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REGION

Radiobiological optimization including consideration of secondary cancer risk: A treatment modality comparison study for pediatric medulloblastoma

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Tack!

- Per Munck af Rosenschöld
- Marianne Aznar
- Per Nilsson
- Thomas Björk-Eriksson
- *Ivan Vogelius*

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Late effects after cancer treatment

- Late effects are a big issue for modern day cancer patients

- Attributable to better treatment
  - Surgery
  - Chemotherapy
  - Radiotherapy

- Secondary cancers
  - Increased awareness - especially for young patients
  - Several risk modeling strategies proposed
  - Radiotherapy being the main contributor

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Secondary cancers

- Nearly 14% of cancer survivors develop a second cancer within 25 years after treatment
- Second cancer ≠ recurrence or metastasis
- Higher risk for younger patients

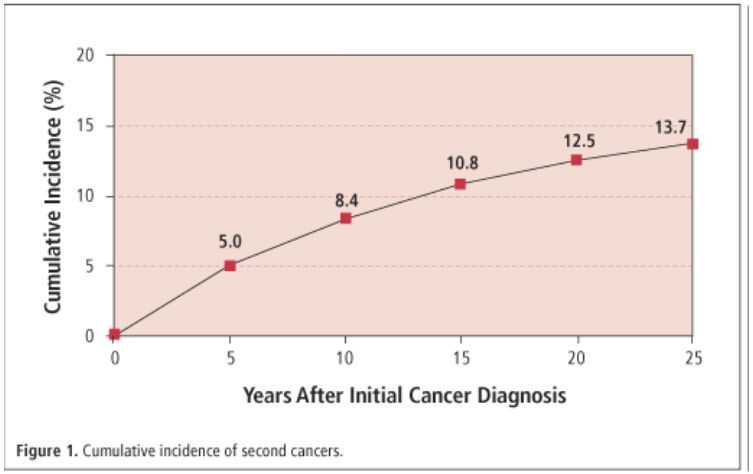
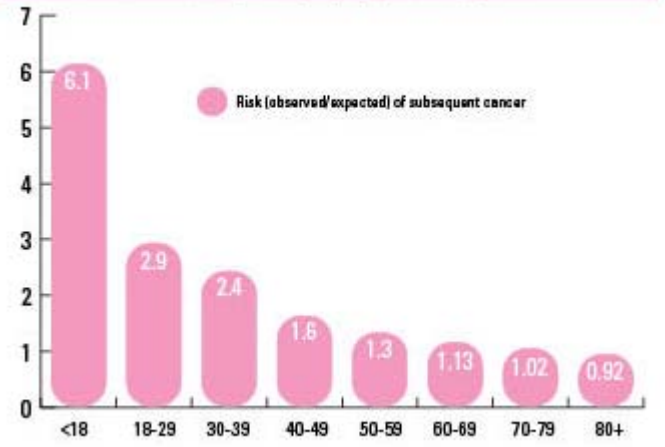


Figure 1. Cumulative incidence of second cancers.

Table

Risk of Second Malignancy by Age at Diagnosis



Adapted from reference 1.

National Cancer Institute. SEER Cancer Statistics Review 1975-2003. Available at: http://seer.cancer.gov/csr/1975_2003/. Accessed January 20, 2007.

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- Non-cancer adverse effects
  - e.g. lung and heart complications

