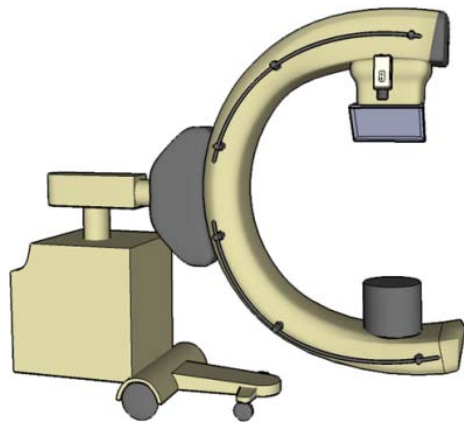
## Effect of ceiling suspended shield on the eyes and hands



without/with ceiling					
L Eye	M Eye	L Wrist	R Wrist	L Finger	R Finger
0,6	0,6	0,8	0,7	0,9	0,8

# STATISTICS IN INTERVENTIONAL CARDIOLOGY

## TUBE CONFIGURATION

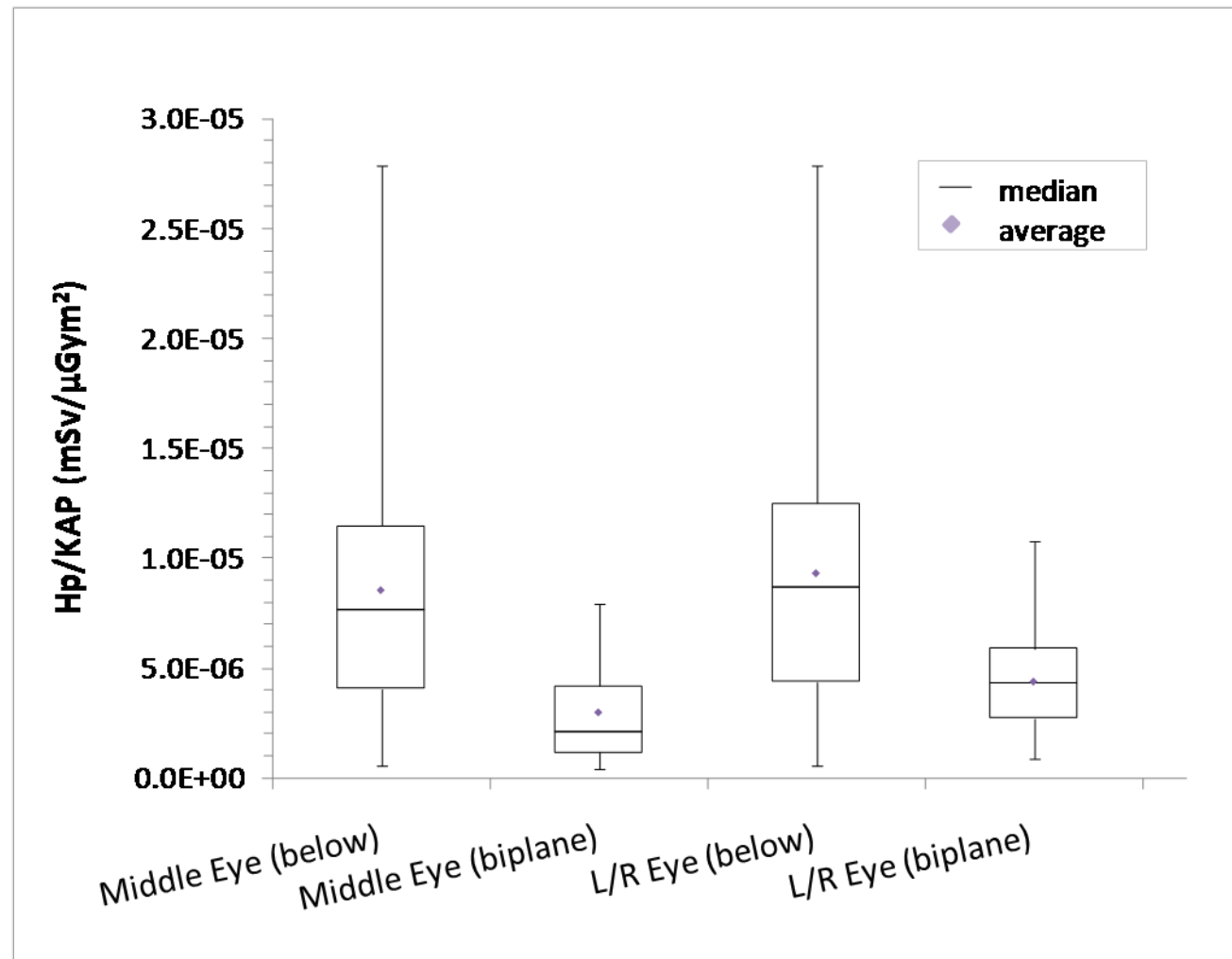


## EFFECT OF TUBE CONFIGURATION [CA PTCA]

**Below**  $\longleftrightarrow$  **Biplane**

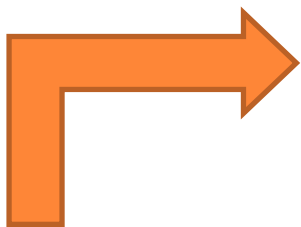
- Hands, legs : no effect
- Eyes: Tube below higher doses than biplane

