

KAP and MSD variation in interventional cardiology

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IC procedures

- Few words on basics

KAP

- DRLs in Finland and measured EU KAP
- Dose variation and ideas what to do about it
- ICRP

Data science

- Data mining for procedure difficulty levels

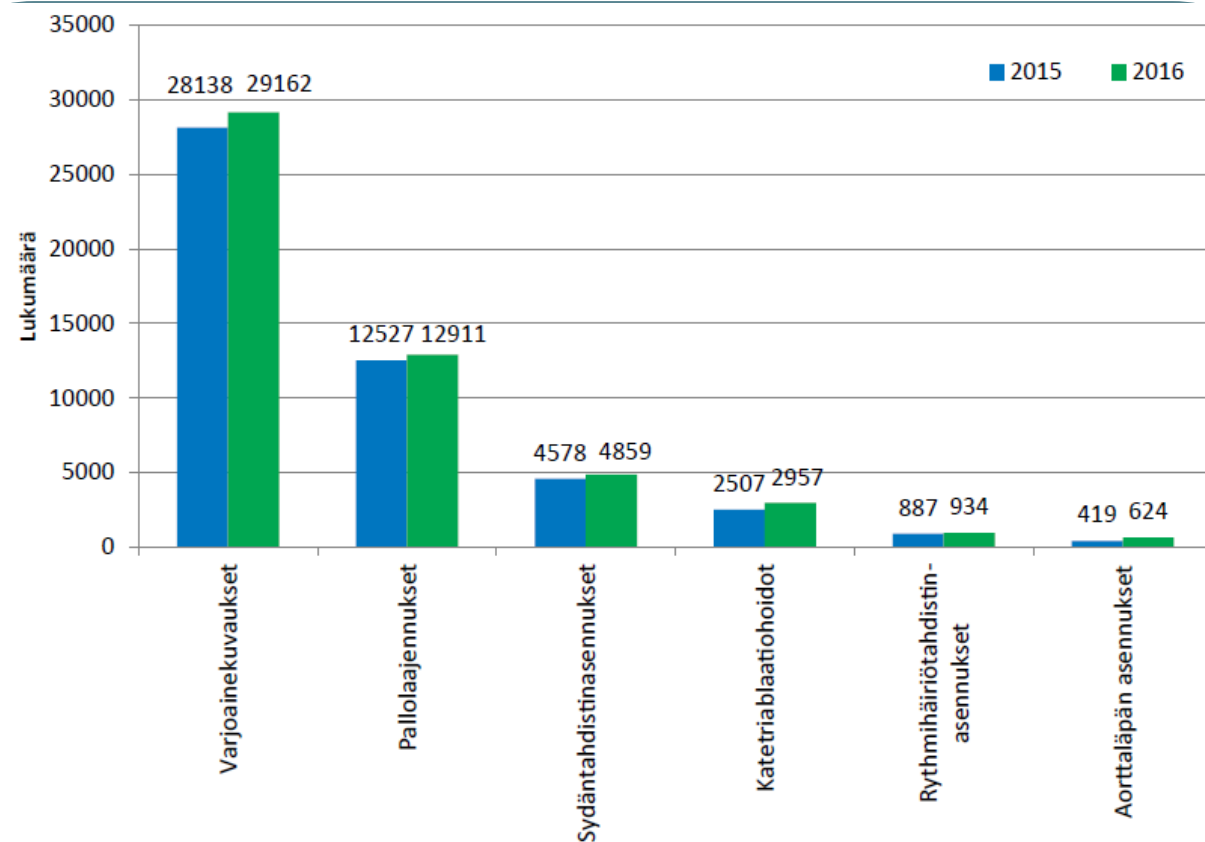
Skin doses

- Gafchromic film MSDs and erythema risks in Finland
- Alert Levels
- Dose variation

Skin dose algorithms

- Skin dose estimation software and their accuracy

- Team work between cardiologist and 2-3 nurses
- Patient is imaged during a procedure from various projections with fluoroscopy and often also cine
- Many clinical practices affect the often instantaneous choices on how and when to obtain necessary diagnostic information



