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Eye lens dosimetry:

The dosimetry service perspective

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Eye lens dosimetry: Dosimetry service perspective

PRESENTATION CONTENTS

- Position of the Dosimetry Service
- To a new infrastructure for eye lens dosimetry
- Implementation example

01

POSITION OF THE DOSIMETRY SERVICE

Dosimetry Services in EU

- COUNCIL DIRECTIVE 2013/59/EURATOM:

> *"dosimetry service" means a body or an individual competent to calibrate, read or interpret individual monitoring devices (…) or to assess doses, whose capacity to act in this respect is recognised by the competent authority;*

- Different types of organizations:
  - from in-house services,
  - to scientific institutes,
  - to commercial service providers

- Different sizes, number of monitored individuals varying
  - from < 1000
  - to > 100.000

Recognition (or Approval)

- By competent authority in EU Member State
- Some guidance available in RP-160: *Technical Recommendations for Monitoring Individuals Occupationally Exposed to External Radiation* (2009)
- Requirements and procedures vary between 28 member states, but also similarities can be found:
  - Dose results have a legal status
  - Quality assurance, well-established procedures, standards
  - Measurement traceability
  - (International) Intercomparisons
  - Accreditation ISO-17025

Before 2013

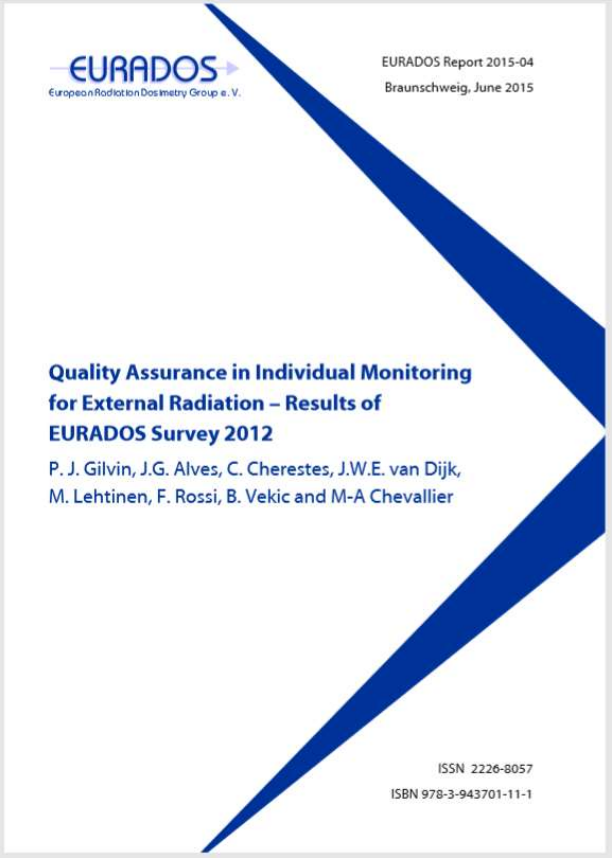
- Effective dose limit 20 mSv per year normally sufficient to comply with limit 150 mSv per year for H_{eye}
- ICRP Publication 103 (2007)

> *personal dose equivalent $H_p(3)$, has rarely been used in practice and very few instruments exist for measuring this quantity. It is suggested that its use is discontinued because the monitoring of the exposure to the eye lens is also sufficiently achieved if the dose to the eye lens is assessed in terms of the other operational quantities*

- Poor "infrastructure" for $H_p(3)$:
  - $H_p(3)$ type tested dosemeters
  - (International) standards
  - Suitable phantom, air kerma K_{air} to $H_p(3)$ conversion factors
  - (International) intercomparisons

2012

- EURADOS WG2 Questionnaire
- 40% of the services evaluated eye lens dose
  - $H_p(3)$ used in 50% of these cases (that means 25% of the total)
  - Dosemeter at eye position in 16% of the cases (that means 6% of the total)
- 7% said to report $H_p(3)$



After 2013

- COUNCIL DIRECTIVE 2013/59/EURATOM (”BSS”)
  - Adopts limit 20 mSv per year for H_{eye}

> *especially category A workers should be systematically monitored based on individual measurements performed by a dosimetry service. In cases where workers are liable to receive significant exposure of the lens of the eye, an adequate system for monitoring must be in place*

