# From martyrs to ‘zero dose’: Changes to protection, and zero dose techniques such as robotics and optical image guidance

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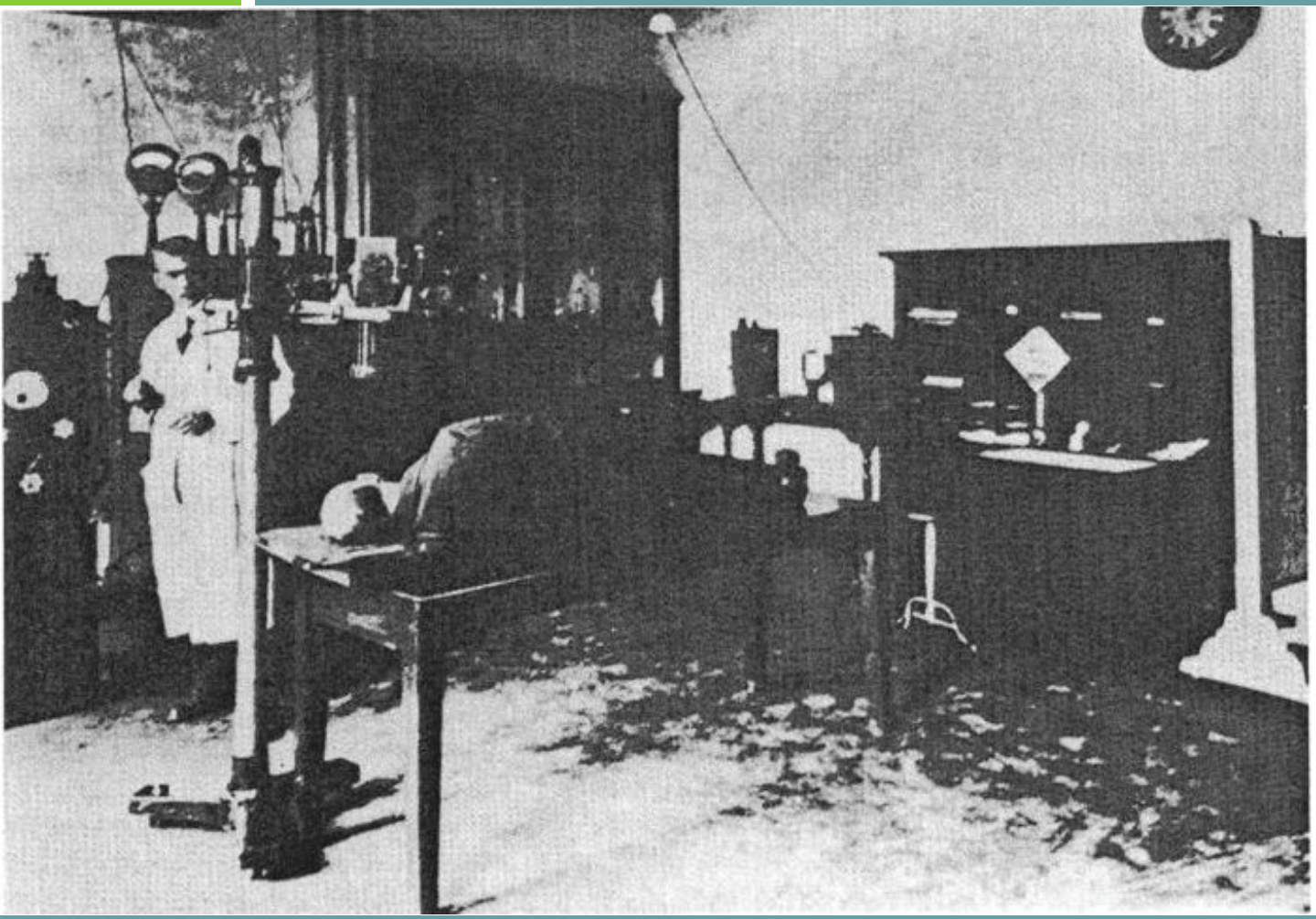
# Declarations of Interest

