DANISH HEALTH
AUTHORITY
Radiation Protection

Comparison of measured eye lens doses at the forehead and at collar level

14 June 2019

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New dose limit on the dose for the lens of the eye

- New EU BSS - Directive 2013/59/EURATOM
- 150 mSv/y → 20 mSv/y
- In force in DK regulation since 02 February 2018

17.1.2014 EN Official Journal of the European Union L 13/1

II

(Non-legislative acts)

DIRECTIVES

COUNCIL DIRECTIVE 2013/59/EURATOM

of 5 December 2013

laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Atomic Energy Community, and in particular Articles 31 and 32 thereof,

Having regard to the proposal from the European Commission, drawn up after having obtained the opinion of a group of persons appointed by the Scientific and Technical Committee from among scientific experts in the Member States, and after having consulted the European Economic and Social Committee,

Having regard to the opinion of the European Parliament,

Having regard to the opinion of the European Economic and Social Committee,

Whereas:

(1) Point (b) of Article 2 of the Euratom Treaty provides for the establishment of uniform safety standards to protect the health of workers and of the general public. Article 30 of the Euratom Treaty defines "basic standards" for the protection of the health of workers and the general public against the dangers arising from ionising radiations.

(2) In order to perform its task, the Community laid down basic standards for the first time in 1959 by means of Directives of 2 February 1959 laying down the basic standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation [1]. The Directives have been revised several times, most recently by Council Directive 96/29/Euratom [2] which repealed the earlier Directives.

(3) Directive 96/29/Euratom establishes the basic safety standards. The provisions of that Directive apply to normal and emergency situations and have been supplemented by more specific legislation.

(4) Council Directive 97/43/Euratom [3], Council Directive 89/618/Euratom [4], Council Directive 90/641/Euratom [5] and Council Directive 2003/122/Euratom [6] cover different specific aspects complementary to Directive 96/29/Euratom.

(5) As recognized by the Court of Justice of the European Union in its case-law, the tasks imposed on the Community by point (b) of Article 2 of the Euratom Treaty to lay down uniform safety standards to protect the health of workers and the general public does not preclude, unless explicitly stated in the standards, a Member State from providing for more stringent measures of protection. As this Directive provides for minimum rules, Member States should be free to adopt or maintain more stringent measures in the subject-matter covered by this Directive, without prejudice to the free movement of goods and services in the internal market as defined by the case-law of the Court of Justice.

(6) The Group of Experts appointed by the Scientific and Technical Committee has advised that the basic safety

[1] OJ L 11, 20.2.1959, p. 221.
[2] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L 159, 29.6.1996, p. 1).
[3] Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure, and repealing Directive 84/466/Euratom (OJ L 180, 9.7.1997, p. 22).
[4] Council Directive 89/618/Euratom of 27 November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency (OJ L 357, 7.12.1989, p. 31).
[5] Council Directive 90/641/Euratom of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas (OJ L 349, 13.12.1990, p. 21).
[6] Council Directive 2003/122/Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources (OJ L 346, 31.12.2003, p. 57).

About comparison
- Pilot measurement project

- Screening period from 2014 to 2018
- All participating on a voluntary basis
- All exposed workers were instructed to used two dosimeters at the same time during the procedures carried out
  - One dosemeter at the forehead
  - One dosemeter at the collar level, outside lead apron
- Measurement period was agreed from time to time
  - The most used measurement period was 1 month
- Participant were asked for information on the practices and profession of each worker, and in most cases this information was provided

Participants in survey

- 10 departments participated

- 8 different practices:
  - Angiography
  - Cardiology
  - CT-guided Intervention
  - Endoscopy
  - Neuro Radiology
  - Nuclear Medicine
  - Surgery
  - Urology