- Implementation in national legislation of Member States by 2018

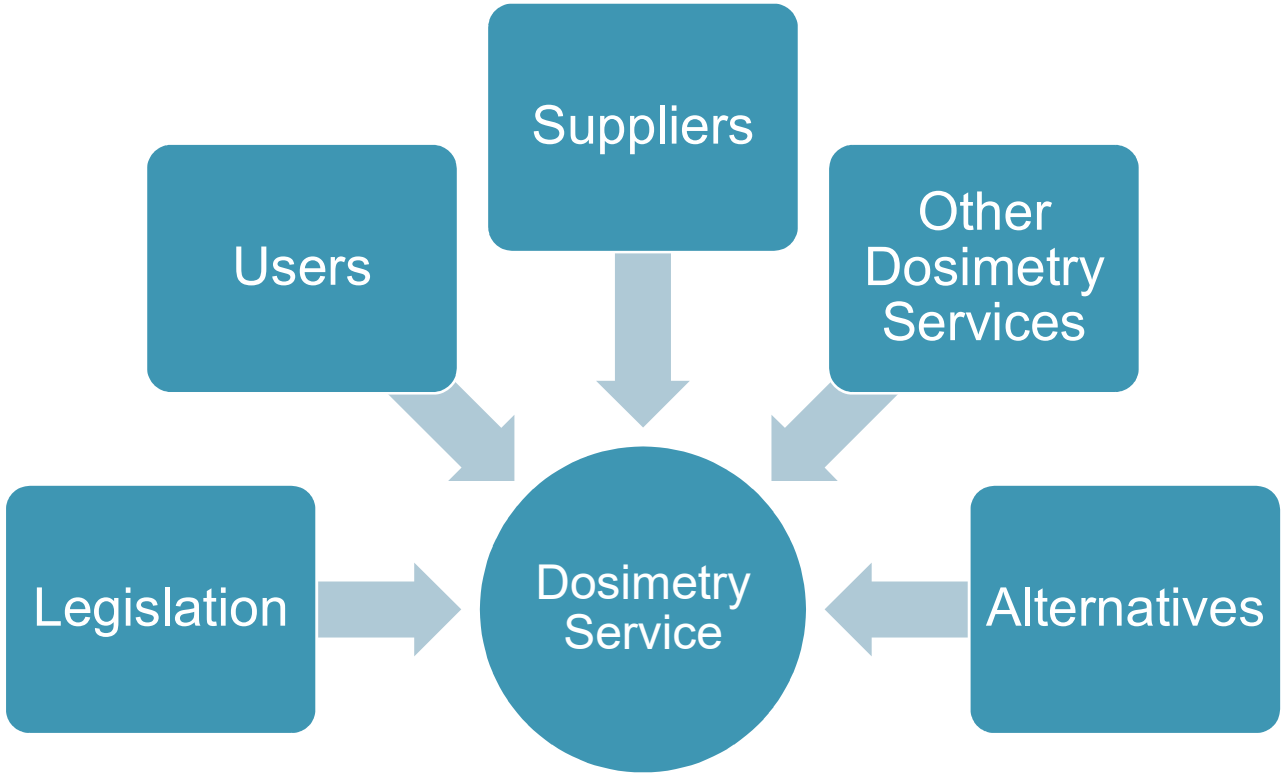
- Requirements for eye monitoring might vary for different Member States

02

TOWARDS NEW INFRASTRUCTURE

Strategy

- Free after Porter's 5 Forces



Legislation

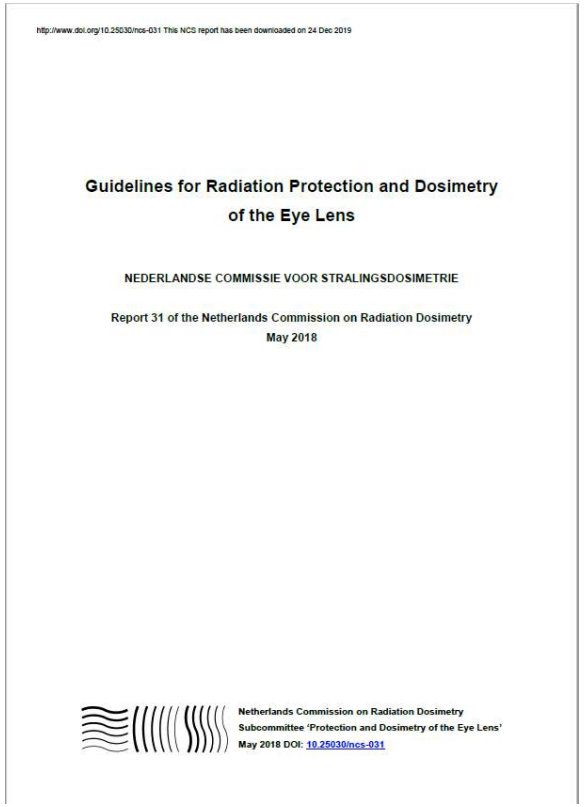
- Requirements for Dosimetry Services
  - Level of technical detail
  - Need to have a specific $H_p(3)$ dosemeter?
  - Need to have a dosemeter suitable for positioning close to the eye?
  - Need to include in formally approved system?
  - Take into account protective eye wear?

- Requirements for Users
  - As above
  - For which workers specific eye lens dosimetry would be applicable?

- National dose registry – radiation passbooks – legal doserecords

Example legal aspects: the Netherlands

- Implementation BSS kept to the minimum
- Only adaptation of yearly limit 20 mSv
- General requirements
  - to provide “suitable system” of monitoring
  - mandatory for exposed workers
- More details in Guidelines from Netherlands Commission on Radiation Dosimetry