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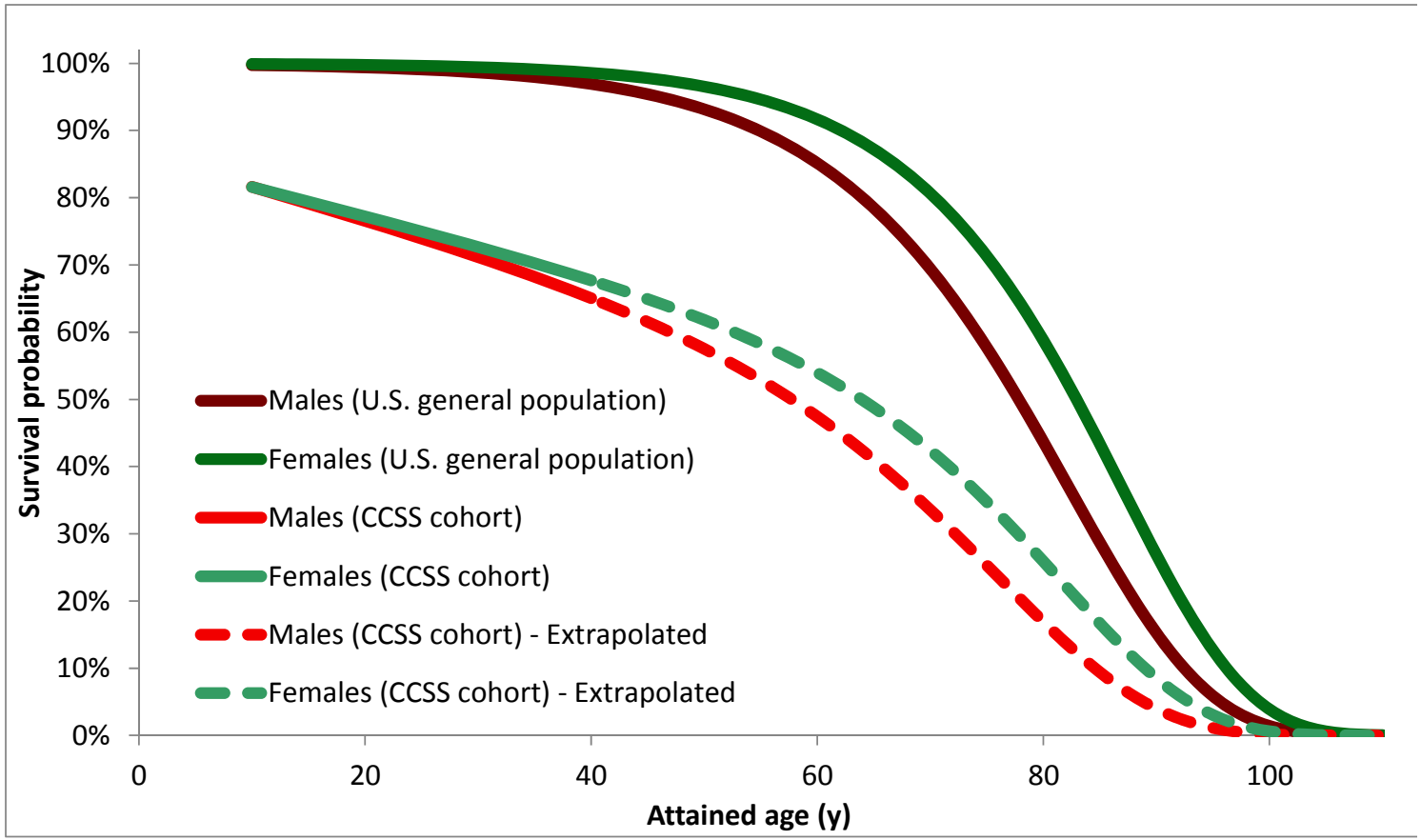
Childhood Cancer Survivor Study (CCSS)



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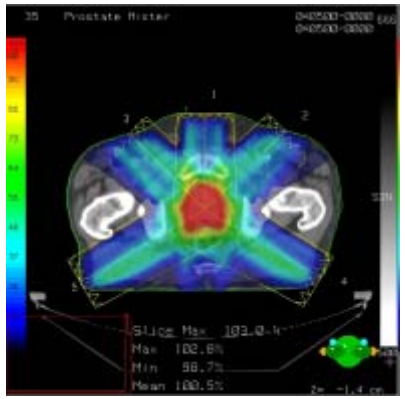
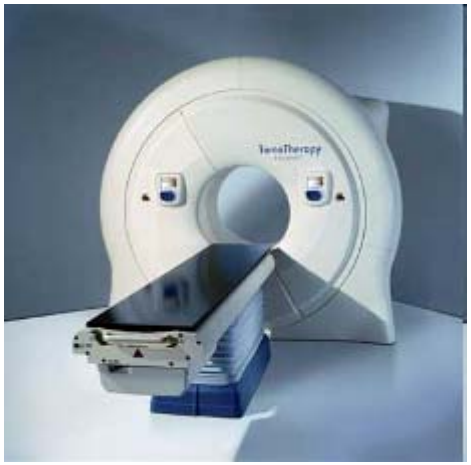
Radiotherapy

- 3D conformal (3D CRT)
- Intensity-modulated (IMRT)
- Rotational therapy (RapidArc, Tomotherapy, VMAT)
- Particle therapy (Protons, Ions)





Treatment planning today

- Advanced treatment modalities used to create highly conformal dose distributions
  - Enables sparing of organs at risk to some extent

- Currently sparing is focused on minimizing early appearing toxicity
  - Bowel toxicity
  - Brainstem injury
  - Rectal bleeding
  - Also some later appearing toxicity like e.g. xerostomia

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Purpose of study

- Estimate risks of secondary cancr risks and risks of non-malignant toxicities for peadiatric medulloblastoma patients
- Compare these estimates between different treatment techniques
- Attempt to optimize the radiotherapy plans with respect to long-term risks

Risk modelling – OED (Organ-equivalent dose)