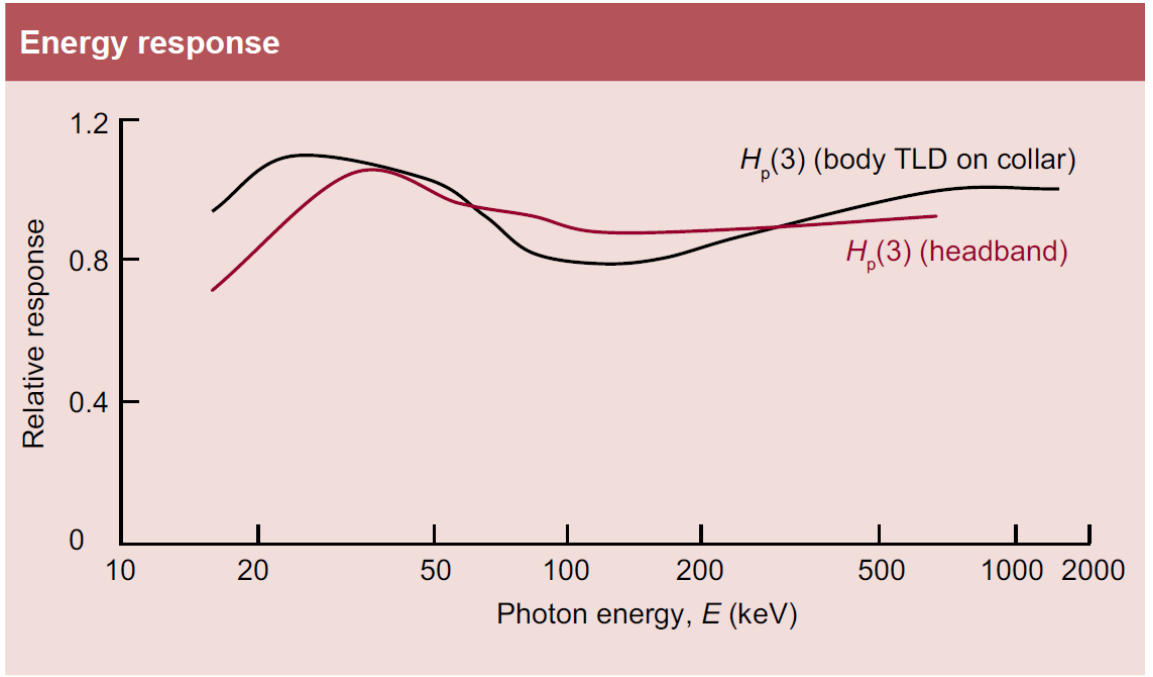
- 231 individual dose measurements

Profession	# Measurements
Doctor	74
Nurse	45
Other	1
Radiographer	88
N.A.	23

Practice	# Measurements
Angiography	28
Cardiology	26
CT-guided intervention	15
Endoscopy	38
Neuro radiology	20
Nuclear Medicine	9
Surgery	9
Urology	2
N.A.	84