Guidelines for Radiation Protection and Dosimetry of the Eye Lens

NEDERLANDSE COMMISSIE VOOR STRALINGSDOSIMETRIE

Report 31 of the Netherlands Commission on Radiation Dosimetry
May 2018

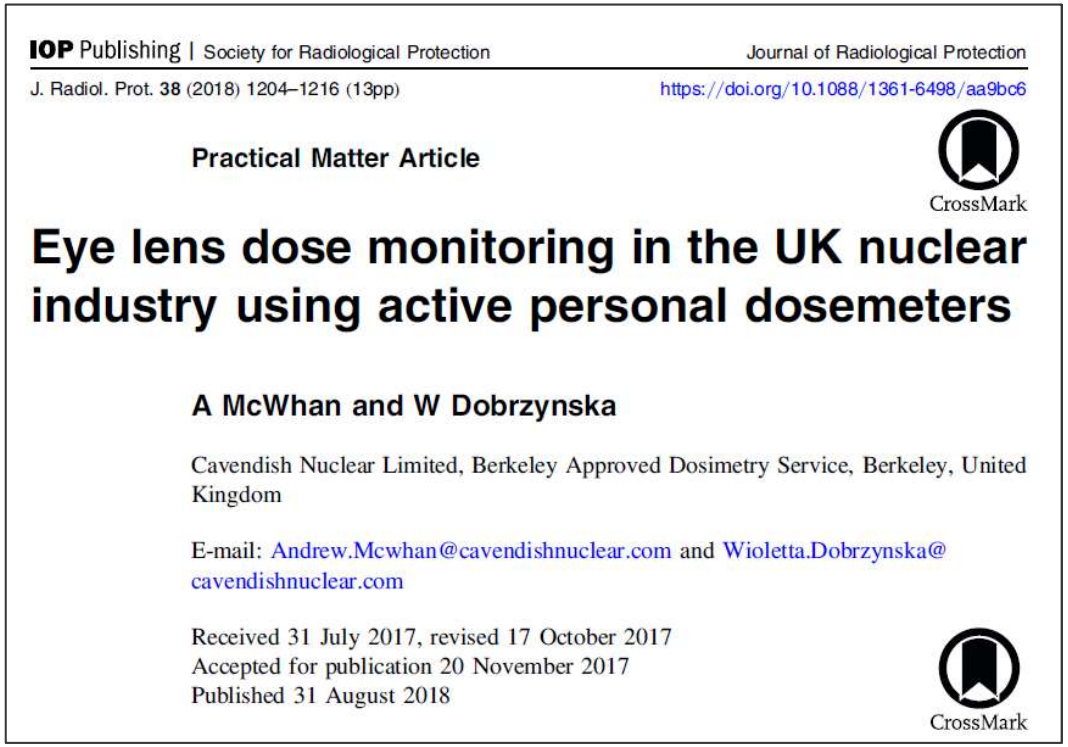
Netherlands Commission on Radiation Dosimetry
Subcommittee ‘Protection and Dosimetry of the Eye Lens’
May 2018 DOI: 10.25030/ncs-031

Example legal aspects: UK

- Problem: how to define the eye lens dose in legal dose records
- Nuclear sector: legal dosimetry with APD, plus sometimes passive eye lens dosemeter
- Before 2018: H_{eye} was set equal to $H_p(0.07)$ from APD, plus $H_p(3)$ from eye dosemeter (if present)
- Limit to 20 mSv per year: Conservative algorithm used in nuclear sector would lead to apparent dose limit violations
- After 2018: H_{eye} is set equal to $H_p(0.07)$ from APD or $H_p(3)$ from eye dosemeter (whichever is higher)

Example legal aspects: UK

- Much more information:



IOP Publishing | Society for Radiological Protection — Journal of Radiological Protection

J. Radiol. Prot. **38** (2018) 1204–1216 (13pp) https://doi.org/10.1088/1361-6498/aa9bc6

Practical Matter Article

CrossMark

Eye lens dose monitoring in the UK nuclear industry using active personal dosemeters