The image intensifier of the other tube could provide extra shielding to the eyes



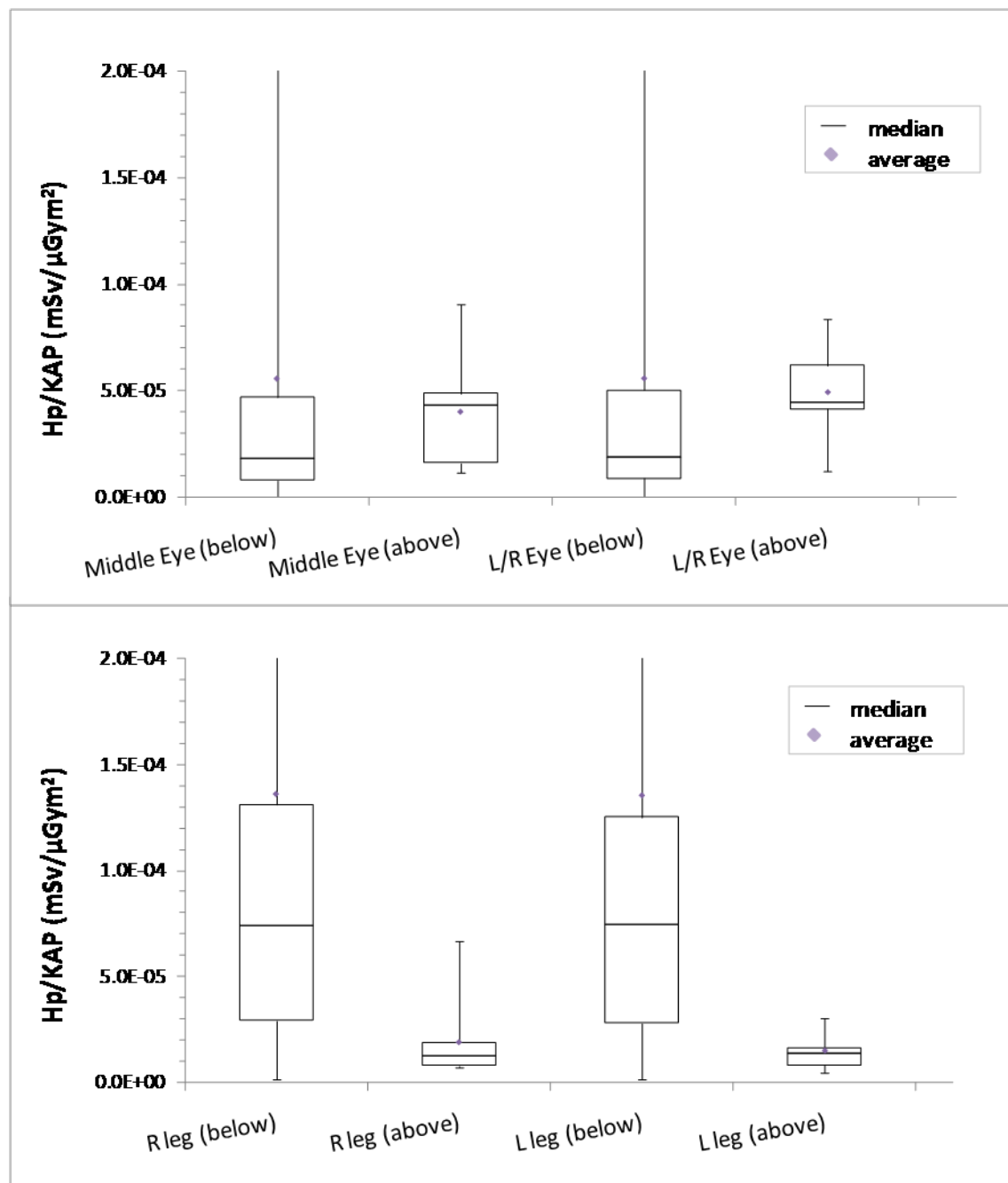
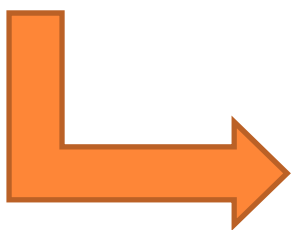
# EFFECT OF TUBE CONFIGURATION [PM/ICD]

