Specialists in Delivery of Radiation

To Help Eradicate Cancer

Xstrahl

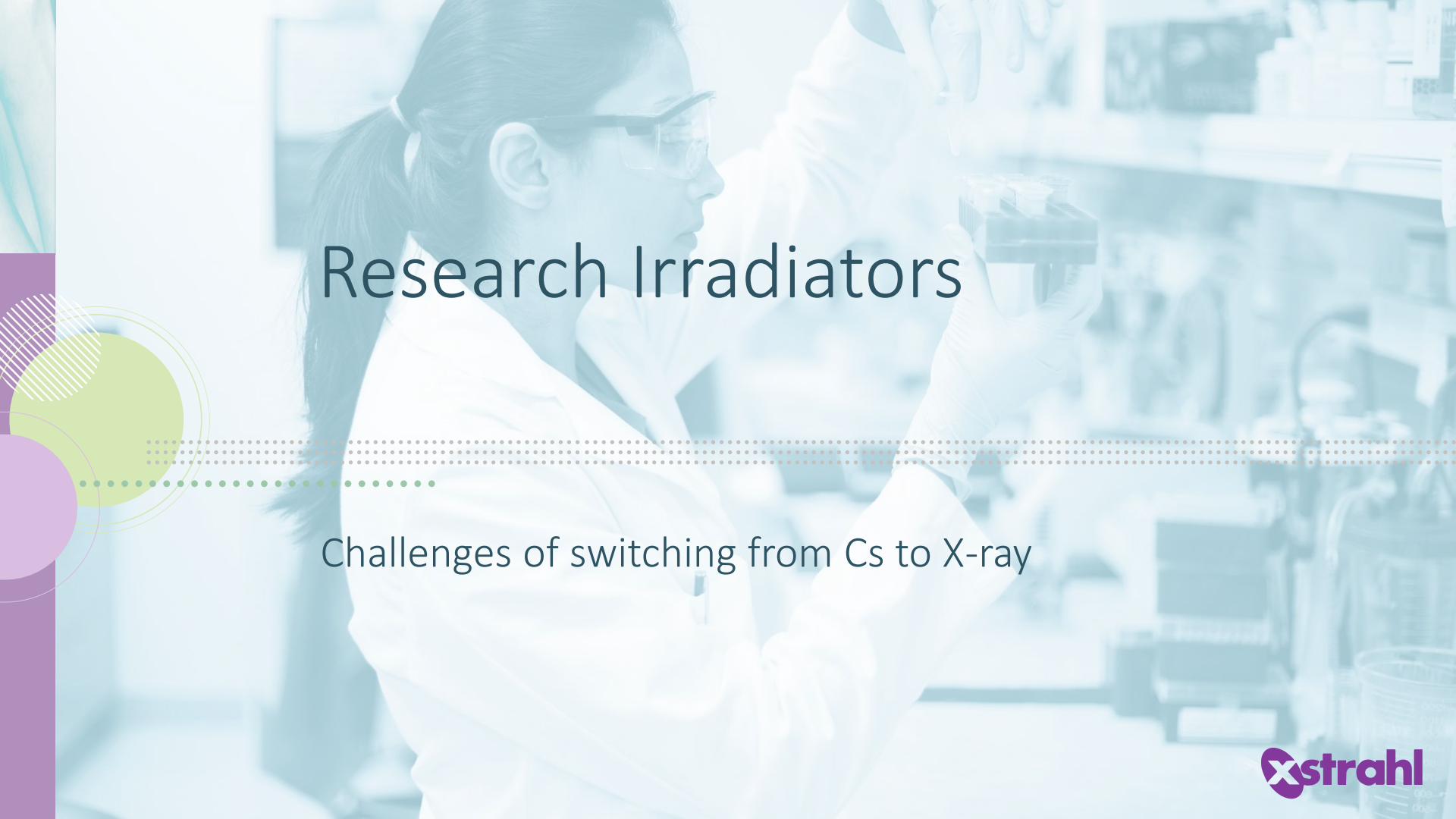
Summary

Non Ionizing solutions

1. Research Irradiators
   - Challenges of switching from Cesium to X-ray
   - The Xstrahl Approach
   - Physics considerations
   - Xstrahl Solutions.
     - Cabinets, SARRP
2. Electronic Brachytherapy
   - Skin cancer is a leading indication of use for Brachytherapy in the USA
   - RADiant – a viable alternative to Brachytherapy

Research Irradiators

Challenges of switching from Cs to X-ray



The Biggest Challenge .. Which RBE ?