Typical Finnish exposures

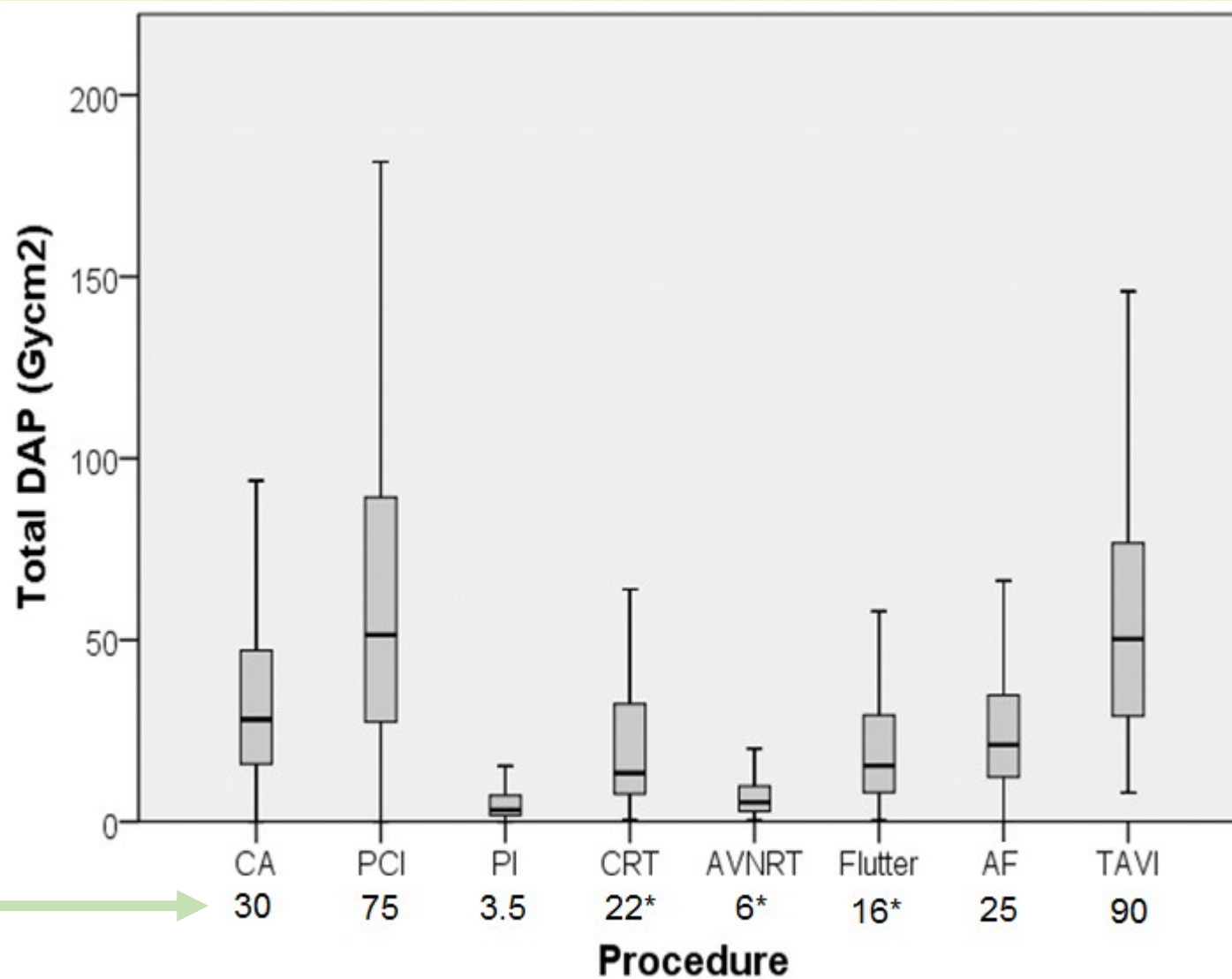
Tyypillisiä suurimpia syväannoksia vuodessa, mSv

| Työntekijäryhmä | $H_p(10)$ |
|-----------------|-----------|
| Kardiologi | 20 |
| Hoitaja | 4 |

Efektiiäinen annos saadaan jakamalla syväannos tekijällä 50–100.