## Effect of ceiling suspended shield on the eyes and legs



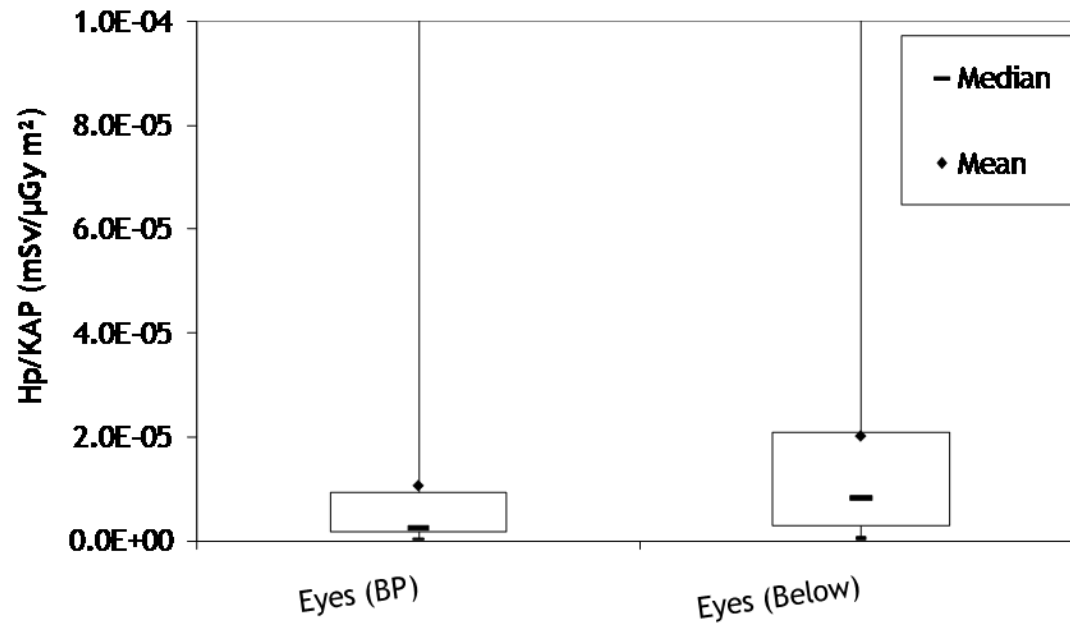
As expected the eye doses are higher when the tube is above the operating table...