I have no financial connection to any products featured in this presentation

I'd take the money but nobody offered

You'll see why



Thomas Dodd
Joined Forth Banks Infirmary in 1899

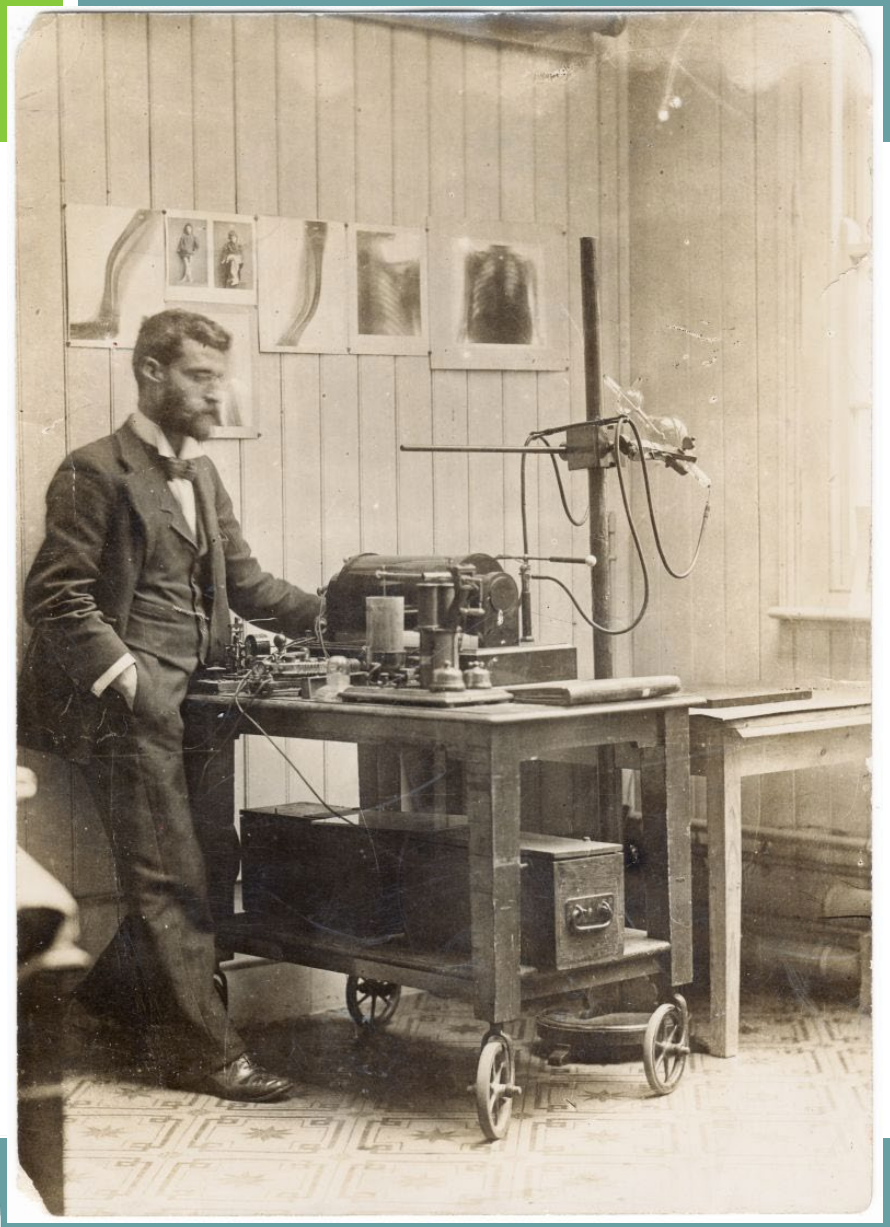
Radiographer for 20 years

Suffered severe radiation injuries and lost 3 fingers