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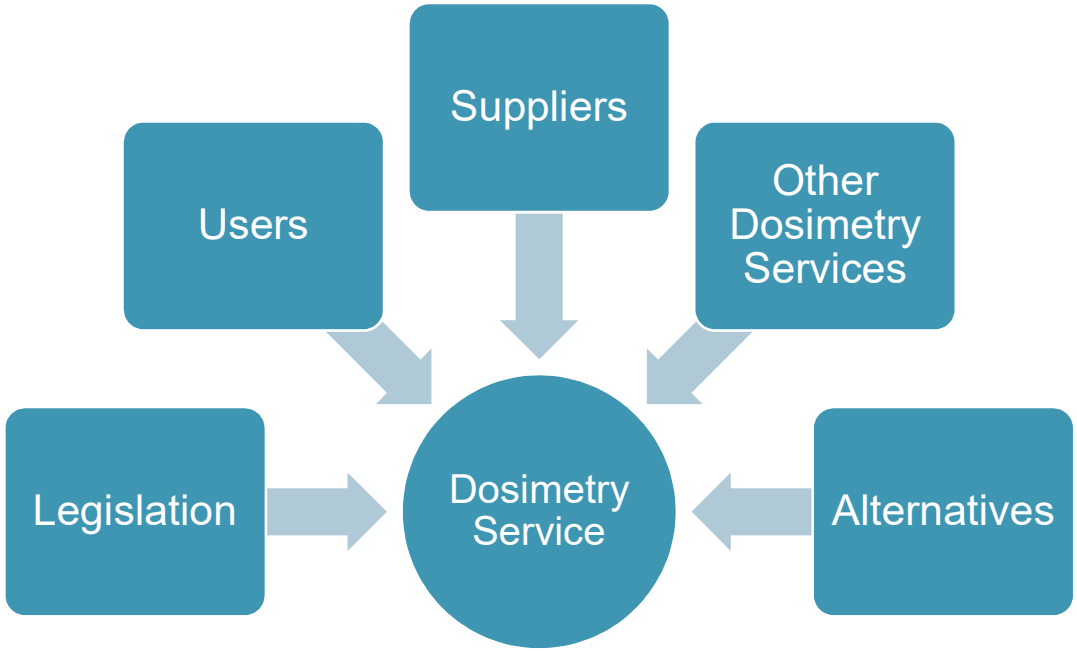
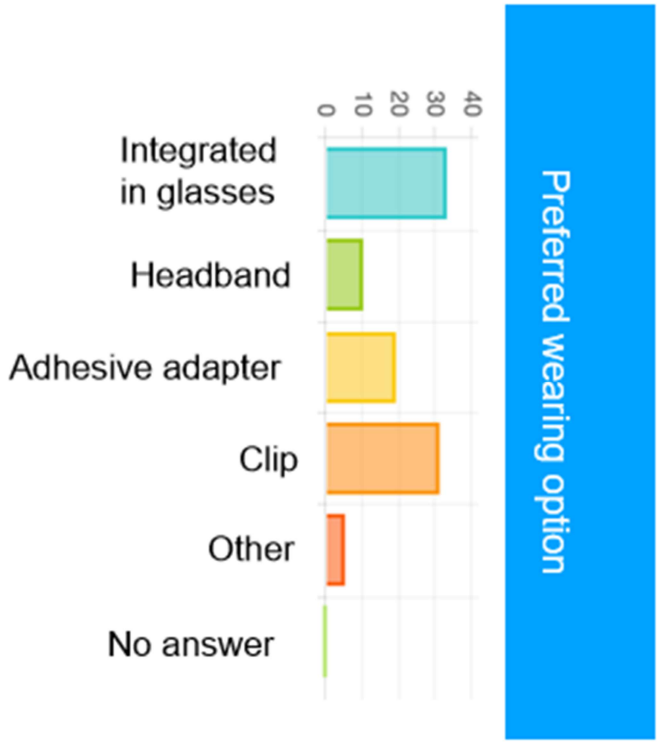

Suppliers
Users
Other Dosimetry Services
Legislation
Dosimetry Service
Alternatives

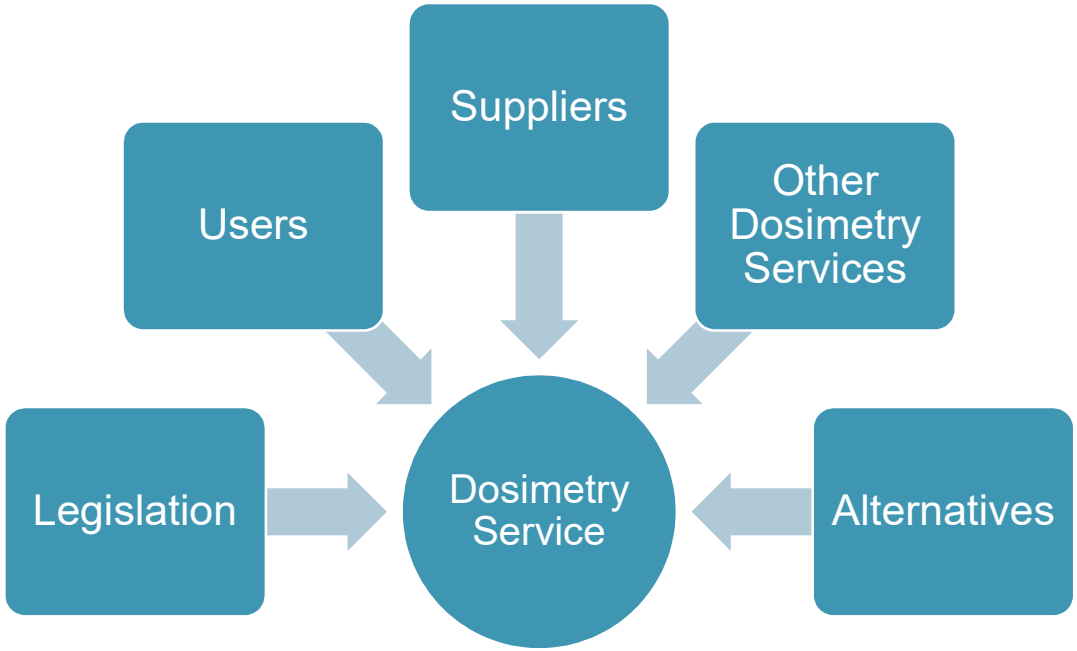
Users

- Protect their workers from harmful effects of ionizing radiation
- Comply with (national) regulations
- Expect the only one true value from the approved dosimetry service
- Limit resources spent on dosimetry program
  - Attention needed from staff managing the dosimetry program
  - Costs dosemeter subscriptions
  - Costs lost dosemeters
- Limit annoyance of employees because of having to wear (multiple) dosemeters
  - Wearing comfort