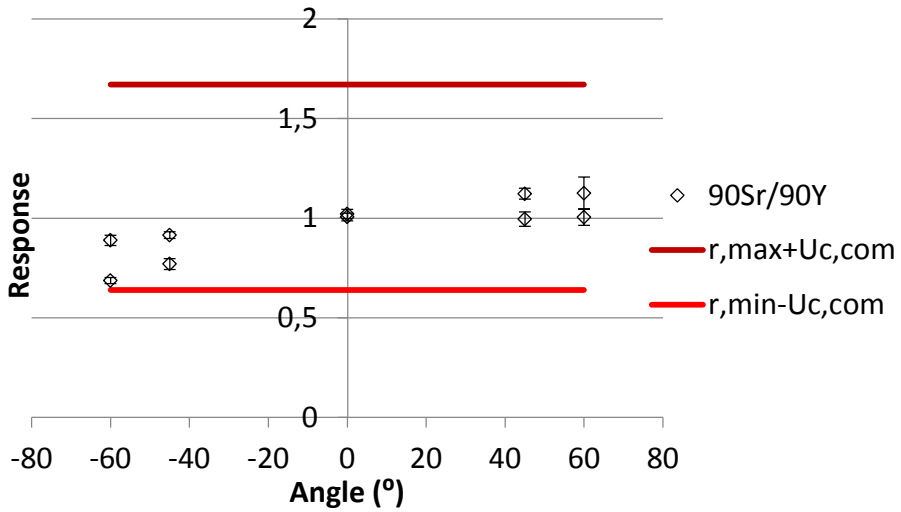
Dosemeter used at the forehead

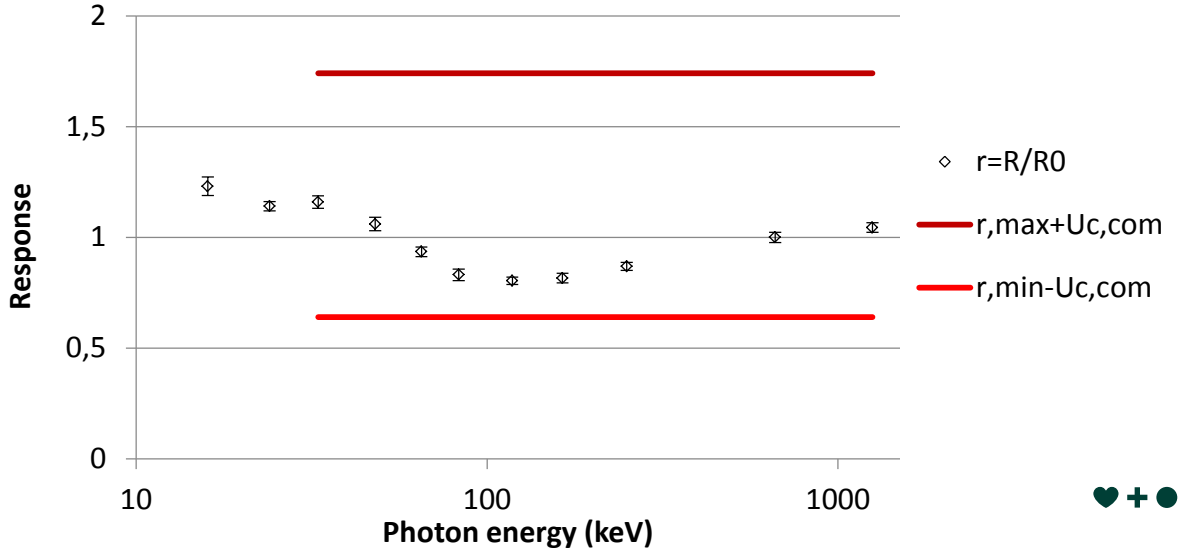
- Used PHE EYE Dosemeter
- The dosemeter element is of the Harshaw EXTRAD™ type, and is enclosed behind a 1.5 mm PTFE (Teflon) filter in a sealed PVC pocket
- The dosemeter have been tested to measure Hp(3) on the ORAMED phantom
- A phantom very similar to the ORAMED phantom have this year been introduces as reference phantom in ISO 4037 for Hp(3) calibrations