Died from cancer in 1929

Name inscribed on Radiation Martyrs Memorial

*Image courtesy of Mersea Museum*



Ernest Harnack joined London Hospital, Whitechapel in 1896 as first radiographer

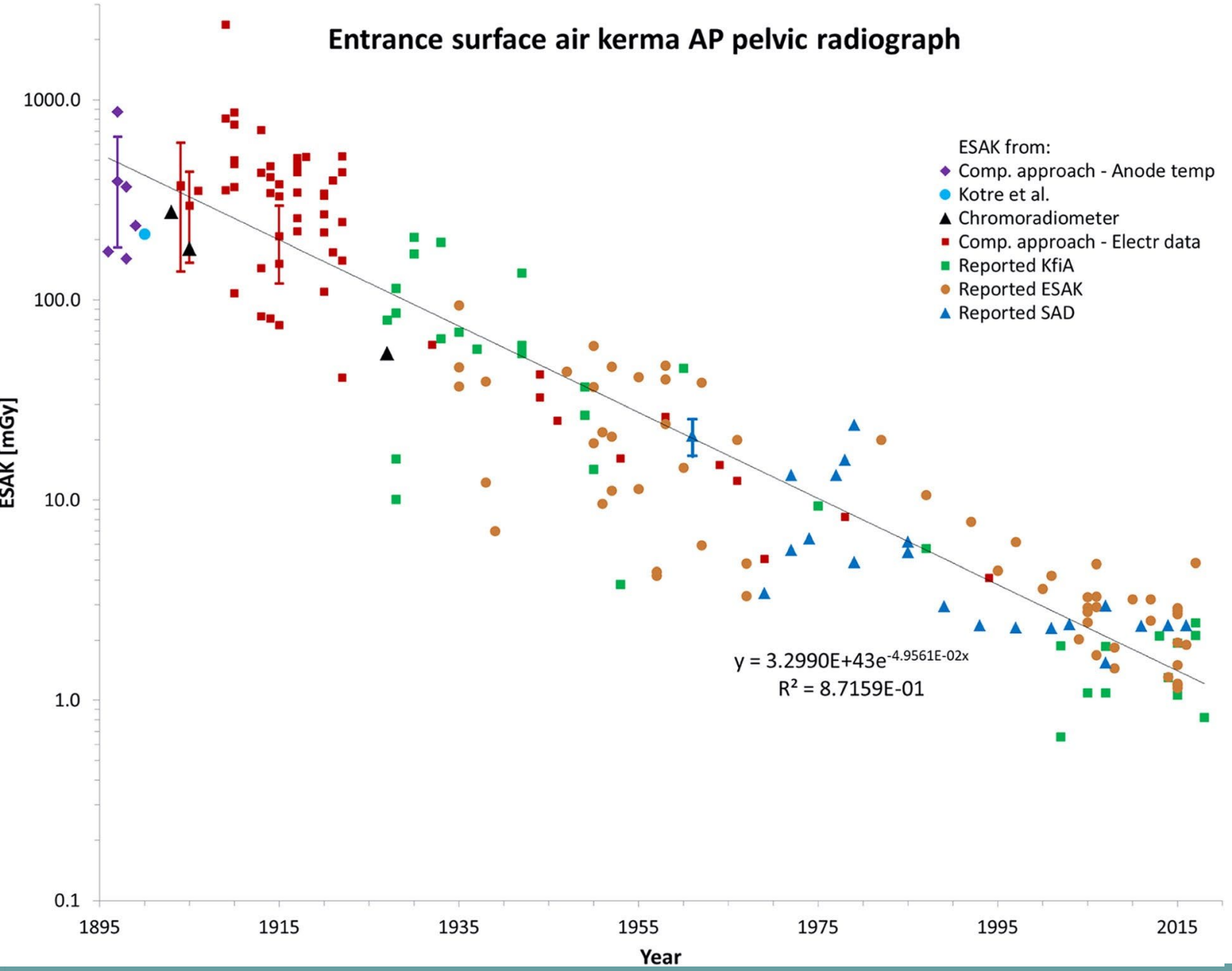
By 1910 listed as ‘Pensioner London Hospital X-ray Operator’