Which RBE is applicable for each site, when switching from Cesium to Xrays ?

A Comparison of Cs-137 γ Rays and 320-kV X-Rays in a Mouse Bone Marrow Transplantation Model. Katherine M. Gott et al (April 2020)

- 320kV photon energy spectrum was suitable for ablating bone marrow, similar to that of 137Cs photons.
- However, X-rays were not as effective as the much higher energy gamma rays at depleting mouse splenocytes
- The X-ray doses used were less effective than the higher energy g rays in allowing the successful engraftment of donor bone marrow, potentially as a result of the incomplete depletion of the spleen cells

More defined studies are warranted

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Xstrahl's Approach to Our Customers:

We need to truly understand what is currently done on the caesium unit.

- Dose Delivered
- Dose Accuracy requirement
- The pre-clinical set up and most importantly the end points for the study

We listen to the whole team

- Open door meeting to allow full discussions with each research team

Forming strategic collaborations

- Connecting research groups, bringing together groups who have already switched their research to X-rays

Xstrahl's ongoing commitment to preclinical dosimetry

Development and Implementation of an End-To-End Test for Absolute Dose Verification of Small Animal Preclinical Irradiation Research Platforms

Ileana Silvestre Patallo et al, March 2020

Purpose of our three-year programme was to implement an end-to-end dosimetry test for small animal radiation research platforms to monitor and help improve accuracy of dose delivery and standardization across institutions.

Vendor miscalibration of preclinical orthovoltage irradiator identified through independent output check.

Quan Chen et al, Dec 2020

A recent article highlighted the impact of calibration errors, more absolute dosimetry training is needed for both vendors and end users for establishing accurate absolute dosimetry.

Dosimetry this is key requirement of any supplier supporting Caesium replacement and the importance of the right partner

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Physics considerations

- X-ray cabinets are more flexible in terms of physics parameters
- Dosimetry and QA are necessary [1,2,8-10]
  - ➢ Also for the Cs source to be replaced!
- Knowing the HVL is key
- Compton vs Photo-electric effect [9]
  - ➢ Different RBE for different energies – and different sites!
- Dose response studies unavoidable
  - ➢ Necessary for any change in equipment

- In the end x-rays are x-rays: we buy tubes from the same vendors

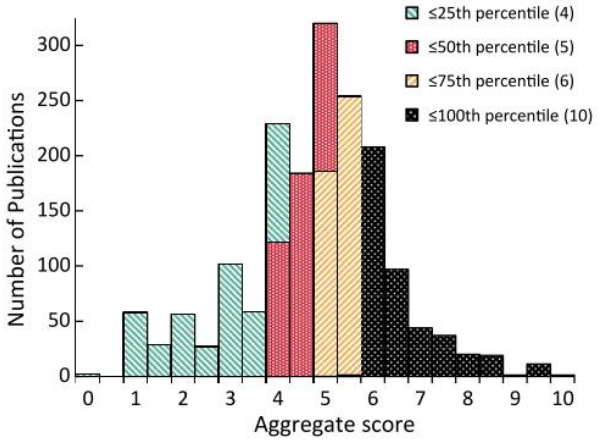
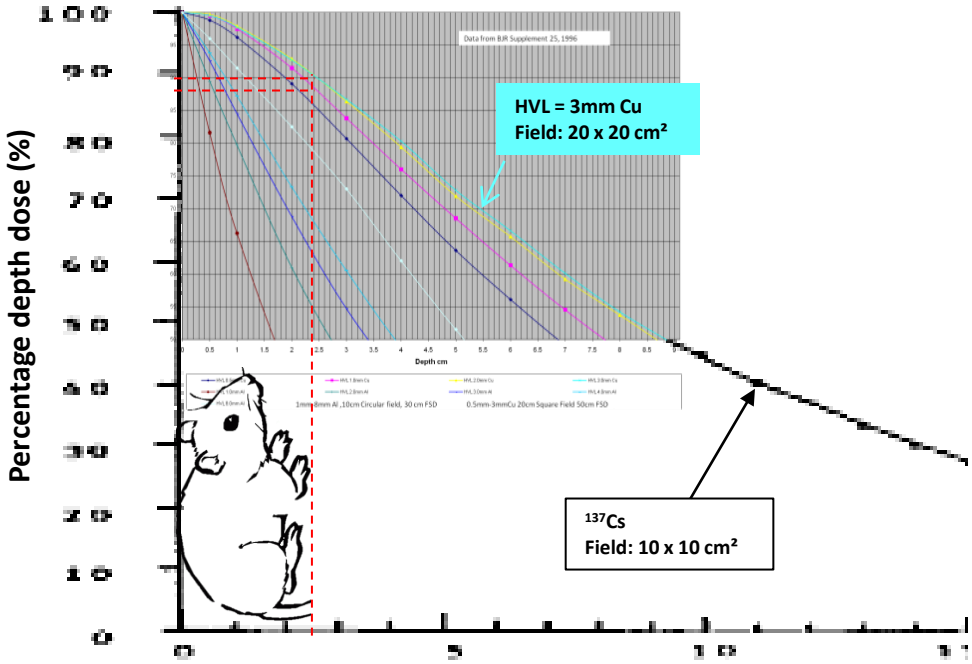