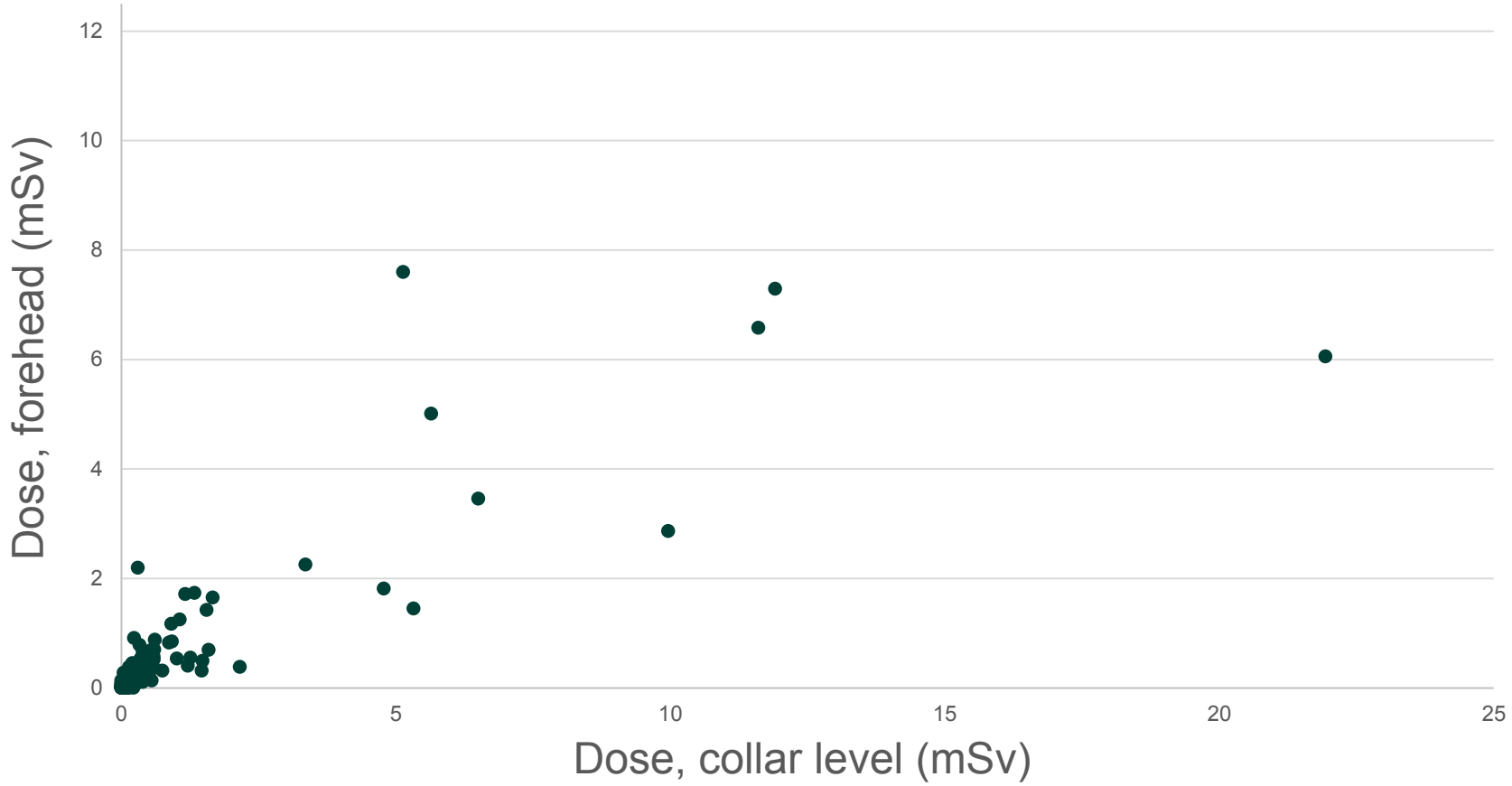
Dosemeter used at the collar level

- Used SIS Whole body dosemeter
- The dosemeter consist of a Harshaw™ Multi-element Card Dosimeter inserted in pp-plastic (polypropylene) badge. The used element is behind a 3 mm pp filter
- The dosemeter have been tested against DS/EN 62387:2016 for measuring Hp(3) on the ICRU slab phantom (ISO 4037) for beta and gamma





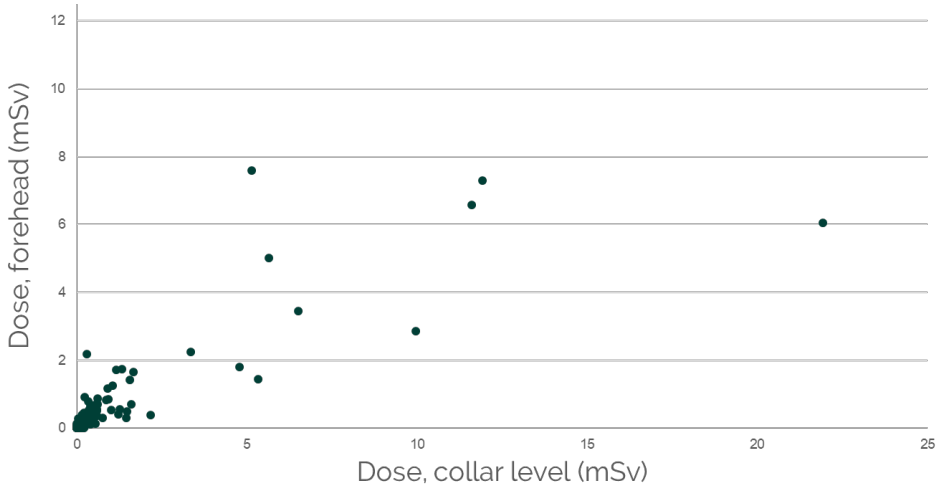
Results of survey
Measurements on forehead compared to collar