User questionnaire in Germany

- HelmholtzZentrum AWST Munich (H. Hoedlmoser)
- 500 customers, 100 replies




Suppliers
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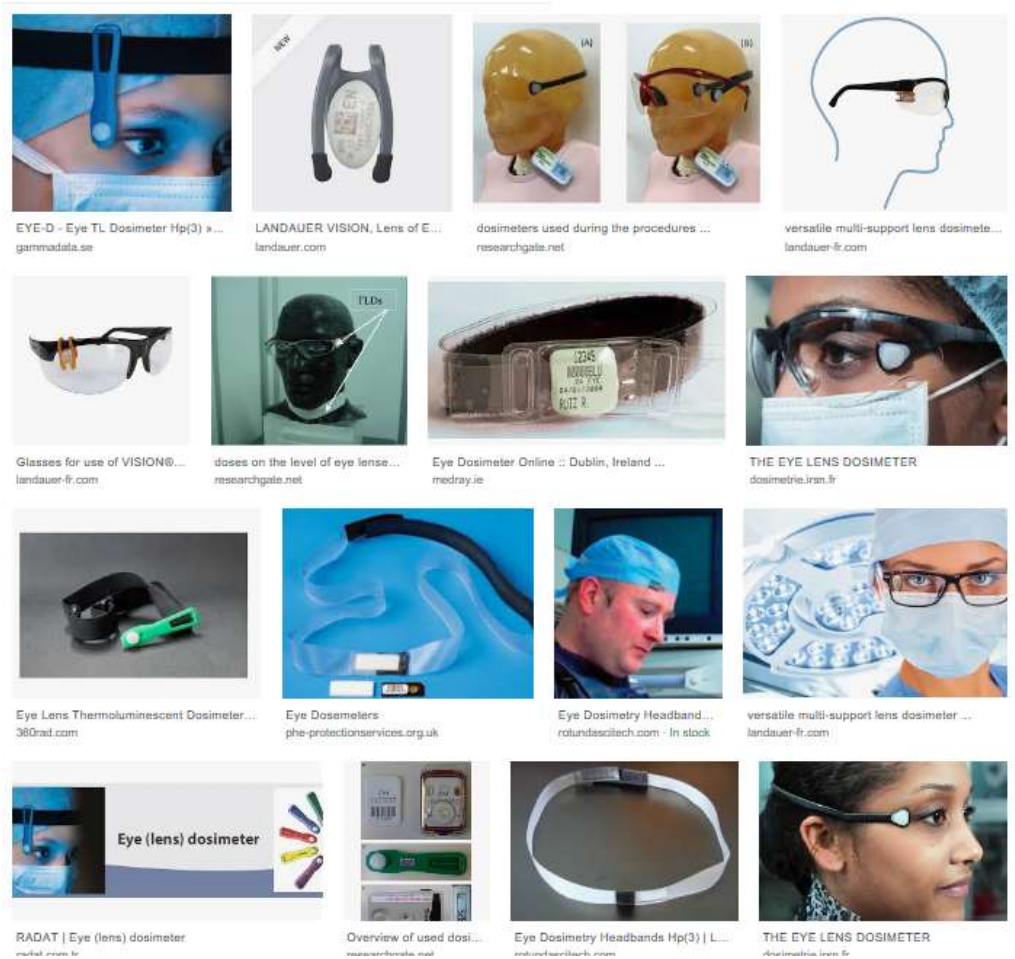
Suppliers

- “Make or buy”
- Buy dosemeter hardware or outsource the service
- At early stage not much choice
- Product developments:
  - Research projects: ORAMED
  - Commercially developed products
  - In-house developed solutions

Google search result:



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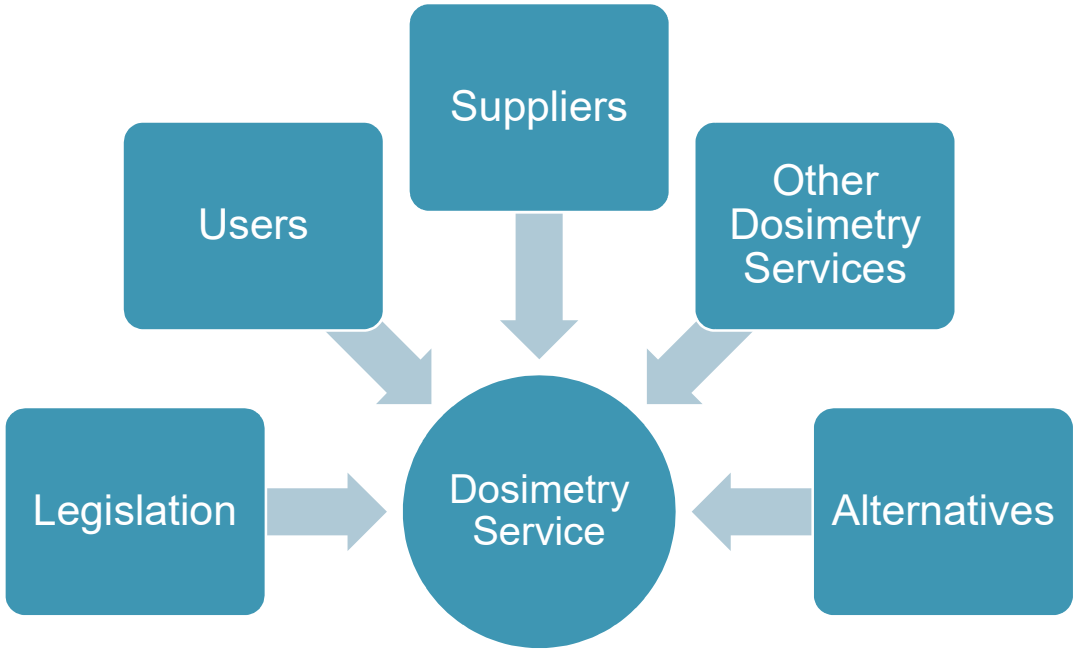
Example development in partnership