while for the legs the situation is the opposite



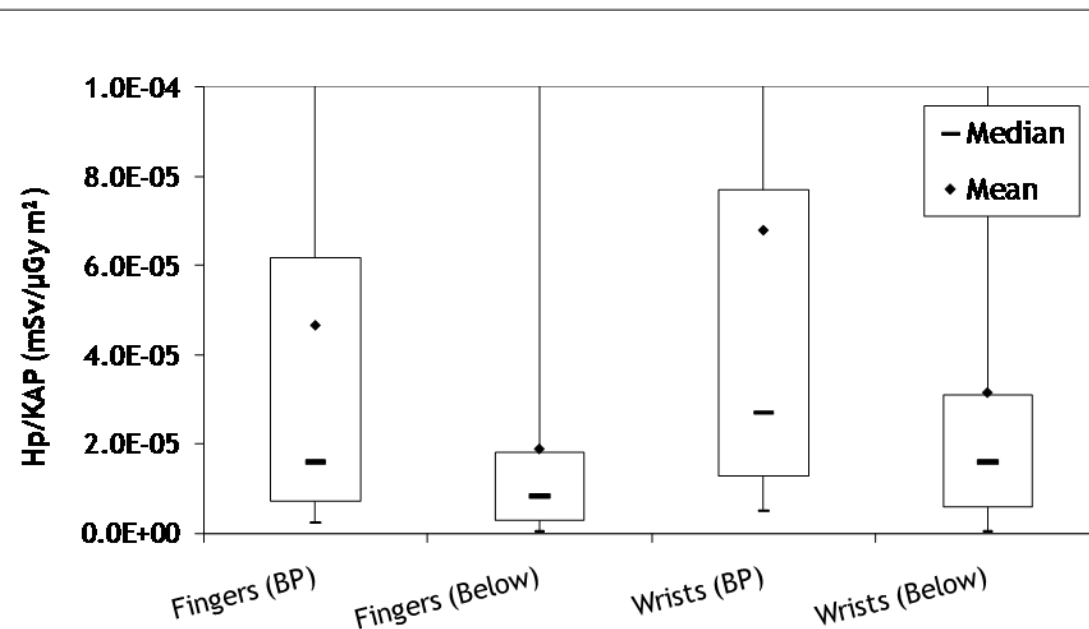


## EFFECT OF TUBE CONFIGURATION [RF ABLATION]



% reduction	
	Legs
median	329%
Ratio (BP/Below)	
median	0.30

reduction comparable  
to CA PTCA

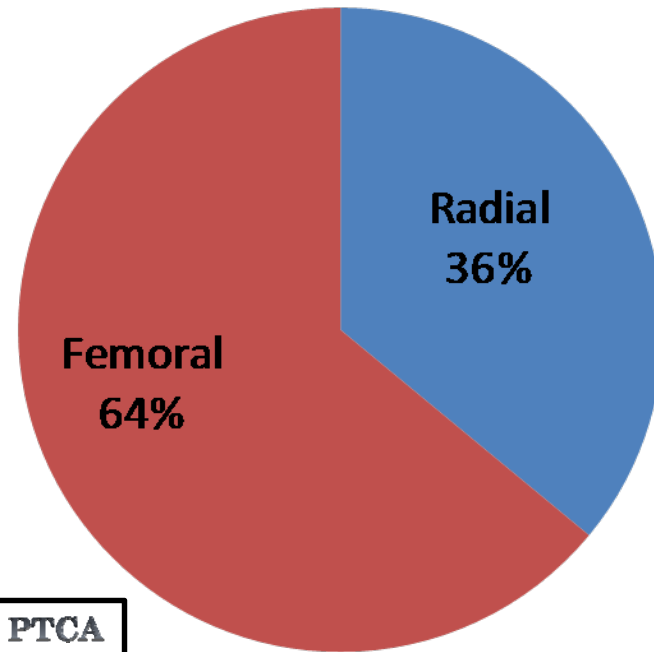


% reduction		
	Fingers	Wrists
median	53%	59%
Ratio (BP/Below)		
median	1.90	1.70