Fig. 4. Statistical distribution of the aggregate reporting score for physics and dosimetry experimental detail reporting in the reviewed literature. The average score ± standard deviation was 4.80 ± 1.6. The majority of articles scored in the 4 to 6 range.

Draeger et al, IJROB 106 (2), 2020

CIX In Vivo: ^{137}Cs V X-Rays Depth Dose



Depth (cm)	X-rays [1] (SSD = 50 cm)	Cs-137 gamma rays (SSD = 50 cm)	Co-60 gamma rays (SSD = 50 cm)
0	100	100 (0.12 cm)	100 (0.5 cm)
1	96.5	95.4	96.7
2	88.3	88.5	90.1
3	78.8	81.2	83.6
4	69.0	74.0	77.3
5	60.1	67.6	71.3

[1] Half-value layer = 3 mm of copper.

Percentage depth dose in water, 6 x 6 cm² field

Technical Report Series 328, *Planning of radiotherapy facilities, Report of a joint IAEA/WHO meeting*, World Health Organization, Geneva (**1966**)

Physical approach to depth dose distributions in a water phantom irradiated by a teleisotope photon beam, Ahuja et al, Med. Phys. 7, 120 (1980)

Research Irradiators

Xstrahl Range of X-ray Irradiators

Xstrahl Life Science Irradiators

CIX

Compact, versatile, fully-shielded cabinet irradiators

XenX

Image-guided 3D irradiation platform; scalable, advanced targeting options

SARRP

Full CT-guidance, with monitoring, gating, dosimetry and optical guidance

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CIX Cabinet Irradiators

- Fully-shielded design can be used in virtually any laboratory; fixed orientation of the beam
- Space-saving, lead-lined vertical door (manual counter-balanced)
- Range of kV and dose rate; focal spot distance from 200mm to 700mm
- Simple user interface; full range of accessories
- Uniform field with unique filter technology

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XenX

Supports high throughput targeted irradiation studies on cells and small animals

- On-board 2D portal X-ray imaging
- High precision beam geometry to achieve 3D-conformal dose distributions
- Simplified targeting and dose calculations
- Scalable image-guided platform that can be upgraded with your research requirements

SARRP

Provides state-of-the-art 3D volumetric image guidance for target localization and dose delivery

- On-board Cone Beam CT imaging system
- High precision beam geometry to achieve 3D-conformal dose distributions
- Submillimetric image-guided accuracy
- Dedicated easy to use and intuitive Treatment Planning Software

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Electronic Brachytherapy

A viable alternative to HDR Brachytherapy

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Brachytherapy for treatment of Non-Melanoma Skin Cancer

- The World Health Organization (WHO) estimates that between 2 million and 3 million nonmelanoma skin cancers (NMSC) are diagnosed worldwide each year.
- HDR Brachytherapy is used for both superficial and Interstitial indications.
- An Estimated 14% of HDR is used for treating skin cancer
- Electronic Brachytherapy is a viable alternative to HDR