Most Dose-heavy procedures in Finland

Finnish DRLs

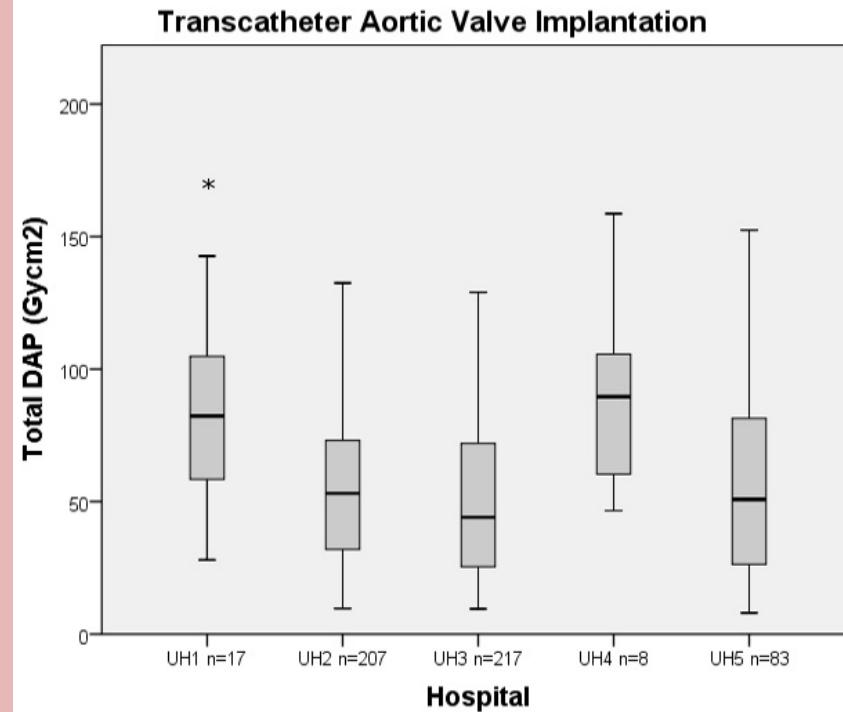
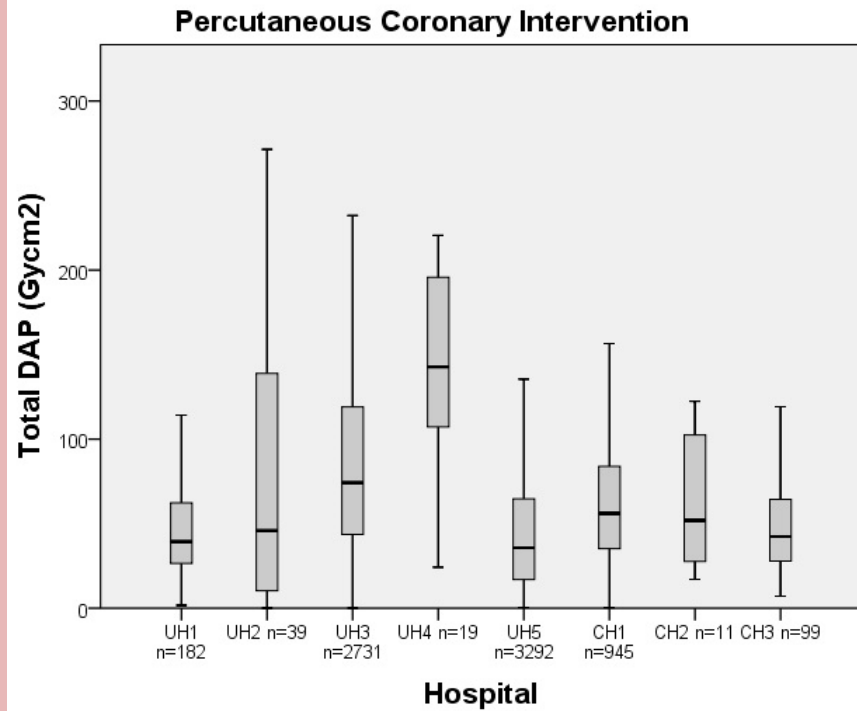


And the same in the EU level

The median total P_{KA} values (in Gy cm²) for each procedure and each country. The last two columns are the 3rd quartiles (without and with weight restriction) of the data on each row. The median P_{KA} values that are based on less than five data points are given in parentheses. DRL was calculated from medians with at least five data points. *Includes ablation. The 3rd quartiles in parenthesis are calculated without this values.