## STATISTICS IN INTERVENTIONAL CARDIOLOGY WITH THE USE OF ACCESS

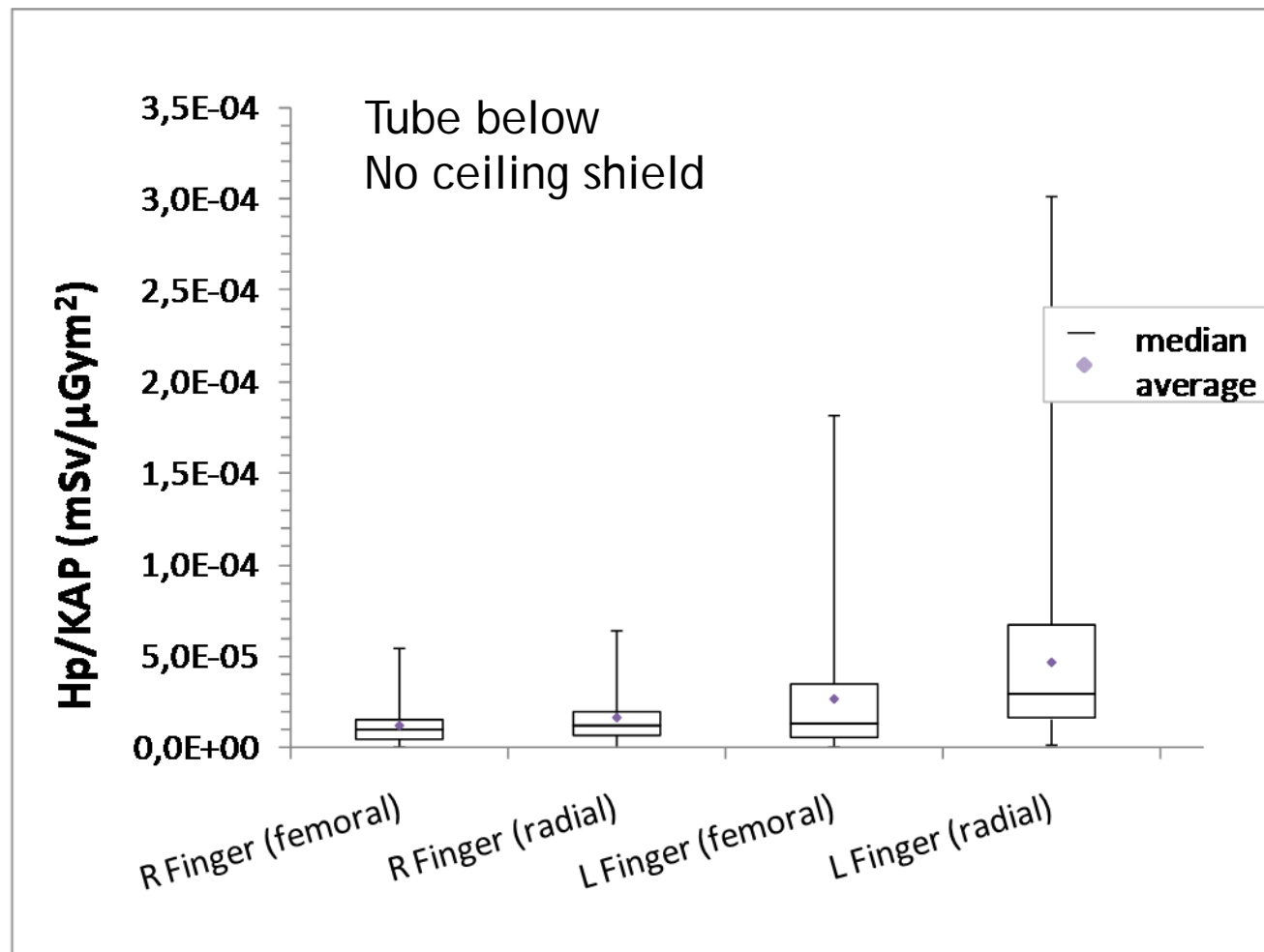


PM/ICD: shoulder  
RF Ablations: femoral



CA / PTCA

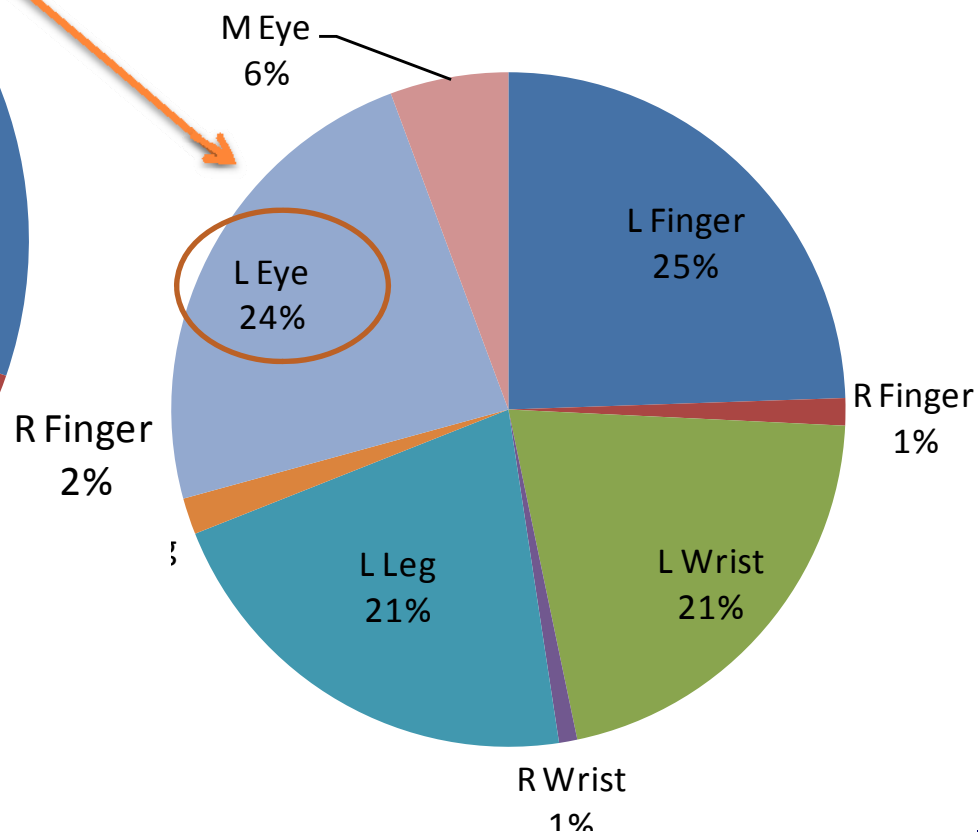
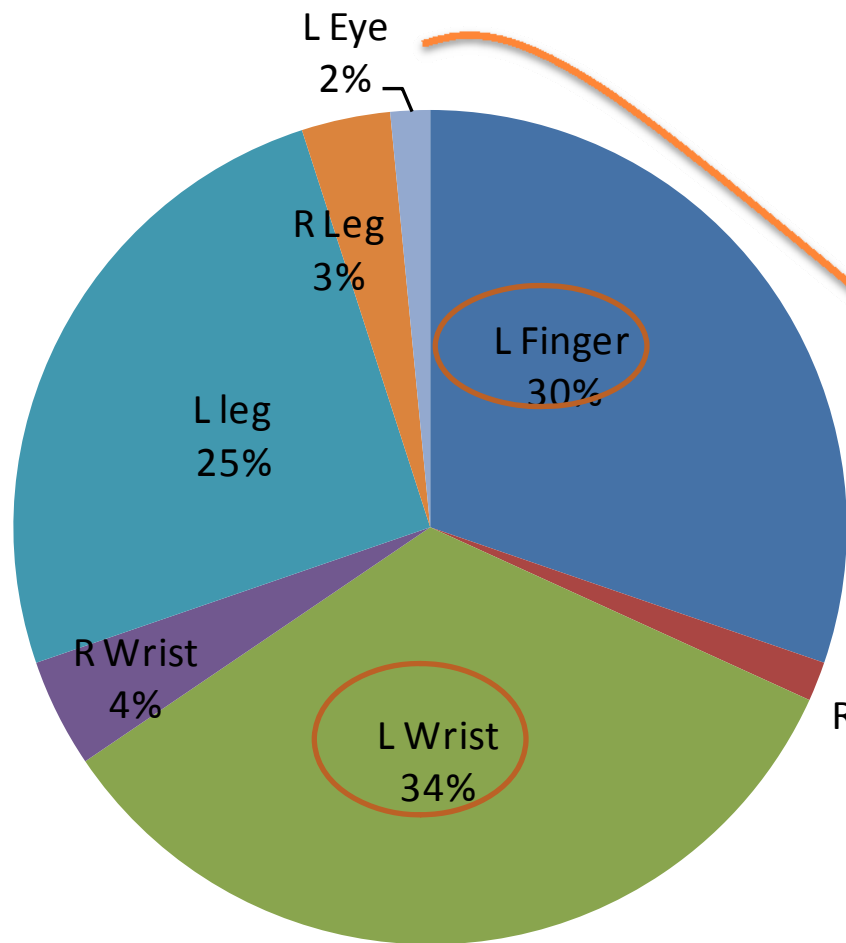
# EFFECT OF ACCESS OF THE CATHETER [CA PTCA]



radial/femoral					
L Eye	M Eye	L Wrist	R Wrist	L Finger	R Finger
1,2	2	2,4	2,8	4,8	2,6