- Concept developed by Schneider et al. in 2005
- A model which describes the secondary cancer risk from an inhomogeneous dose distribution
- Using the data from a DVH one can calculate an OED given in Gy that represents:
  - The same secondary cancer risk as a homogeneous irradiation to that dose would yield
- Requires empirical data

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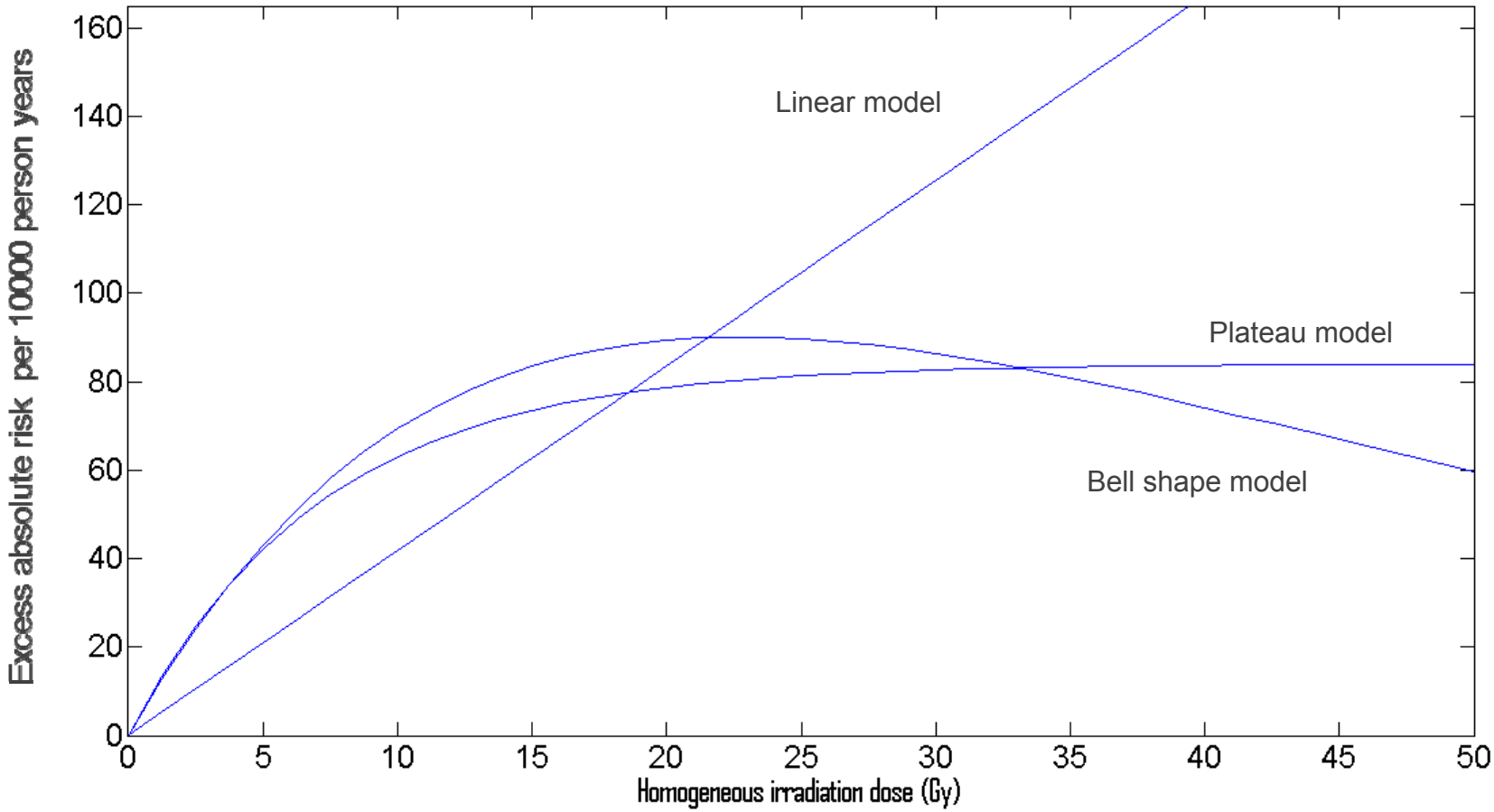
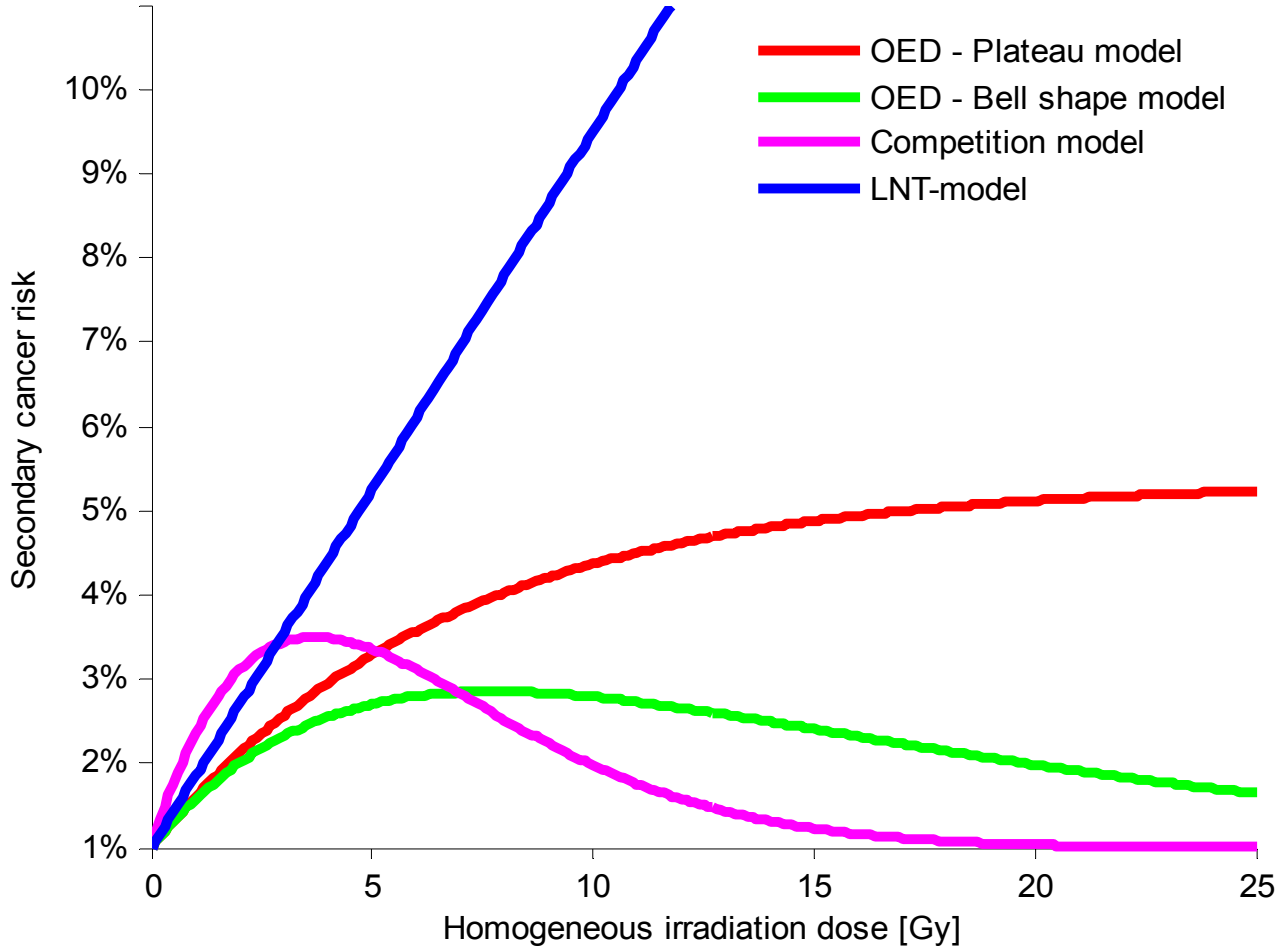
Risk modelling – OED (Organ-equivalent dose)