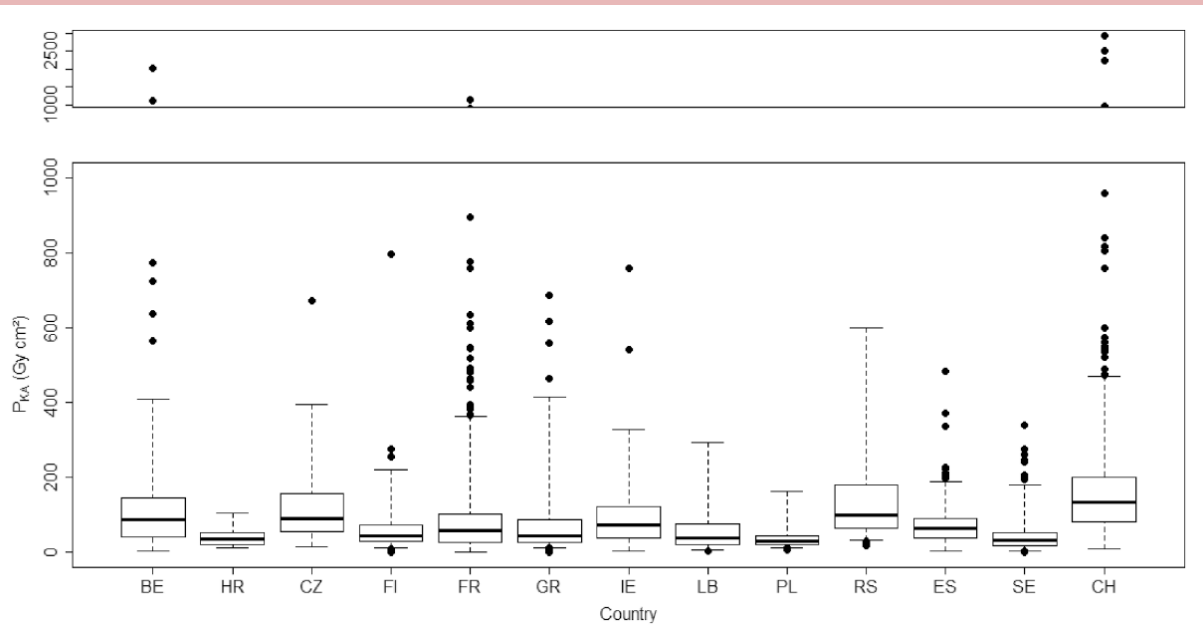
| Procedure | BE | HR | CZ | FI | FR | GR | IR | LB | PL | RS | ES | SE | CH | 3rd quartile | 3rd quartile (restr) |
|-----------|---------|--------|------|------|------|------|--------|--------|------|------|------|------|------|--------------|----------------------|
| CA | 35.6 | | 35.5 | 21.2 | 22.0 | - | 35.3 | 12.8 | 14.1 | 42.2 | 34.2 | 17.5 | 65.7 | 85.5 | 36.8 |
| PCI | 87.3 | 35.9 | 89.8 | 45.7 | 57.6 | 44.5 | 73.0 | 37.7 | 28.5 | 98.1 | 63.4 | 31.7 | 135 | 87.3 | 68 |
| CTO | - | - | - | - | 120 | - | (271) | - | - | - | - | 143 | - | 137 | - |
| TAVI | (305.4) | (55.4) | 130 | 89.4 | 134 | 193 | 87.1 | 99.2 | - | - | 25.9 | 87.2 | 96.8 | 130 | 140 |
| PI SCH | - | - | 2.18 | 1.86 | - | 5.60 | 2.63 | 2.40 | - | 2.97 | - | 1.43 | - | 2.80 | 3.8 |
| PI DCH | - | - | 2.28 | 3.20 | - | (25) | 2.53 | 3.84 | - | 5.16 | - | 0.86 | - | 3.65 | 4.23 |
| PI CRT | - | - | 18.4 | 31.4 | 14 | 6.63 | 15.8 | 4.96 | - | 19.2 | 5.82 | 4.13 | - | 18.4 | 20.8 |
| EF AVNRT | - | - | 0.97 | 3.67 | - | - | (2.26) | - | - | - | - | 2.73 | - | 3.2 | 4.75 |
| EF FL | - | - | 0.96 | 14.5 | - | - | - | - | - | - | - | 6.58 | - | 10.5 | - |
| EF AF | - | - | 2.51 | 29.2 | - | - | 4.84 | - | - | - | - | 8.41 | - | 13.6 | 16.0 |
| EF ALL | - | - | 1.09 | 14.5 | 3.5 | 5.28 | 3.5 | 109.1* | - | - | 13.7 | 6.53 | - | 14.1 (11.9) | (13.5) |

Dose variation in Finland

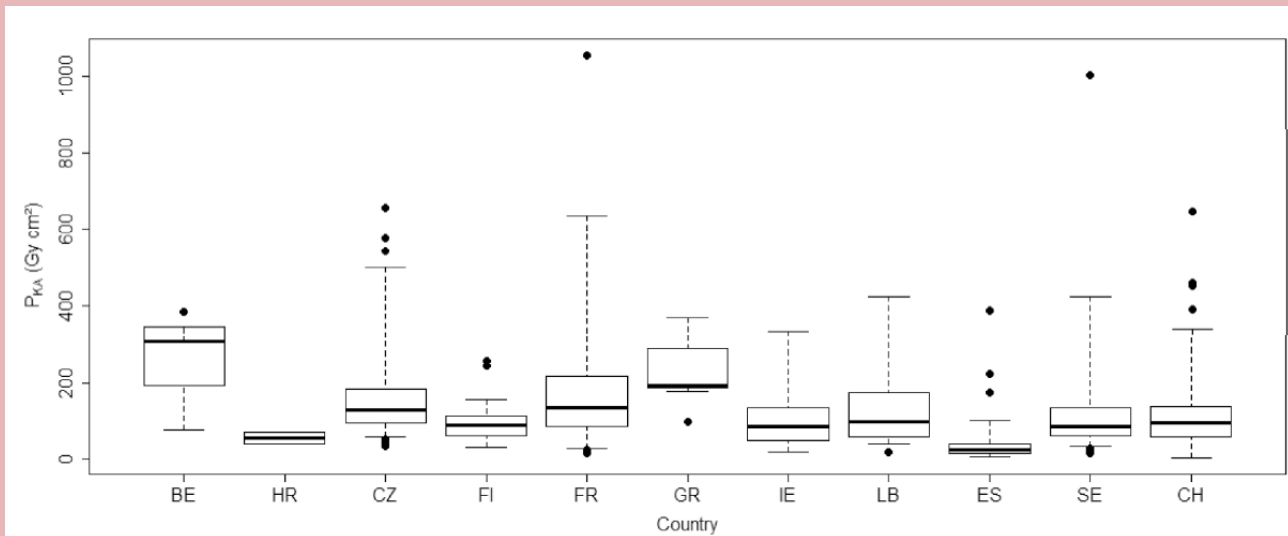


Dose variation in the EU

PCI



TAVI



Parameters and Practices

➤ Procedure difficulty

- Many possible parameters depending on the procedure

➤ Optimization

- Imaging protocols
- FL time
- Cine
- Collimation
- Projections
- Zoom

Dose monitoring software

- DoseWatch, Radimetrics and many others available
- Angiospecific parameters
- Exportation of data