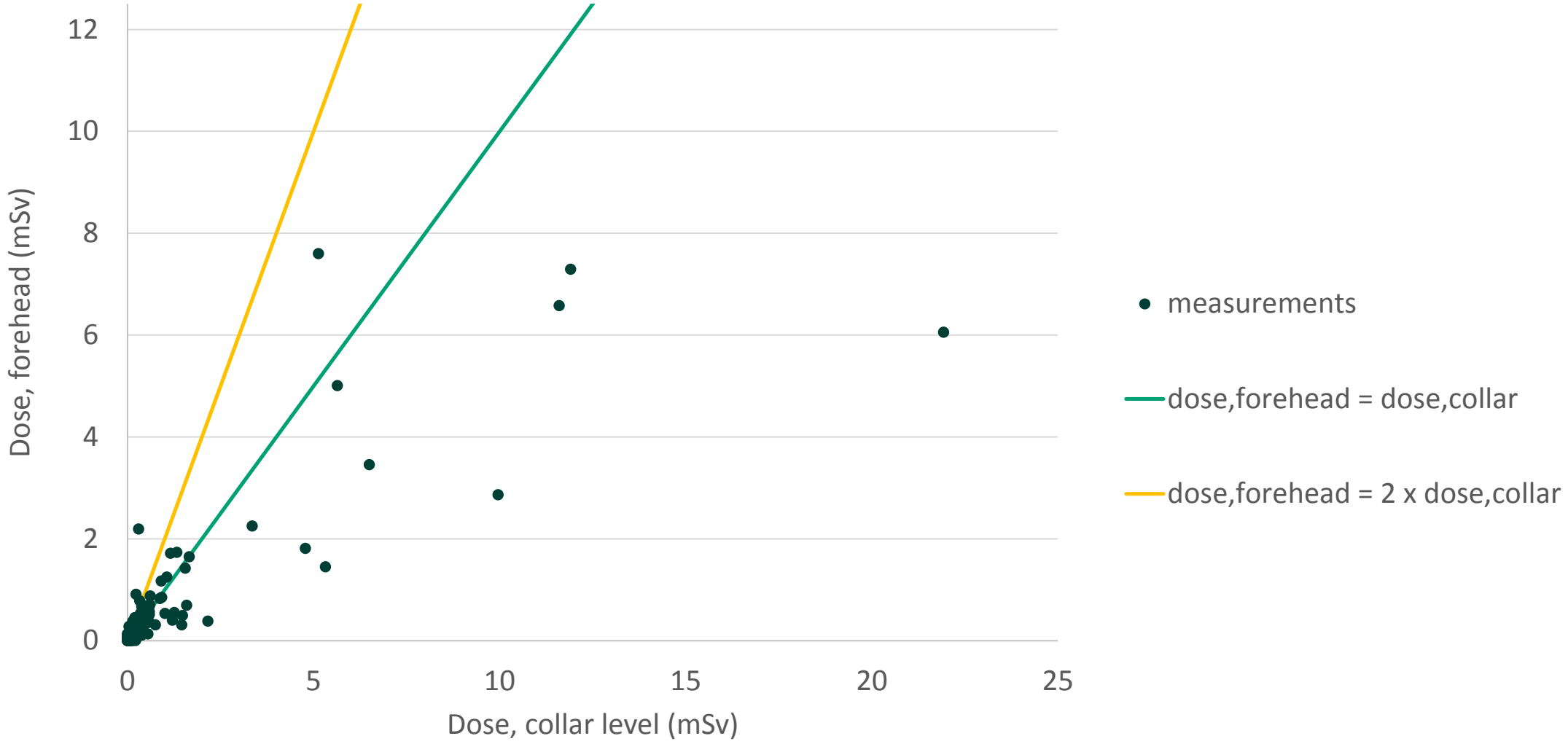
Results of survey
Measurements on forehead compared to collar

- The measured doses are generally low
  - 93 % of the doses measured at the forehead are lower than 1 mSv
  - 62 % of the doses measured at the forehead are lower than 0.1 mSv

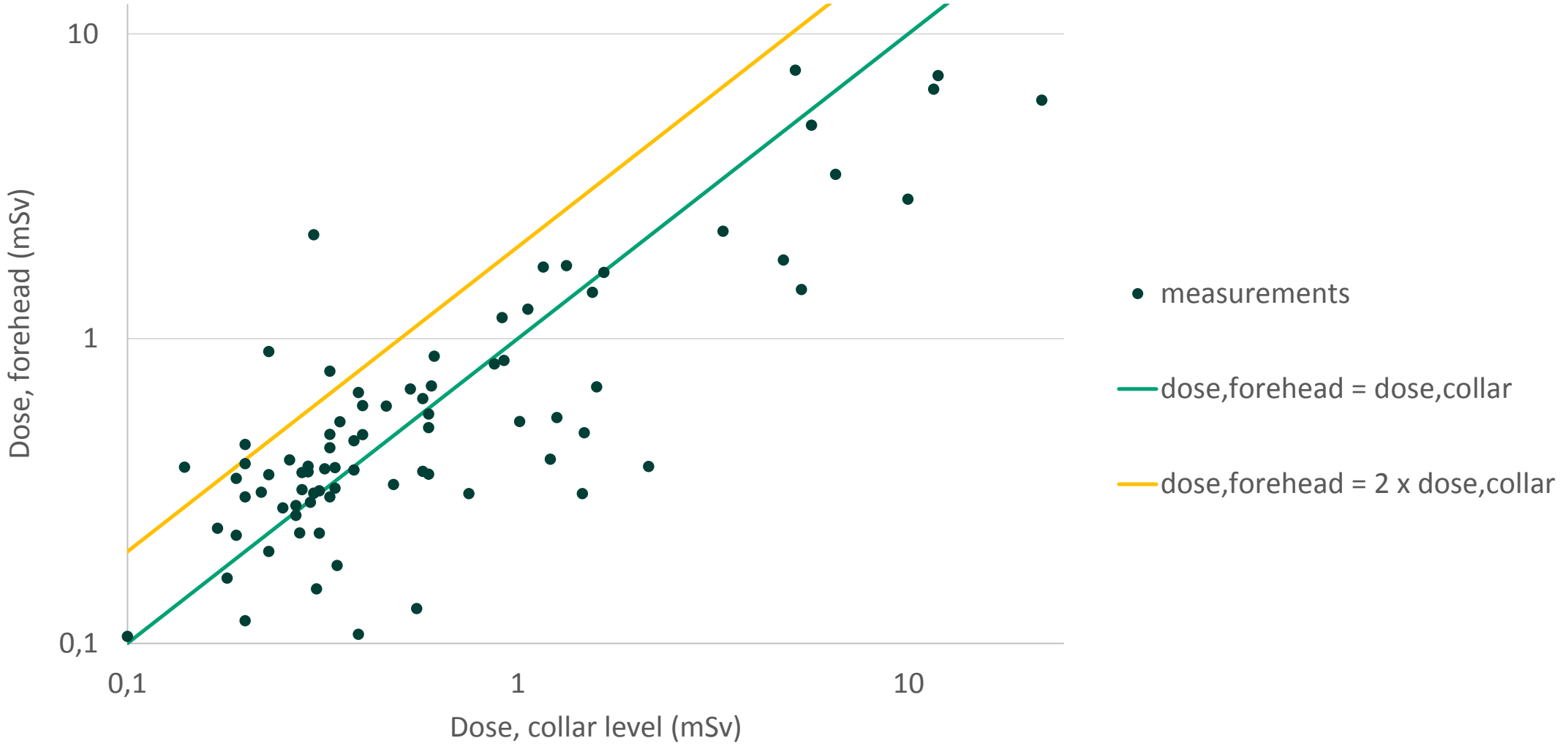
- The dose at the collar level are generally higher than the dose at the forehead
  - 59 % of measurements of dose at collar level is higher than dose at forehead
  - 95 % of measurements of dose at collar level is higher than half the dose at forehead