Secondary lung cancer risk



Pediatric medulloblastoma

- Primitive neuroectodermal tumor in the posterior fossa
- ~20% of childhood brain tumors
- 5-year survival ~80% for standard risk patients
- Treatment consists of:
  - Surgery
  - Post operative radio- and chemotherapy
- The impact of chemotherapy is not considered in this study!

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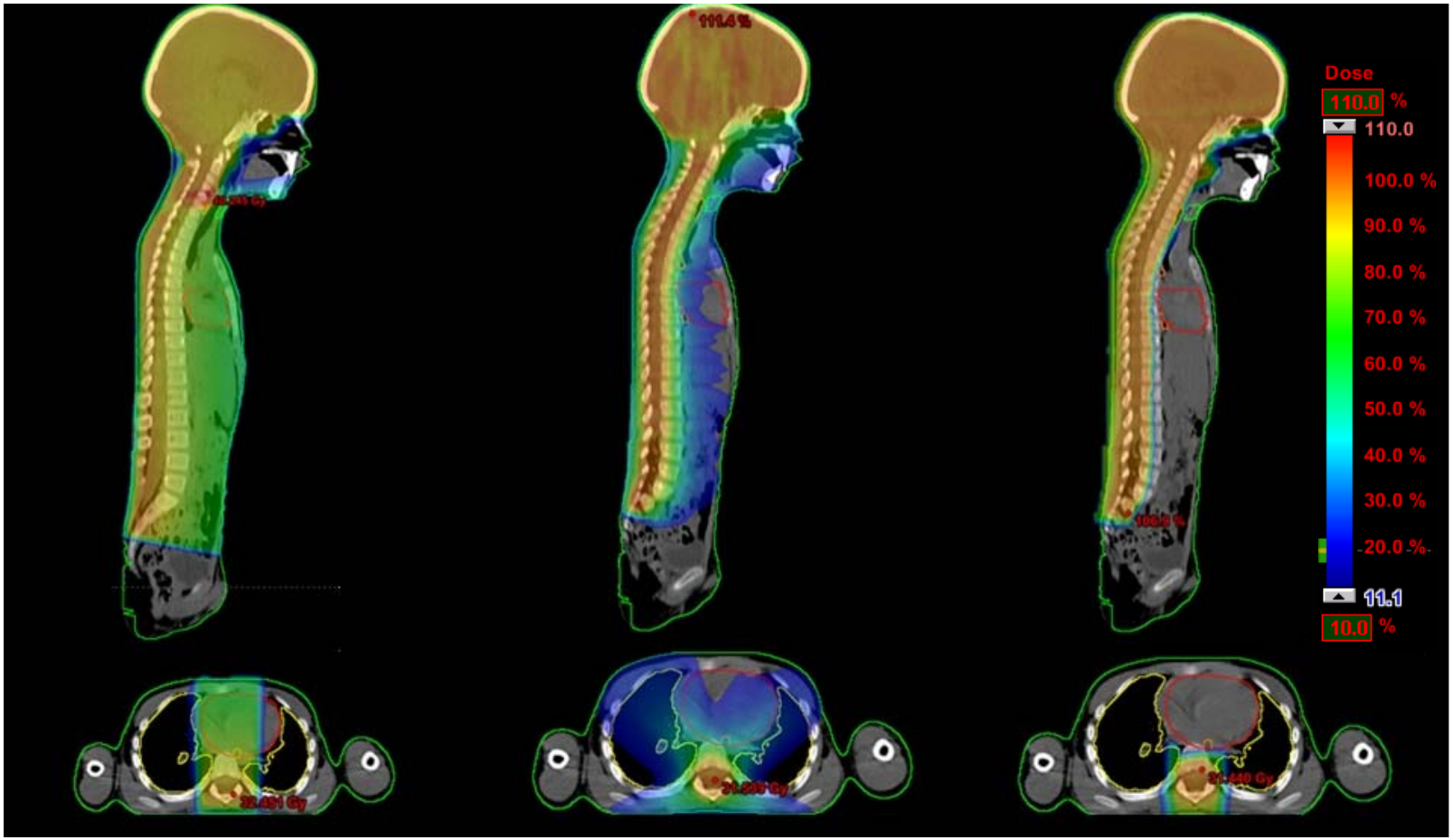
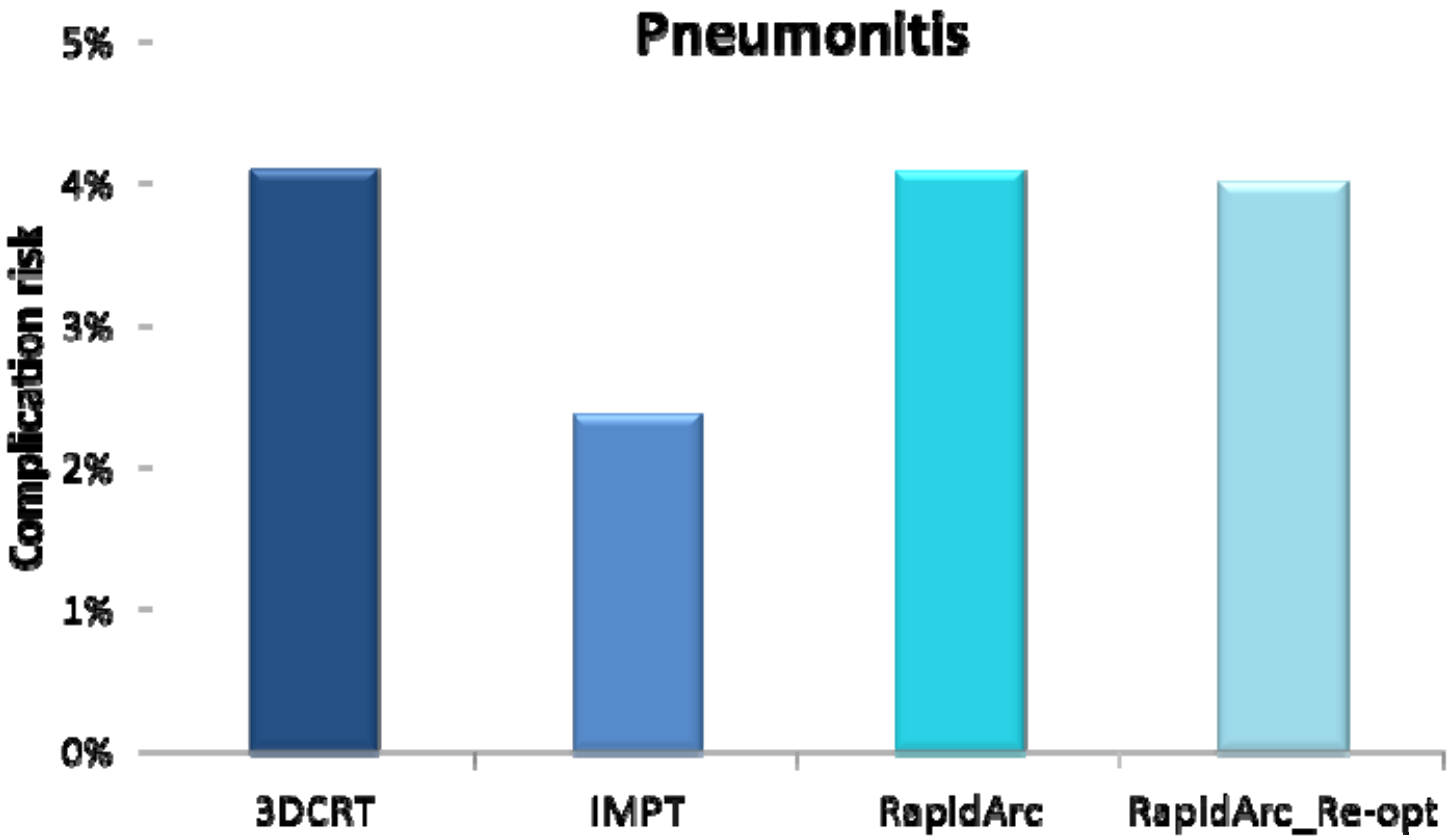
Paediatric craniospinal irradiation