Procedure registries

BCB Invasiivikardiologian rekisteri Parametristot Rekisteri Raportointi Etsi potilas JARVIJUK

Lisää potilas Toimenpidelistä Tutkimukset

HOITOKORTTI POTILASKORTTI

TESTI, POTILAS
090909-0909

Potilaan tiedot
Tutkimuspotilas

OPERATIIVINEN

6.9.2013 Angio ja PCI
29.3.2013
KÄYNTI
3.9.2018 Kontrolli

MUUT TOIMENPITEET JA TUTKIMUKSET
Laboratoriotutkimukset

YHTEENVETO Pilota yhteenveto

| | | | | | |
|-------------------------|-------------------------|--------|---|-------------------|------------|
| Päädiagnoosi | I21.9 Sydäninfarkti NAS | Kohde | - | Kokonaissädeannos | - |
| Päätoimenpide | FN1AD Sepelvaltimoiden | P-Krea | - | Varjoaine | 06.09.2013 |
| | TT | | | | |
| Sepelvaltimotaudin dg.t | I21.9 | | | | |

06.09.2013 Toimenpiteen tiedot Esitiedot Sydän STEMI Angiografia Muu tmp PCI Komplikaatiot Yhteenveto Kertomus

Tallentanut , viimeksi muokattu 18. tammikuuta 2016 kello 02:10

Tekijät

PCI-tyyppi

Suoni

Luo uusi

Suoni

| | | |
|---------------|-------------------------------------|--|
| Suoni | Esilaajennus | Menetelmä |
| Ahtauma | Lääkepallot | <input type="checkbox"/> Pallo |
| Ahtaumatyyppi | Stentit | <input type="checkbox"/> Lääkepallo |
| Bifurkaatio | Stenttityyppi | <input type="checkbox"/> Stenttaus esilaajennuksen jälkeen |
| Ahtauma pre | <input type="checkbox"/> Metalli | <input type="checkbox"/> Suora stenttaus |
| Ahtauma post | <input type="checkbox"/> Lääke | <input type="checkbox"/> Poraus |
| TIMI pre | <input type="checkbox"/> Biohajoava | <input type="checkbox"/> Trombi-imu |
| TIMI post | Stentin poikkimitta | <input type="checkbox"/> Muu |
| | mm | Tulos |
| | Jälkilaajennus | |
| | Pallon suurin läpimitta | |
| | mm | |
| | Suurimman pallon paine | |
| | ATM | |