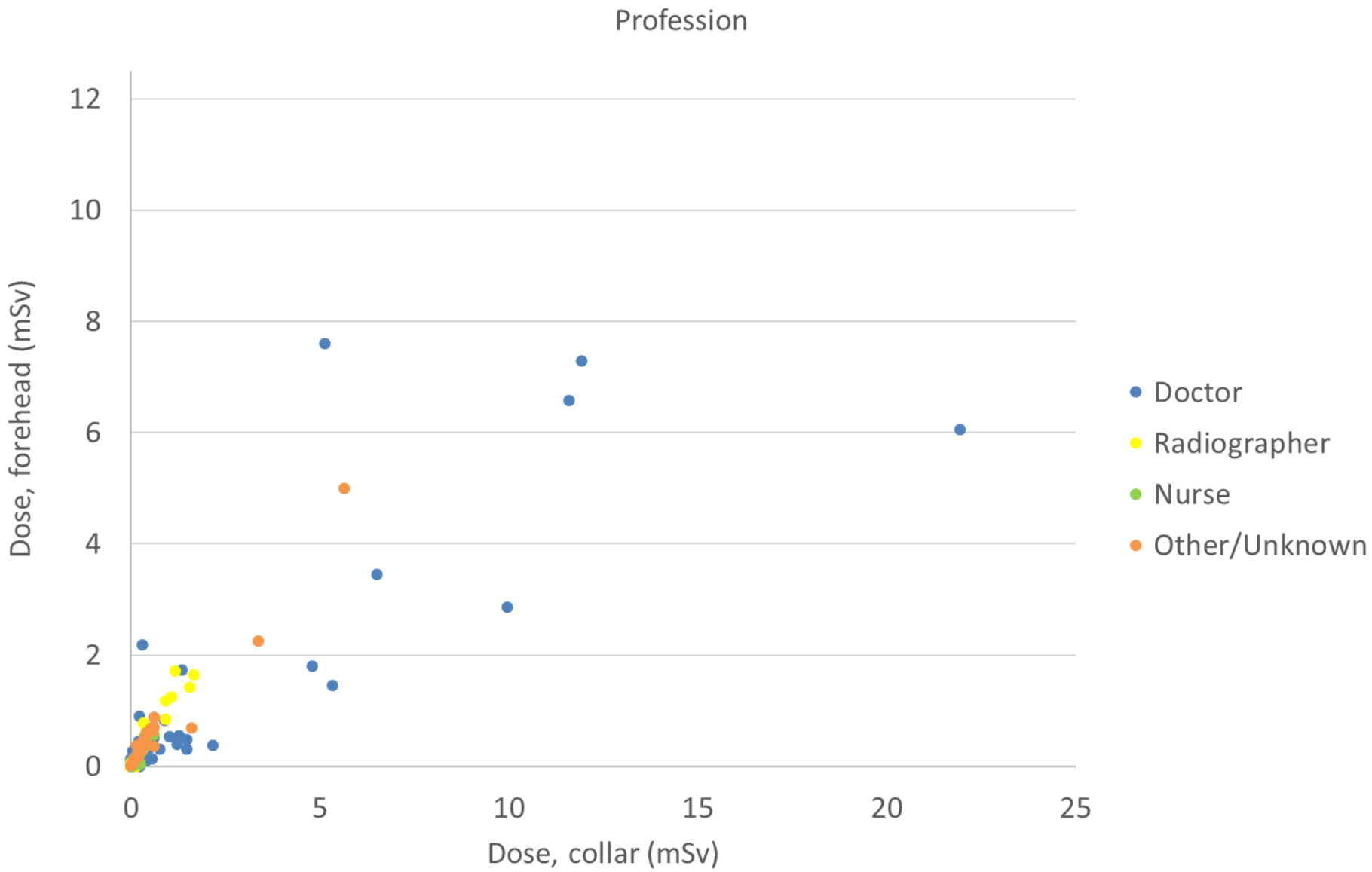
Correlation between collar and forehead doses