H. Hoedlmoser et. al. New eye lens dosemeters for integration in radiation protection glasses, Rad. Meas. 125, 106-115, (2019). https://doi.org/10.1016/j.radmeas.2019.05.002


Suppliers
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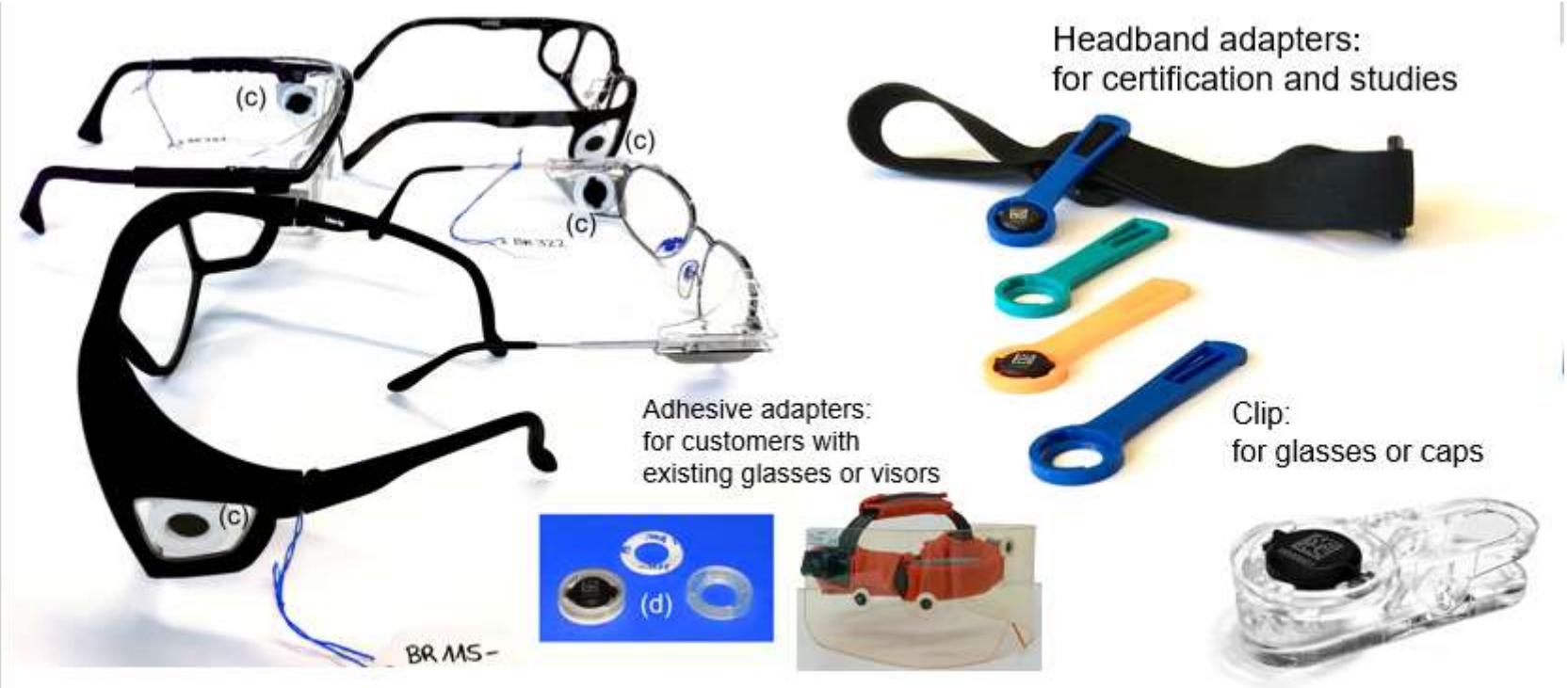
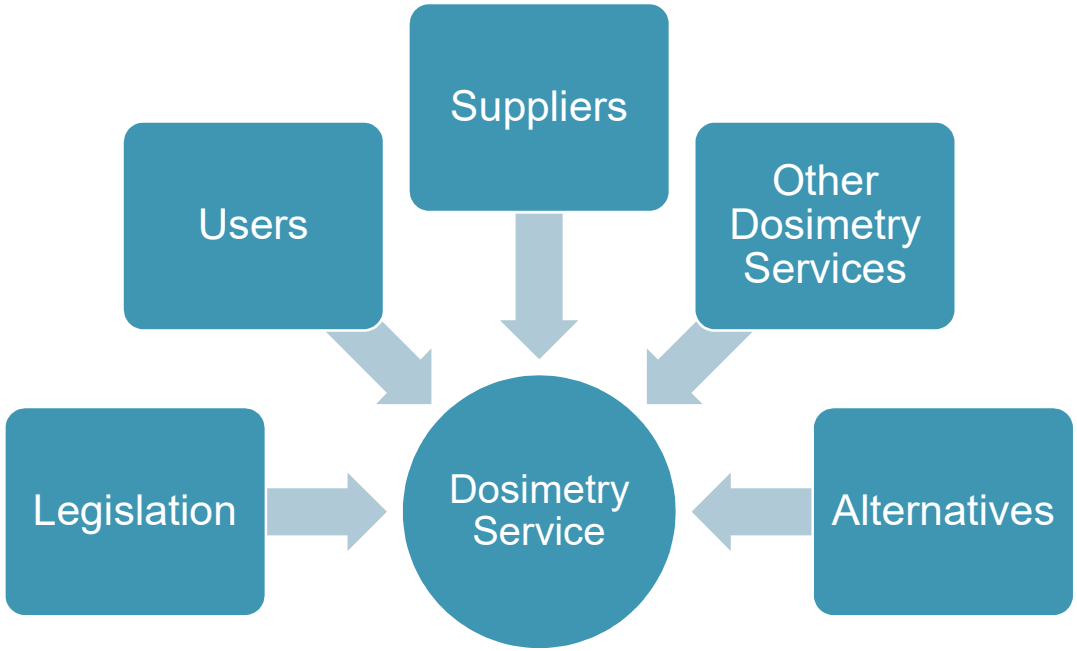
Other dosimetry services