3D CRT RapidArc IMPT

Results – Normal tissue toxicity



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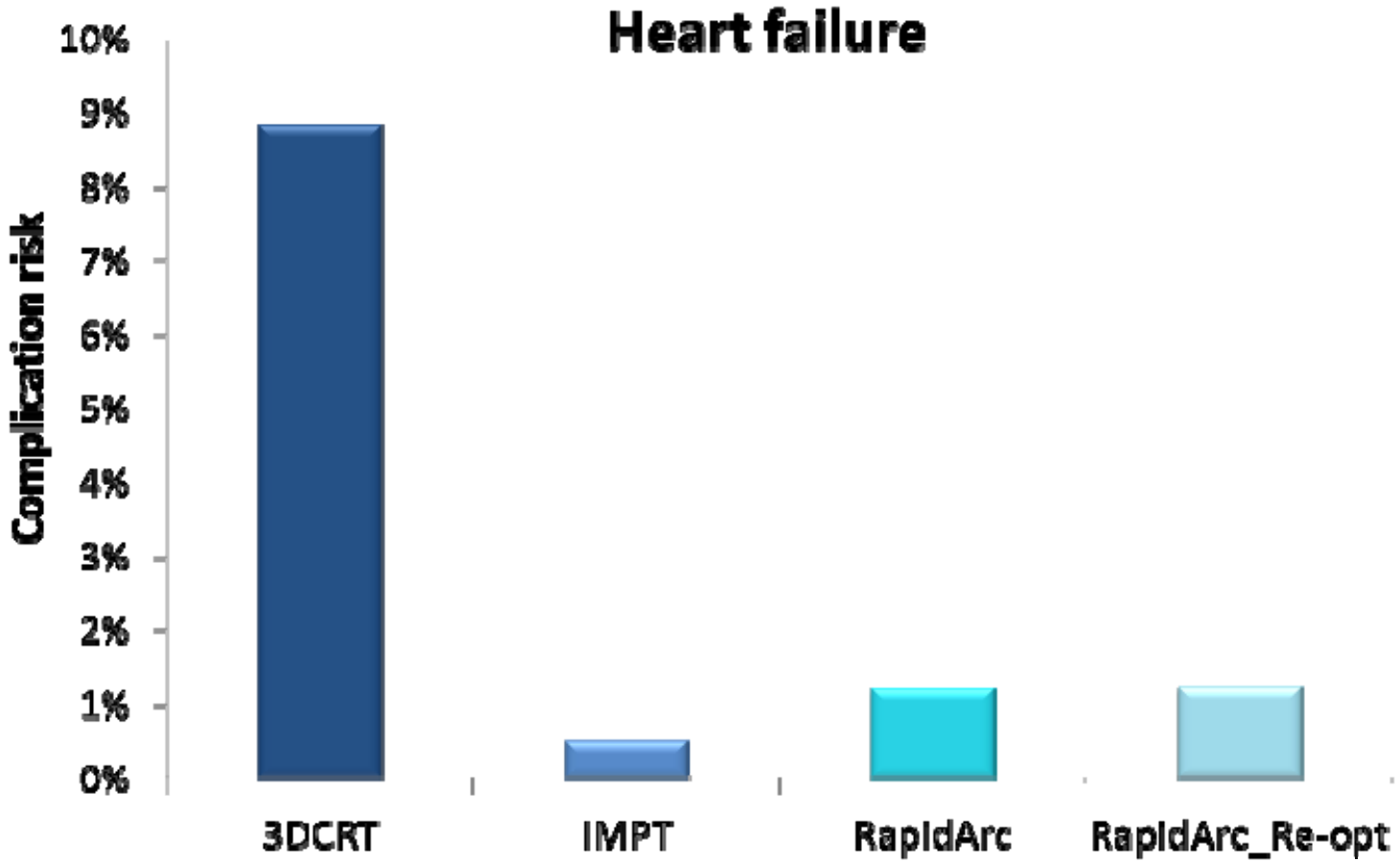
Results – Normal tissue toxicity