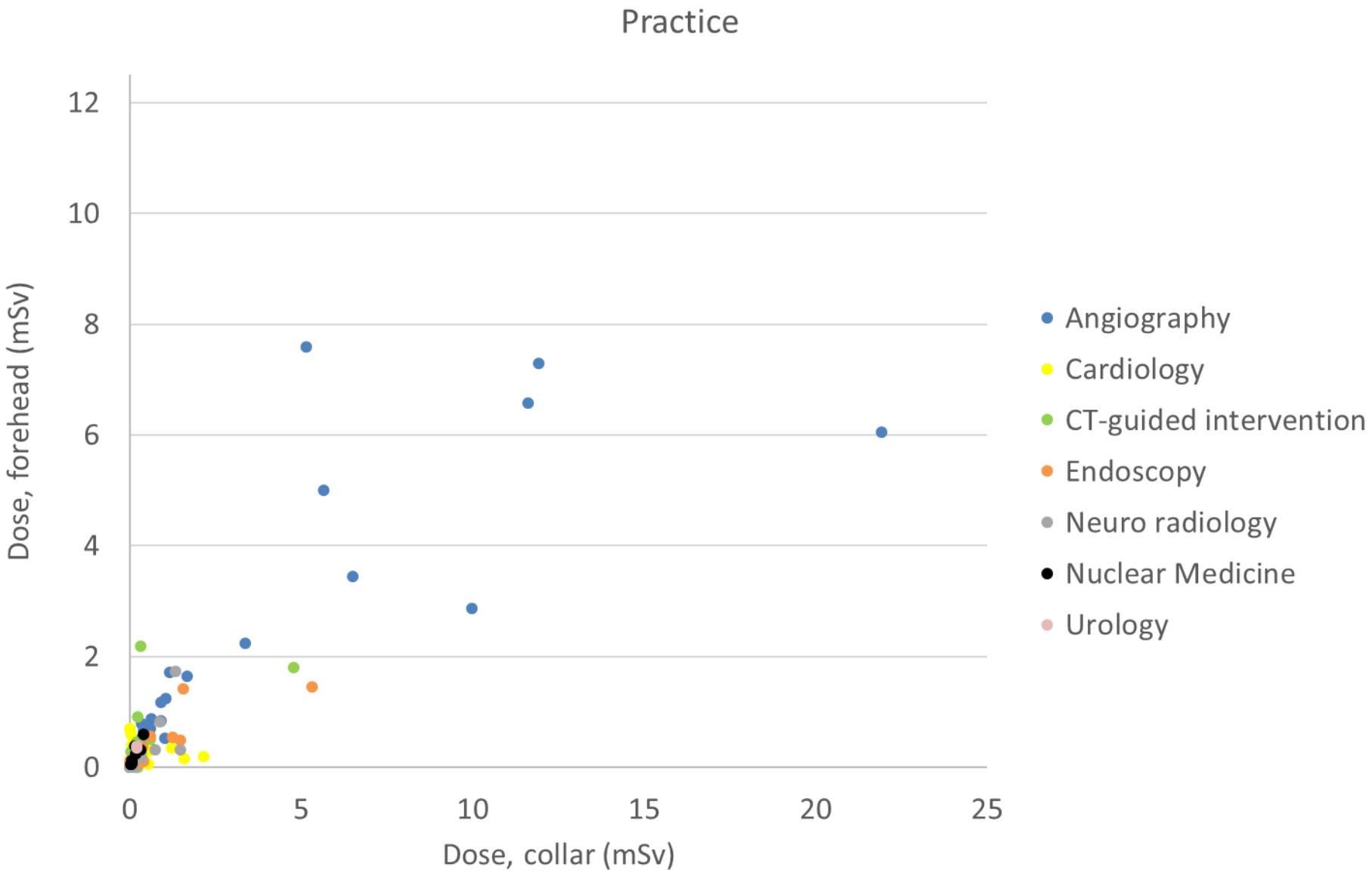
Correlation between collar and forehead doses