Patient demographic data

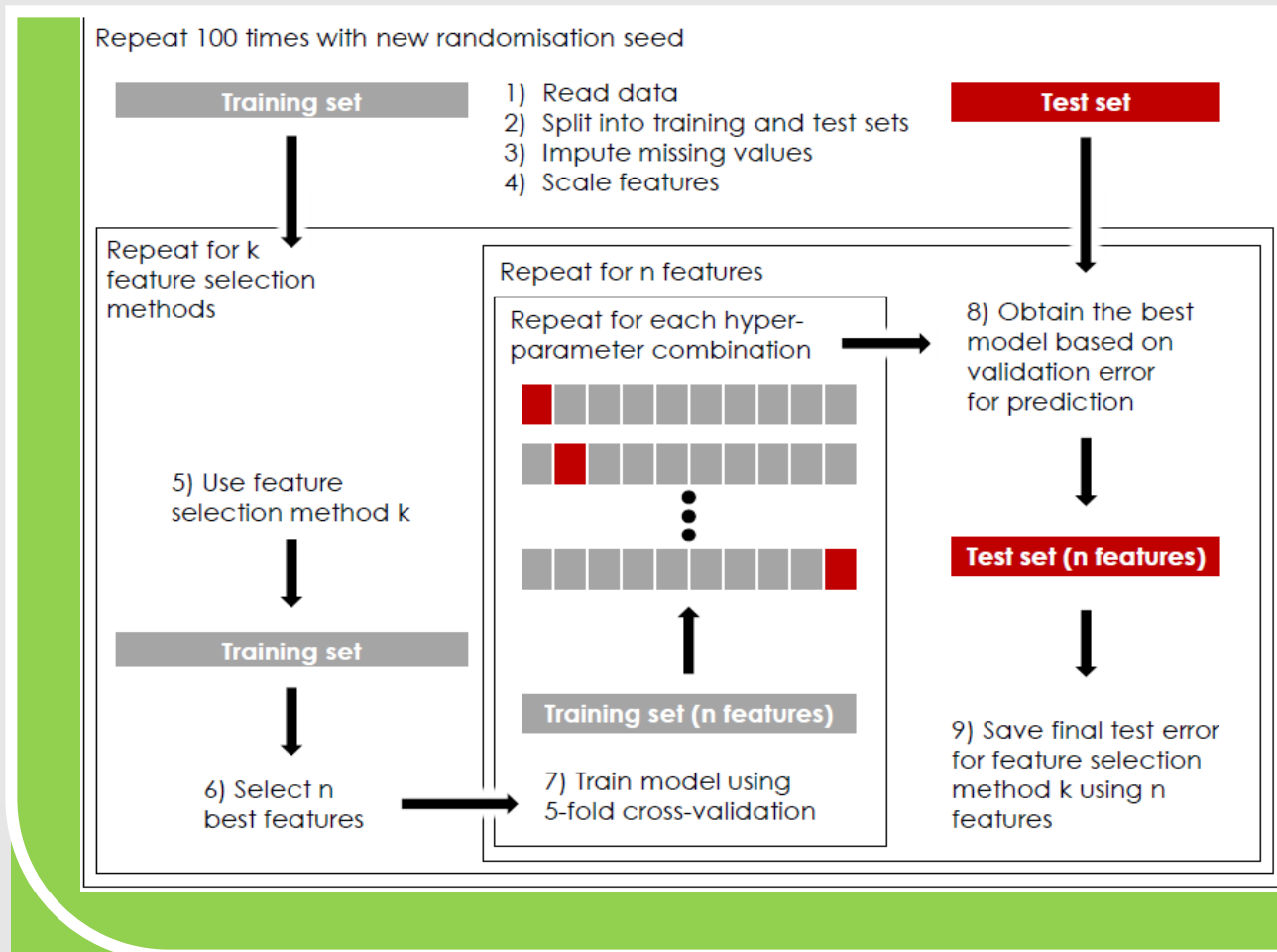
- Weight

- Height

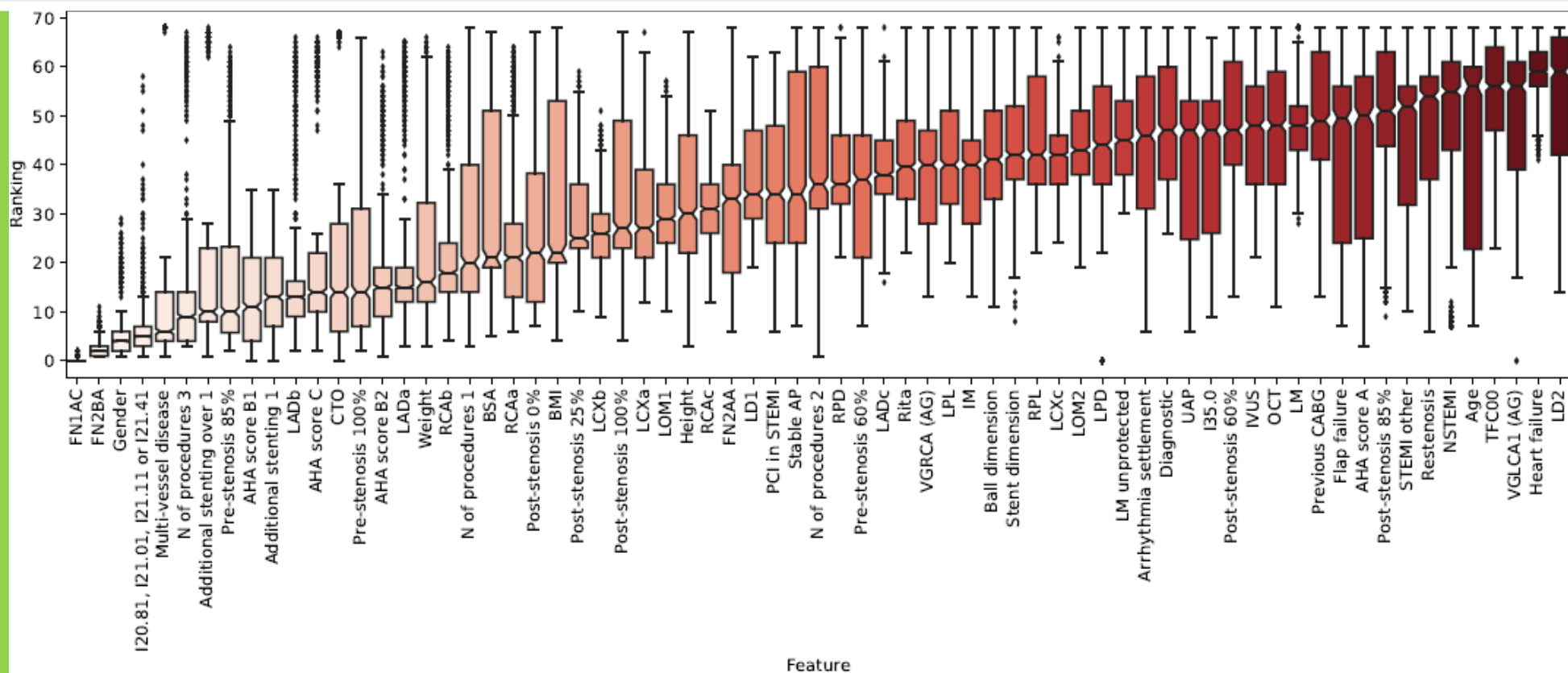
- Age

- Gender

Dose prediction



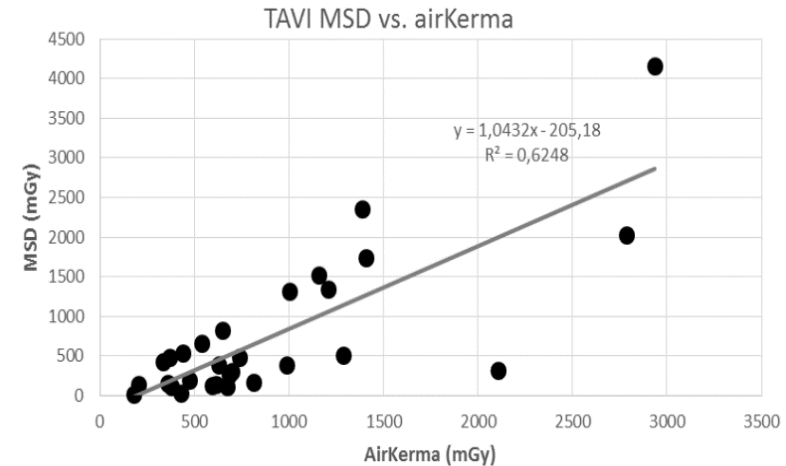
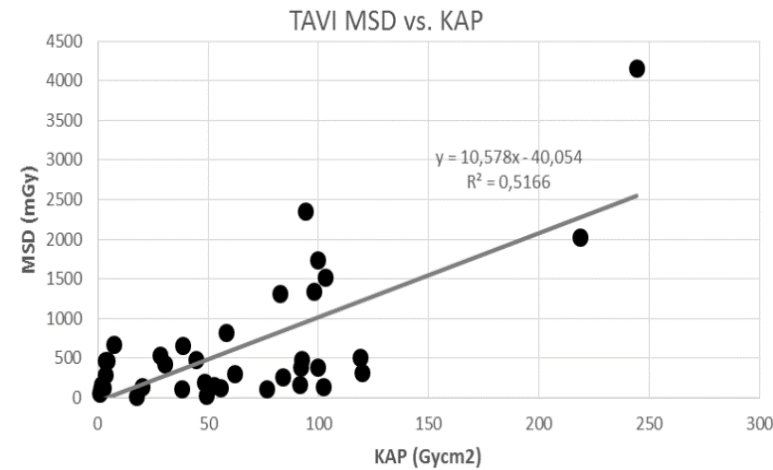