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RADiant – Dual Modality System

kV	**10-80 kV**
mA Range	**up to 2mA**
Max HVL	**2.26mm Cu**
95% dose line	**1.5mm***
Clinical Energies	**Up to 3**
Applicators	**Up to 5**

SKIN CONDITIONS

- ✓ Dermatological conditions
- ✓ BCC, SCC, Bowens disease

BENIGN CONDITIONS

- ✓ Keloids

Key Features

- Mobile system in the treatment room
- Minimal room shielding required
- Integrated cooling system & generator
- Applicator recognition
- Dose rates of 1Gy to 3Gy per minute
- Typical treatment time <3 mins
- 80kV, 100% on the skin surface, 94% at 1mm and 70% at 5mm
- Combined electronic brachytherapy and superficial radiotherapy system using low energy photons

*depth in water

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Electronic Brachytherapy

"These devices provide effective dose over a few to several millimeters, depending on the energy of the source and how deep the dose is specified. The data for eBT are very limited, but preliminary reports show excellent responses and minimal toxicity."

Kasper M, Chaudhary A. Novel treatment options for nonmelanoma skin cancer: focus on electronic brachytherapy. *Med Devices (Auckl)*. 2015;8:493-502 https://doi.org/10.2147/MDER.S61585

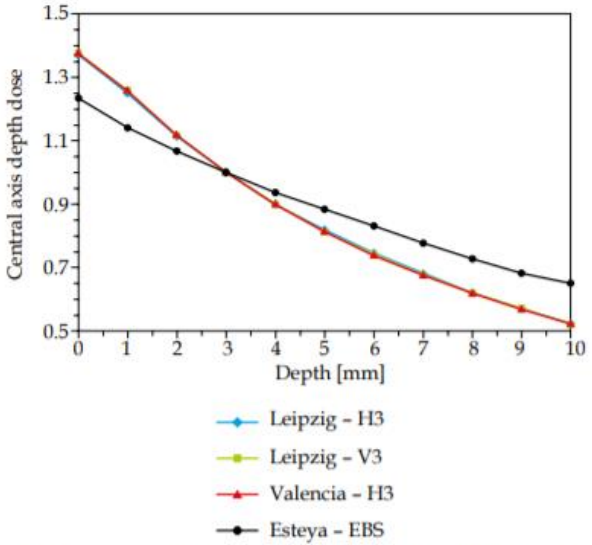

Fig. 5. 30 mm applicator central axis depth dose normalized @ 3 mm

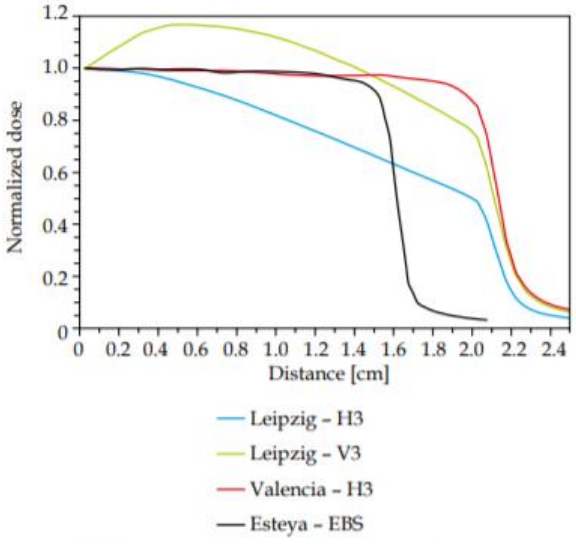

Fig. 6. Half profiles at 5 mm depth normalized to the central axis value for the 30 mm in diameter applicators

Garcia-Martinez T, Chan JP, Perez-Calatayud J, Ballester F. Dosimetric characteristics of a new unit for electronic skin Brachytherapy. J Contemp Brachytherapy. 2014;6(1):45–53

Xstrahl is here to help

- Postdoc Support team
- Range of Products to suit Research and clinical needs
  - X-ray Cabinets
  - 3D Irradiators
  - Electronic brachytherapy
- Library of publications to support system use

Innovation

- Xstrahl are continuing to develop solutions for delivery of Radiation.
- Working with universities and industrial partners across the globe we are funding innovation
- New technologies to enable Flash Radiotherapy, High dose rate irradiation, extending electronic Brachytherapy and making irradiators more accessible in developing countries


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