Professions



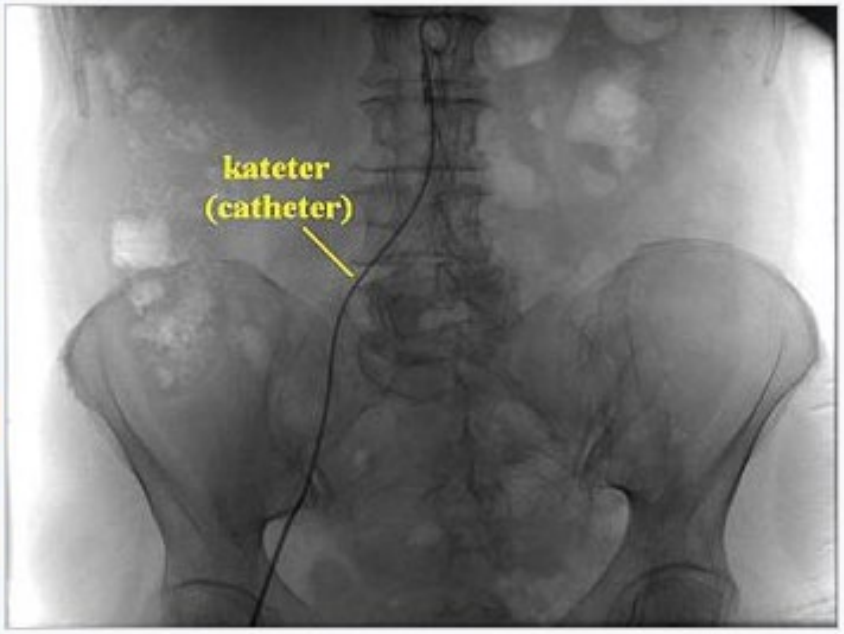
Practices


Practice
Dose, forehead (mSv)
12
10
8
6
4
2
0
0
5
10
15
20
25
Dose, collar (mSv)
Angiography
Cardiology
CT-guided intervention
Endoscopy
Neuro radiology
Nuclear Medicine
Urology

What is Angiography

- Angiography or arteriography is a medical imaging technique used to visualize the inside, or lumen, of blood vessels and organs of the body, with particular interest in the arteries, veins, and the heart chambers. This is traditionally done by injecting a radio-opaque contrast agent into the blood vessel and imaging using X-ray based techniques such as fluoroscopy

Catheterization Lab



Catheterization in selective angiography

Source: en.wikipedia.org

Routine monitoring using dosemeter worn at collar level

Data from NDR September 2018 to April 2019

- 1 Monthly monitoring period
- Dose data for 38 workers
- Doctors and workers involved in interventional radiology receive highest doses
- The monthly average dose indicate that a few workers could exceed the yearly dose limit of 20 mSv
- One worker has received a very high dose
  - Currently under investigation

Profession	No. of workers monitored	Average dose Hp(3) (mSv)	Median dose Hp(3) (mSv)	95% quartile Hp(3) (mSv)	Maximum dose Hp(3) (mSv)
Doctor	24	0.48	0.27	1.4	6.7
Nurse	12	0.26	0.10	0.8	1.0
Other	2	0.00	0.00	0.0	0.0
Interventional Radiology	30	0.48	0.18	1.4	6.7
Surgery	4	0.34	0.26	1.2	1.4
Other	4	0.31	0.11	1.3	1.3

Conclusion

- Only a few workers are likely to receive more than 20 mSv per year
- Generally, the dose to the lens of the eye for occupationally exposed workers in Denmark is low, well below the dose limit
- The study also indicates that doctors, especially those involved in angiography procedures, receive the highest doses
- A whole body dosemeter worn at the collar level outside any personal protective apron can be used as an investigation tool on whether the dose limit is likely to be exceeded
  - It is more convenient to wear the dosemeter at the collar level?
- Need for special follow up in some cases (high doses)
  - Including investigation on influence from use of lead glasses

Thank you for your attention