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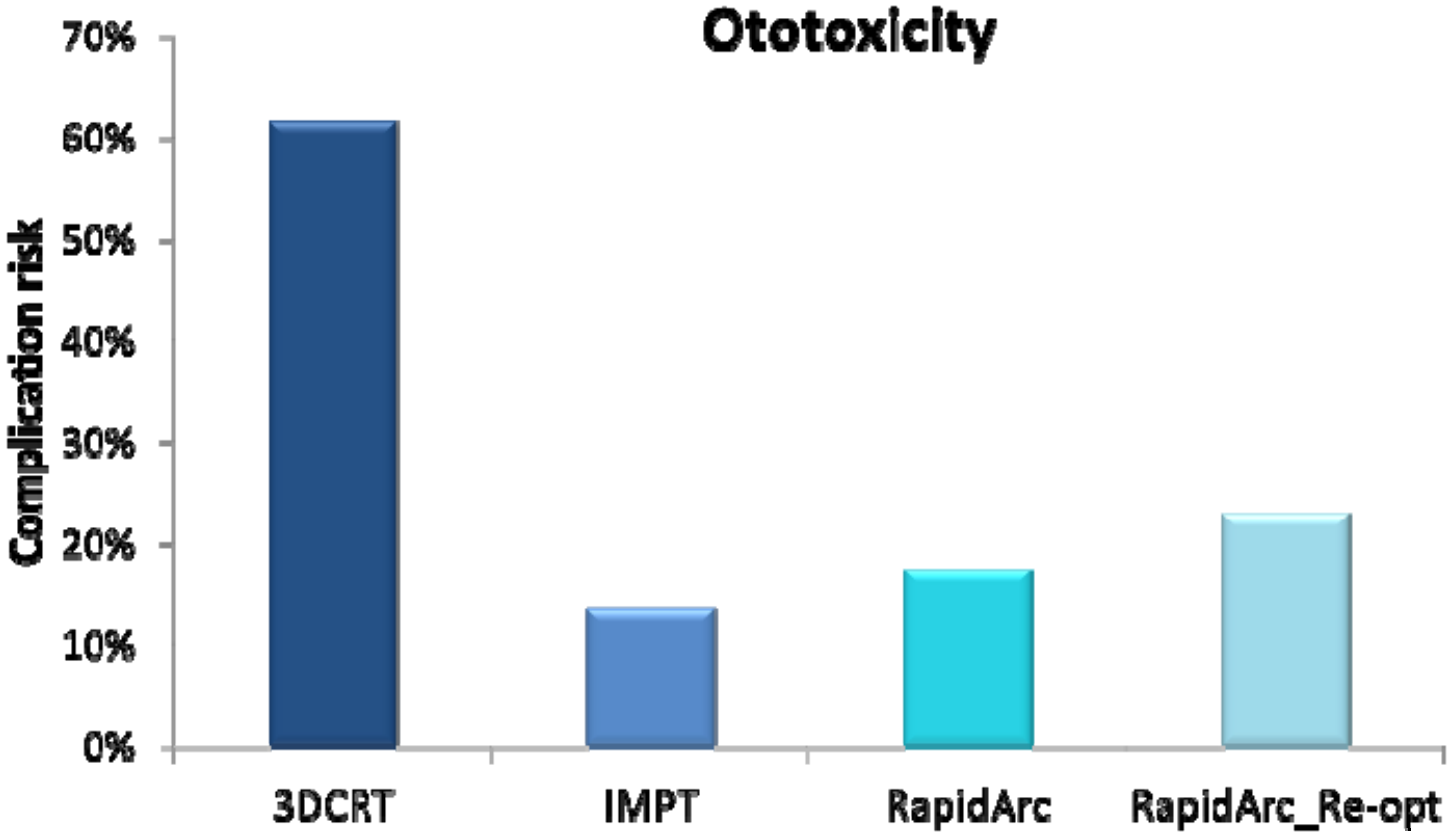