- May be either partner/supplier or competitor
- Partner/supplier
  - Share development costs
  - No need to re-invent the wheel
- Competitor
  - Unique selling points
  - Price

Example offering of a large dosimetry service




Suppliers
Users
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Alternatives

Alternatives - substitutes

- Use $H_p(10)$ and/or $H_p(0.07)$ dosemeter
  - Whole body
  - Extremity
  - Specific wearing position

- "Conversion factor" from $H_p(10)$ and/or $H_p(0.07)$ (collar, whole body) to H_{eye}
- Demonstrate compliance based on risk assessments
- Sophisticated calculations like demonstrated with the "Podium" project ("Personal Online DosImetry Using computational Methods")

PODIUM
Personal Online DosImetry
Using computational Methods

EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH
CONCERT

03

Implementation example

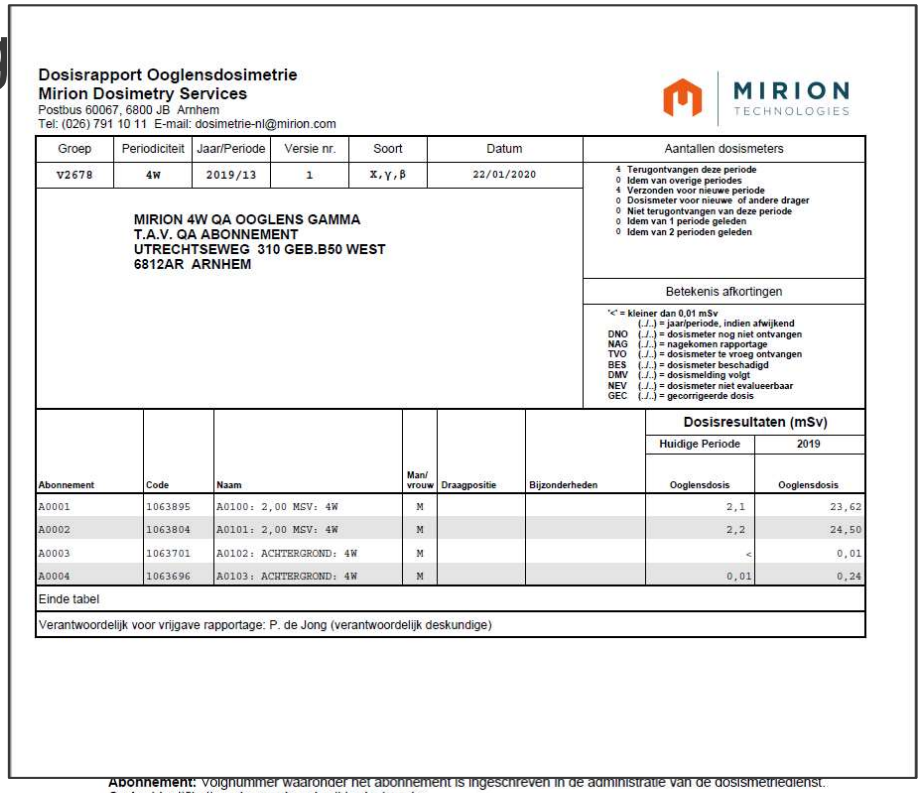
Mirion Dosimetry Services (Arnhem, the Netherlands)

Implementation at Mirion Arnhem (Netherlands)

- No provision for reporting eye lens dose to national dose registry NDRIS
- Additional to the approved dosimetry service (no formal approval required)
- Not within accreditation scope
- Outsourced measurements
- Headband type dosemeter
- Following the Guidelines of Netherlands Commission on Radiation Dosimetry

QA, training, IT, reporting

- Training staff
  - new procedures
  - Logistics
  - QA procedures
  - Customer service
- Dummy customer subscription
- Extra attention for transit doses
- Participation in EURADOS IC2019$_{ext,eye}$
- Integration in customer portal



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Groep	Periodiciteit	Jaar/Periode	Versie nr.	Soort	Datum
V2678	4W	2019/13	1	X,γ,β	22/01/2020