Lost both hands due to radiation injuries

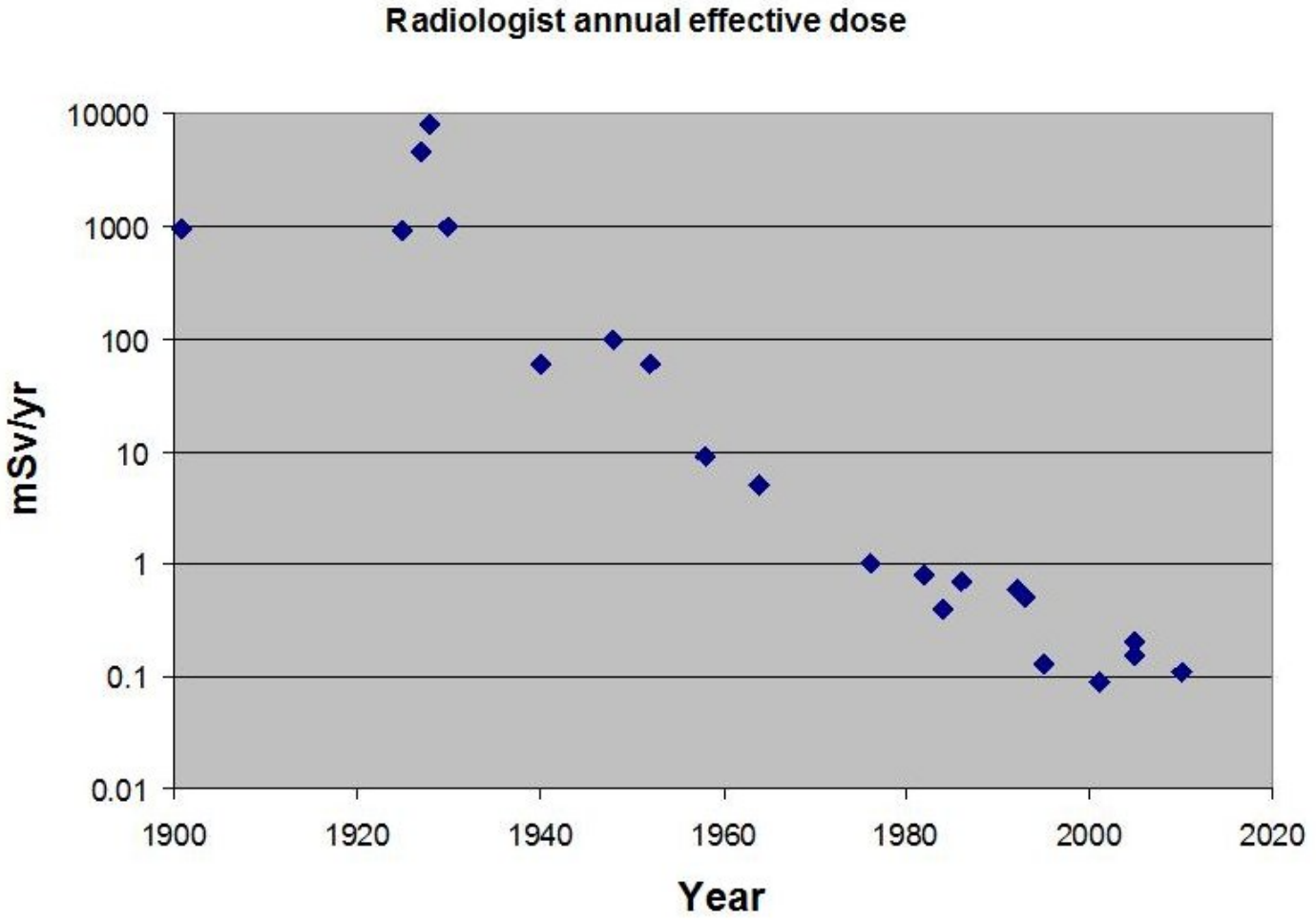
Died 1942 after traffic accident

Commemorated on the Radiation Martyrs Memorial

*Image courtesy of Mersea Museum*




Kemerink et al 2019




*Data from Linet et al 2010 plus PHE and Kotre*

# So is this As Low As Reasonably Practicable?

ALARP legally defined by costs not being ‘disproportionate’ to benefits (Edwards v. NCB, 1949)

Cost of human life lost to cancer estimated at 3.5M (HSE)

Assume fractional probability of a death has fractional cost

Suggested disproportion factor 2 for low public risks, 3 for workers, 10 for high risks (HSE submission to Sizewell B enquiry)

Risk factor for fatal cancer 5% per Sievert (ICRP 103)

# ICRP 103

(87) It is therefore the recommendation of the Commission that the approximated overall fatal risk coefficient of 5% per Sv on which current international radiation safety standards are based continues to be appropriate for the purposes of radiological protection.

(219) Optimisation of protection is not minimisation of dose. Optimised protection is the result of an evaluation which carefully balances the detriment and the resources available for the protection of individuals. Thus the best option is not necessarily the one with the lowest dose.