# CA / PTCA

## LOCATION OF THE MAXIMUM



Location of maximum dose using  
annual dose limits

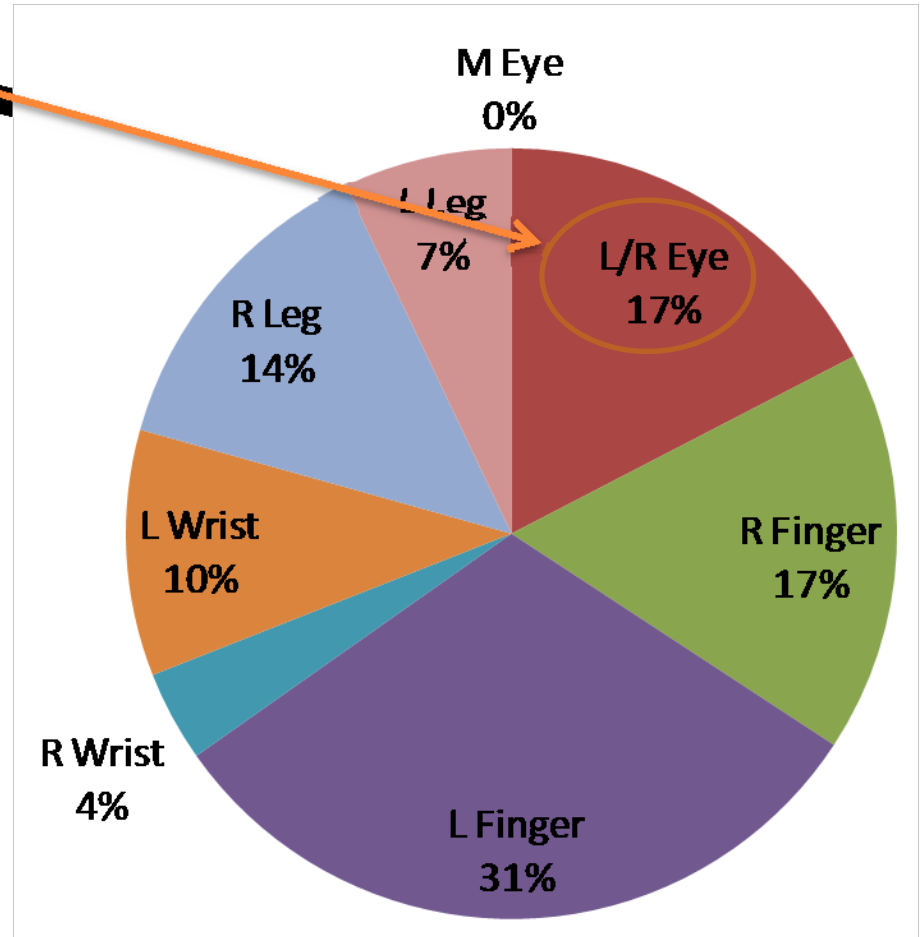
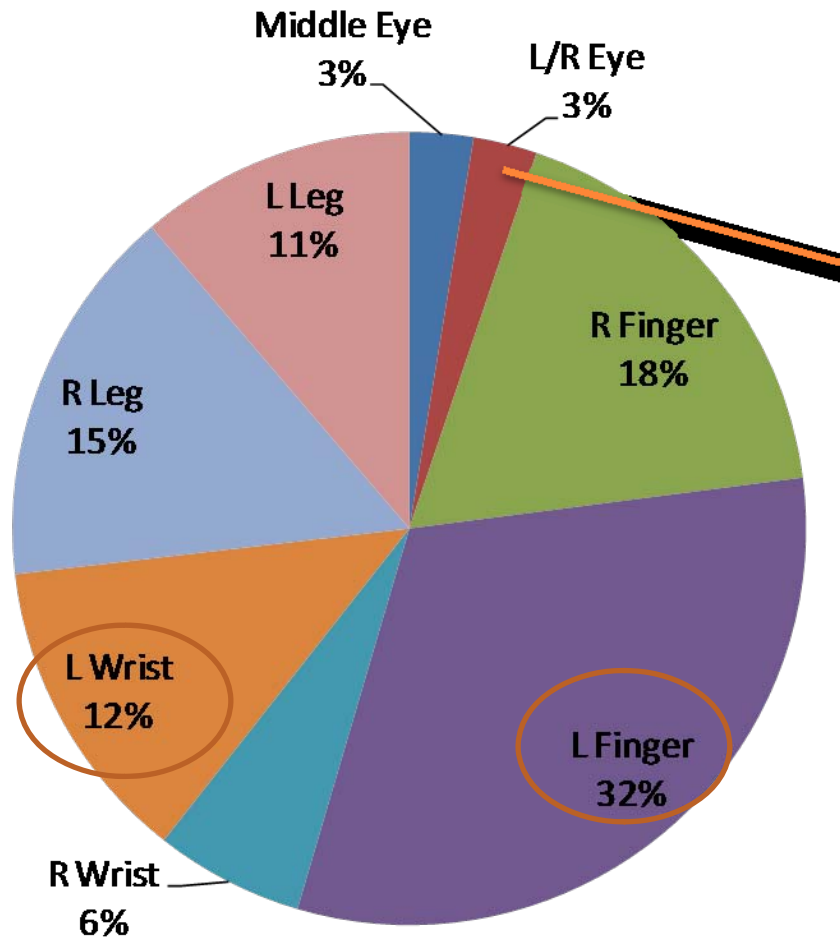
# CA / PTCA

## MAXIMUM DOSES

	L Finger	R Finger	L Wrist	R Wrist	L Leg	R Leg	L Eye	Middle Eye
Hp(0.07) [mSv]	5.0	0.5	1.8	0.6	1.6	1.2	0.8	0.6
type	CA & PTCA	CA	PTCA	CA	CA & PTCA	PTCA	CA & PTCA	
experience	low	low	high	high	low	high	high	
tube	below	below	biplane	biplane	biplane	biplane	below	
access	femoral	radial	femoral	femoral	femoral	femoral	radial	
protective equipment	table, patient	table, ceiling	table	table ceiling	table, ceiling	table, ceiling	table	
KAP [μGym <sup>2</sup> ]	23597	19881	40458	38409	6827	-	19152	