MIRION 4W QA OOGLENS GAMMA
T.A.V. QA ABONNEMENT
UTRECHTSEWEG 310 GEB.B50 WEST
6812AR ARNHEM

Aantallen dosismeters

4 Terugontvangen deze periode
0 Idem van overige periodes
4 Verzonden voor nieuwe periode
0 Dosismeter voor nieuwe of andere drager
0 Niet terugontvangen van deze periode
0 Idem van 1 periode geleden
0 Idem van 2 perioden geleden

Betekenis afkortingen

'<' = kleiner dan 0,01 mSv
(../..) = jaar/periode, indien afwijkend
DNO (../..) = dosismeter nog niet ontvangen
NAG (../..) = nagekomen rapportage
TVO (../..) = dosismeter te vroeg ontvangen
BES (../..) = dosismeter beschadigd
DMV (../..) = dosismelding volgt
NEV (../..) = dosismeter niet evalueerbaar
GEC (../..) = gecorrigeerde dosis

Abonnement	Code	Naam	Man/ vrouw	Draagpositie	Bijzonderheden	Dosisresultaten (mSv) Huidige Periode Ooglensdosis	Dosisresultaten (mSv) 2019 Ooglensdosis
A0001	1063895	A0100: 2,00 MSV: 4W	M			2,1	23,62
A0002	1063804	A0101: 2,00 MSV: 4W	M			2,2	24,50
A0003	1063701	A0102: ACHTERGROND: 4W	M			<	0,01
A0004	1063696	A0103: ACHTERGROND: 4W	M			0,01	0,24

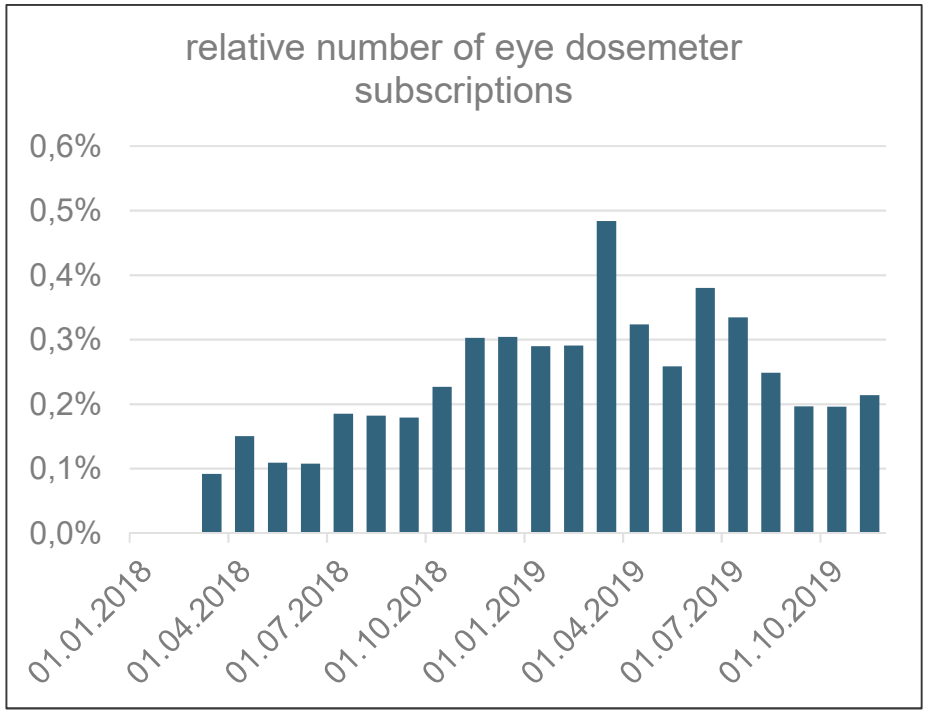
Einde tabel

Verantwoordelijk voor vrijgave rapportage: P. de Jong (verantwoordelijk deskundige)

Abonnement: Volgnummer waaronder het abonnement is ingeschreven in de administratie van de dosismetriedienst.
Code: Identifikatiecode van de gebruikte dosismeter.
Naam: Naam van de drager van de dosismeter gedurende de draagperiode.
Draagpositie: Geeft de opgegeven draagpositie weer.
Bijzonderheden: Voor mededelingen in deze rubriek wordt van afkortingen gebruik gemaakt, zoals rechtsboven aan de voorzijde van dit rapport is aangegeven.
Dosisresultaten (mSv)/Huidige periode: Het persoonsdosisequivalent $H_p(3)$ voor in de kop van het eerste blad

Implementation at Mirion Arnhem (Netherlands)

- Since start, requests from about 2% of all customers
- So far yearly doses < 10 mSv
- Meanwhile about half of them stopped the subscriptions (used only for survey / trial)
- Number of subscriptions peaked early 2019



04

Summary

Eye lens dosimetry: the dosimetry service perspective

Summary of the dosimetry service perspective

- Strategy will depend on local requirements
- Infrastructure for $H_p(3)$ has been build up
- Set-up and maintenance of a dosimetry system for $H_p(3)$ requires similar efforts as for any other dosimetry system
- Depending on local requirements and status of radiation protection practices, the number of actual subscriptions to eye lens dosimetry service will be limited to a relatively (or very?) low number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