# A Test for ALARP

## A ≈ 175 R N T D

A is the limit at which the proposed expenditure is no longer ALARP (£)
R is the proposed annual dose reduction to the individual (mSv/yr)
N is the number of individuals to which the dose reduction will apply
T is the time over which the proposed intervention will apply (yr)
D is the disproportion factor 2, 3, 10 depending on risk

# Example

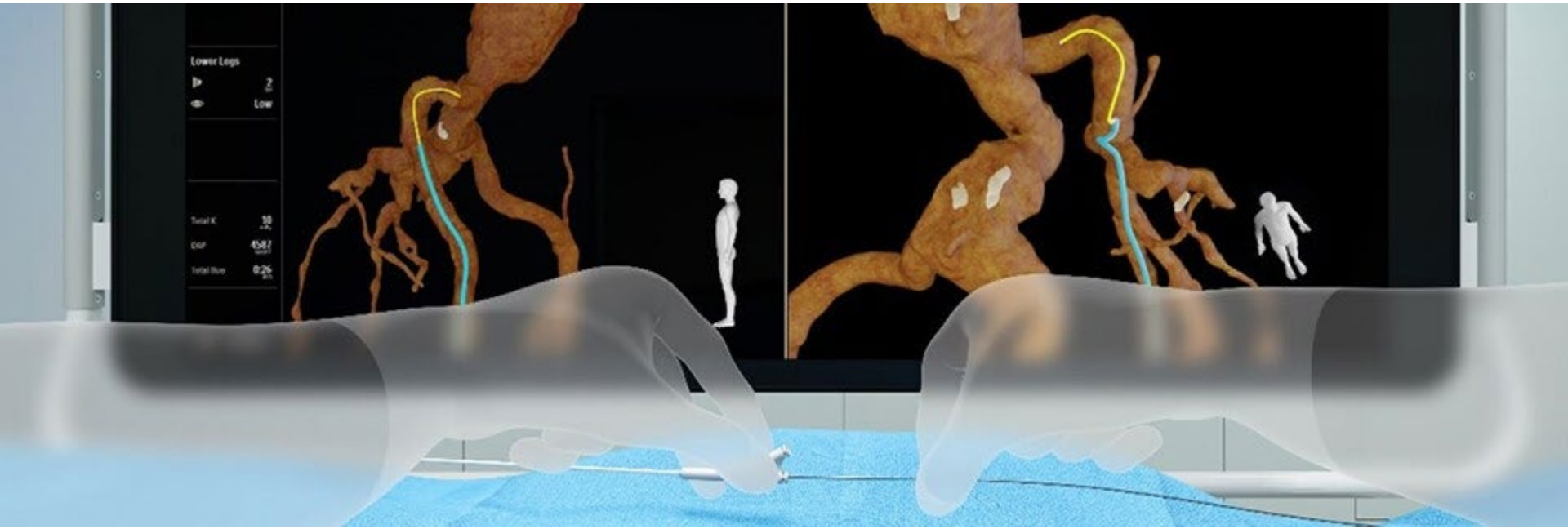
The Health Protection Agency 2010 review of radiation exposure to the UK population gives an average figure of 0.11 mSv/yr occupational exposure for radiologists and 0.12 mSv/yr for cardiologists. Taking the higher figure of 0.12 mSv/yr and supposing that 10 individual radiologists/cardiologists would be using the purchased equipment over a period of 5 years, then the upper limit to ALARP expenditure using a disproportion factor of 3 in the expression above is £3150 over the 5 year period, or £630 per year. This would not purchase much in the way of protective equipment. Shows doses are already well controlled.

*Image courtesy of Biotronik Inc.*

*Image courtesy of Egg Medical Inc.*

BIR The British Institute of Radiology

*Image courtesy of Corindus Inc.*




FORS - Fibre Optic Real-Shape

*Image courtesy of Philips N.V*

# Conclusions

Radiation protection for radiology staff has come a long way in 120 years and doses are well controlled by standard procedures

Significant investment aimed solely at further reducing staff doses could be argued not to be within the ALARP principle

The most valuable technical developments would seem be those aimed at reductions in patient radiation doses which in turn offer the possibility of reduced staff doses

# References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