# PM / ICD

## LOCATION OF THE MAXIMUM



**Position of the maximum dose/annual dose  
limit in Pacemaker procedur**

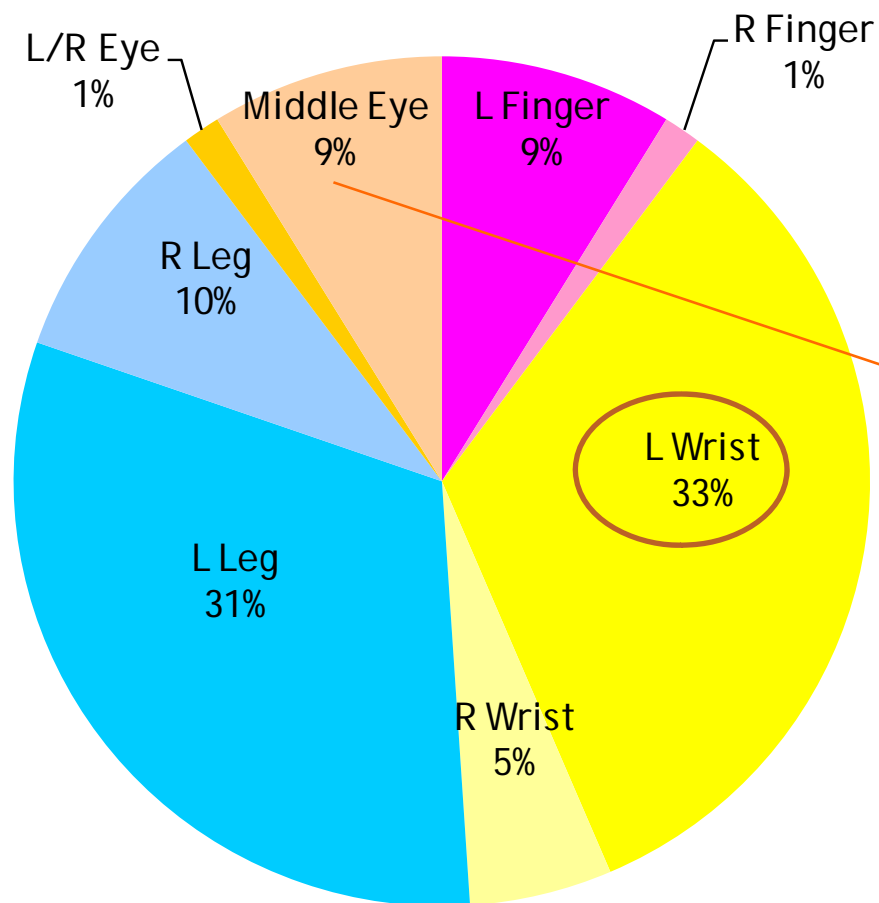
# PM / ICD

## MAXIMUM DOSES

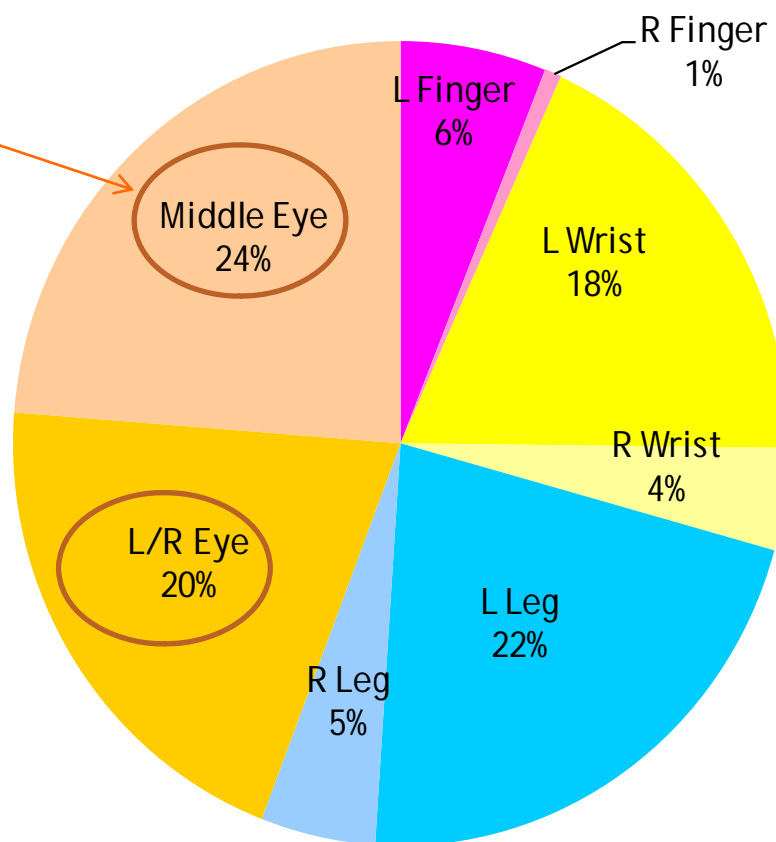
	L Finger	R Finger	L Wrist	R Wrist	L Leg	R Leg	L/R Eye	Middle Eye
<b>Maximum Dose (mSv)</b>	6.54	4.33	4.82	3.83	7.82	5.00	1.08	0.81
Protective equipment	none	none	none	none	none	none	none	
Tube configuration	below	below	below	below	below	below	below	
<b>Comments</b>		Hands in beam		Hands in beam				