Dose prediction



Maximum Skin Doses and Erythema Risks

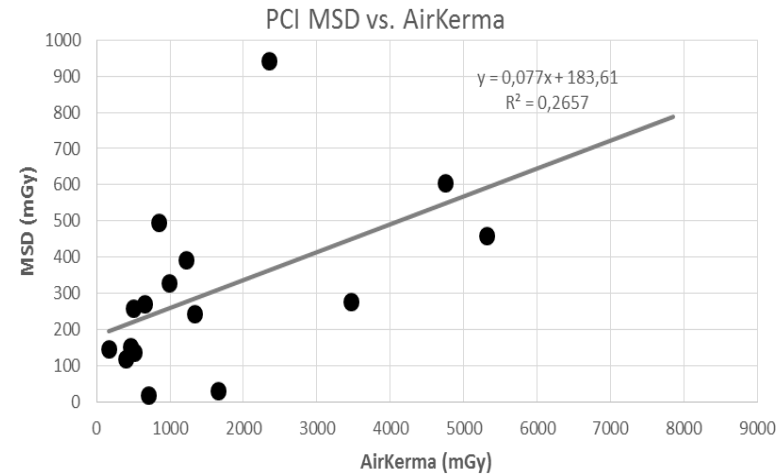
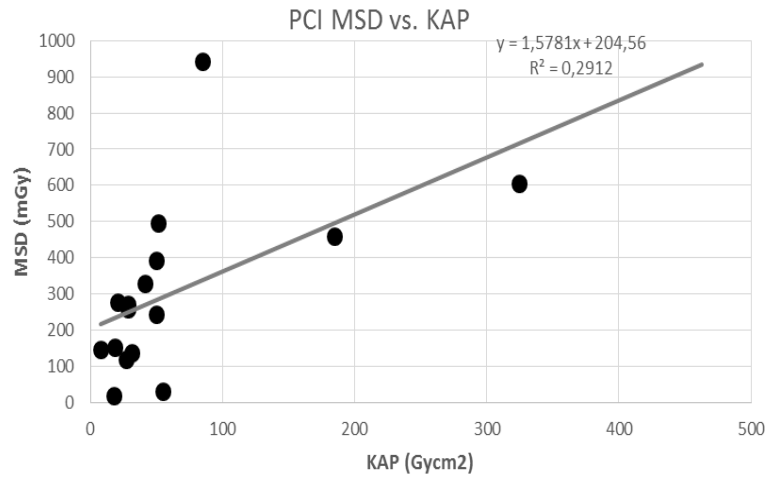
- ▶ There is a risk but how big is it?
- ▶ How to communicate it?
- ▶ How to implement good practices?

Dose variation in Gafchromic Film Measurements



| | CA | PCI | PI | CRT | AVNRT | Atrial Fibrillation | TAVI |
|--------------------------------|--------|---------|--------|--------|--------|---------------------|--------|
| N | 87 | 50 | 41 | 10 | 14 | 6 | 45 |
| Mean Gafchromic film MSD (mGy) | 116.15 | 437.08 | 96.34 | 121.76 | 158.74 | 210.55 | 623.81 |
| Mean KAP (Gycm ²) | 26.67 | 95.86 | 5.45 | 31.07 | 7.85 | 20.48 | 64.66 |
| Mean Air kerma (mGy) | 479.63 | 1949.77 | 32.97 | 395.95 | 52.22 | 497.73 | 853.65 |
| Max MSD (mGy) | 377.27 | 941.68 | 187.16 | 235.98 | 415.35 | 322.99 | 4158.8 |
| MSD standard deviation | 91.97 | 589.86 | 62.90 | 98.00 | 154.07 | 104.86 | 823.93 |

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{ What causes this variation? }

{ What causes this variation? }

- ▶ Use of projections
- ▶ Patient size
- ▶ Imaging protocols

Alert Levels

- For 2 Gy MSD to be exceeded in TAVI
 - 200 000 mGy cm^2 KAP
 - Or
 - 2 Gy air kerma

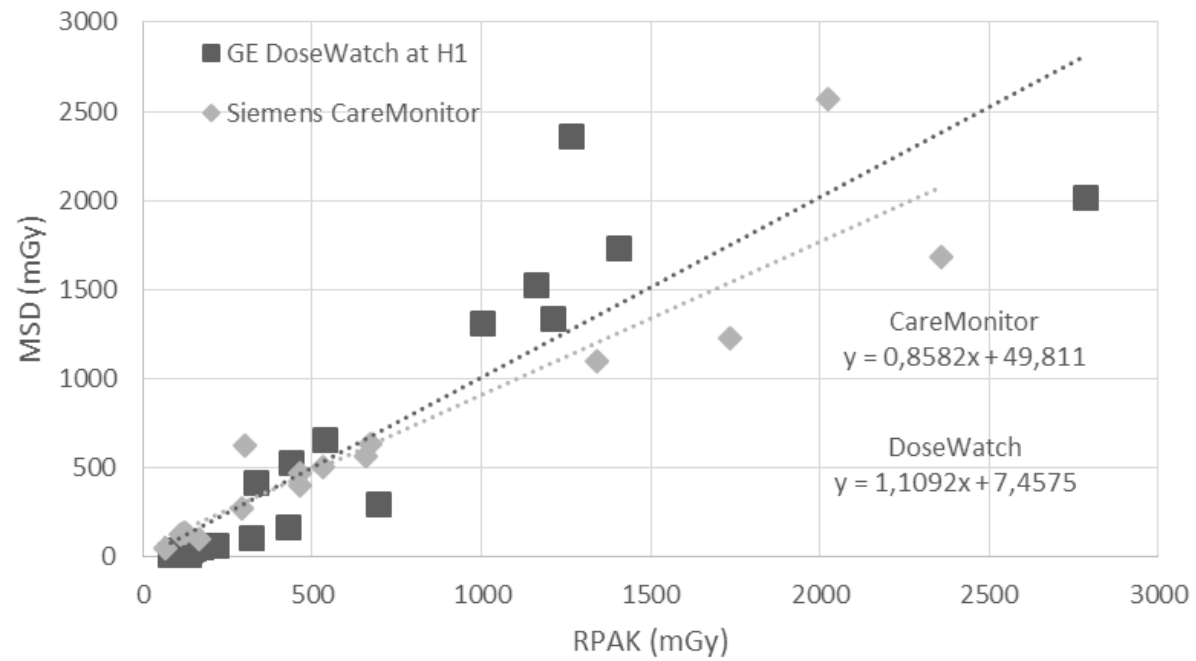


Skin dose algorithms

Rough outline on how they work

- Estimation of patient size and location
- Realtime data collection of projections and irradiations
- Estimation of entry points and summing skin doses
- DoseWatch, DoseWise, CareMonitor, Dose tracking system..

Software Comparisons





Validation?

Thank you!

(References)

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