# RF ABLATION

## POSITION OF THE MAXIMUM



Position of the maximum dose when the annual limit is taken into account





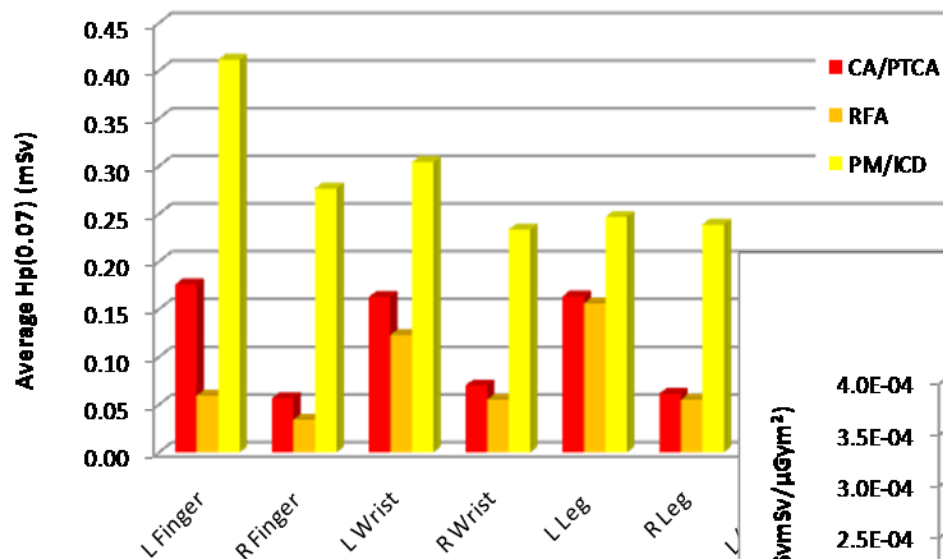
# RF ABLATION

## MAXIMUM DOSES

	L Finger	R Finger	L Wrist	R Wrist	L Leg	R Leg	L/R Eye	Middle Eye
$H_p(0.07)$ [mSv]	0.90	0.45	1.84	0.53	1.82	0.78	0.88	0.63
Protection	table + ceiling	table	table + ceiling	none	ceiling	patient	table	
Tube	biplane	below	biplane	below	below	below	below	
Total KAP ( $\mu\text{Gy.m}^2$ )	25400	16300	25400	5394	20400	24900	16300	

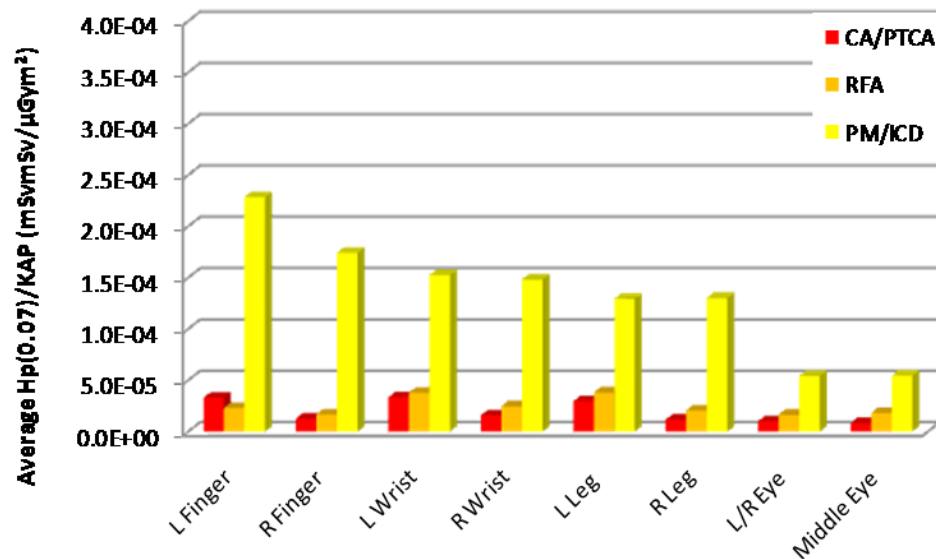
# SUMMARY OF IC PROCEDURES

IC procedures



← Average Hp(0,07)

IC procedures



Average Hp(0,07)/KAP →

## CONCLUSIONS

### Protective equipment

- Table shield, when used properly, can reduce the leg doses up to 4 times
- For CA and PTCA procedures and radial access there is a reduction of the eye doses up to 50%

### Tube configuration

- When the tube is above of the operating table the doses at the eyes are higher 3 times compared to the ones that the tube is below
- For biplane systems lower doses for the eyes are observed than in the cases where the tube is below the table due to the extra shielding of the image intensifier of the lateral tube. The opposite effect is observed for the hands.

### Access

- The doses to the eyes, wrists and fingers are lower (1.2 to 4.8 times) for the femoral access compared to the radial one

**Thank you  
for your attention!**