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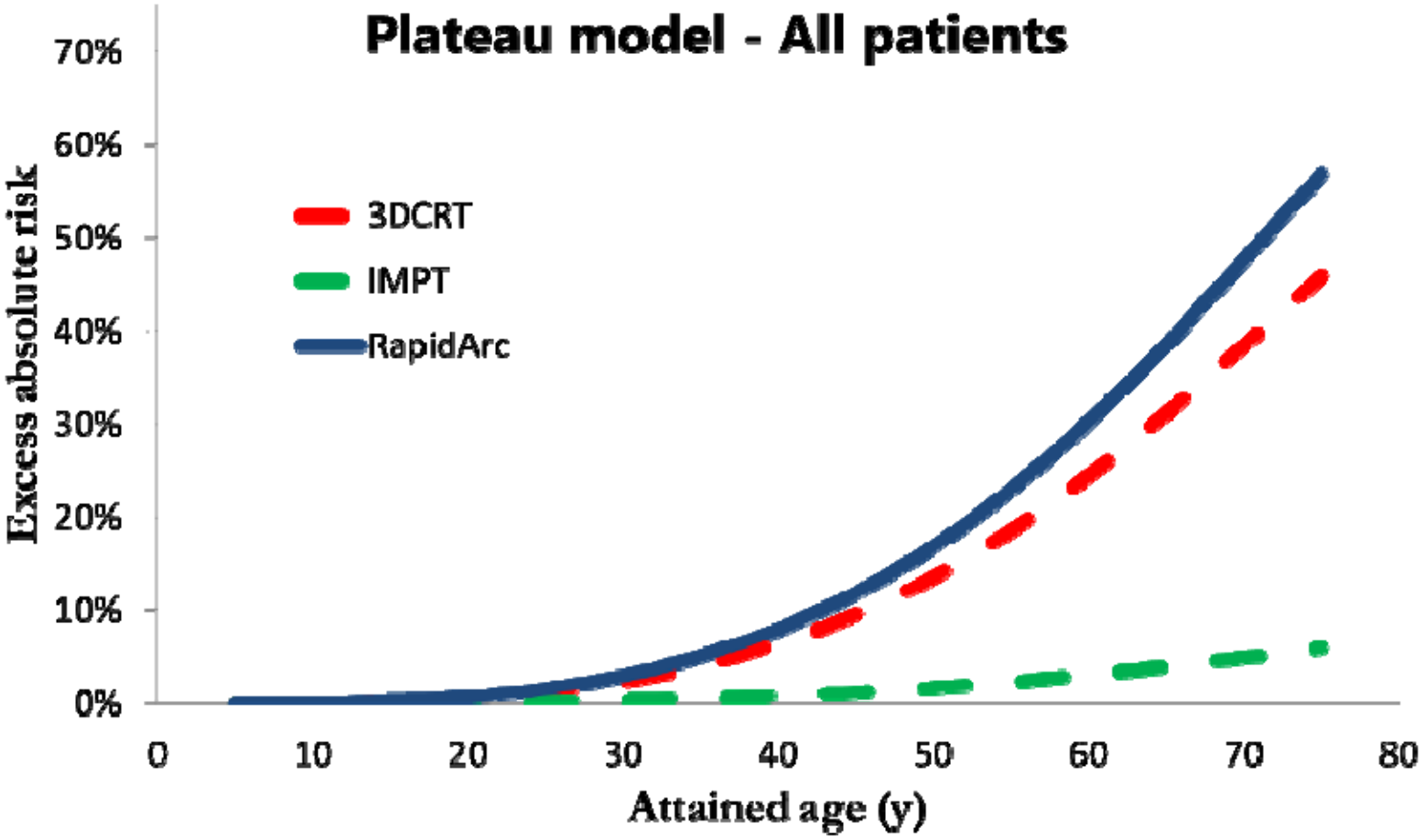
Results – Risk of solid secondary cancer



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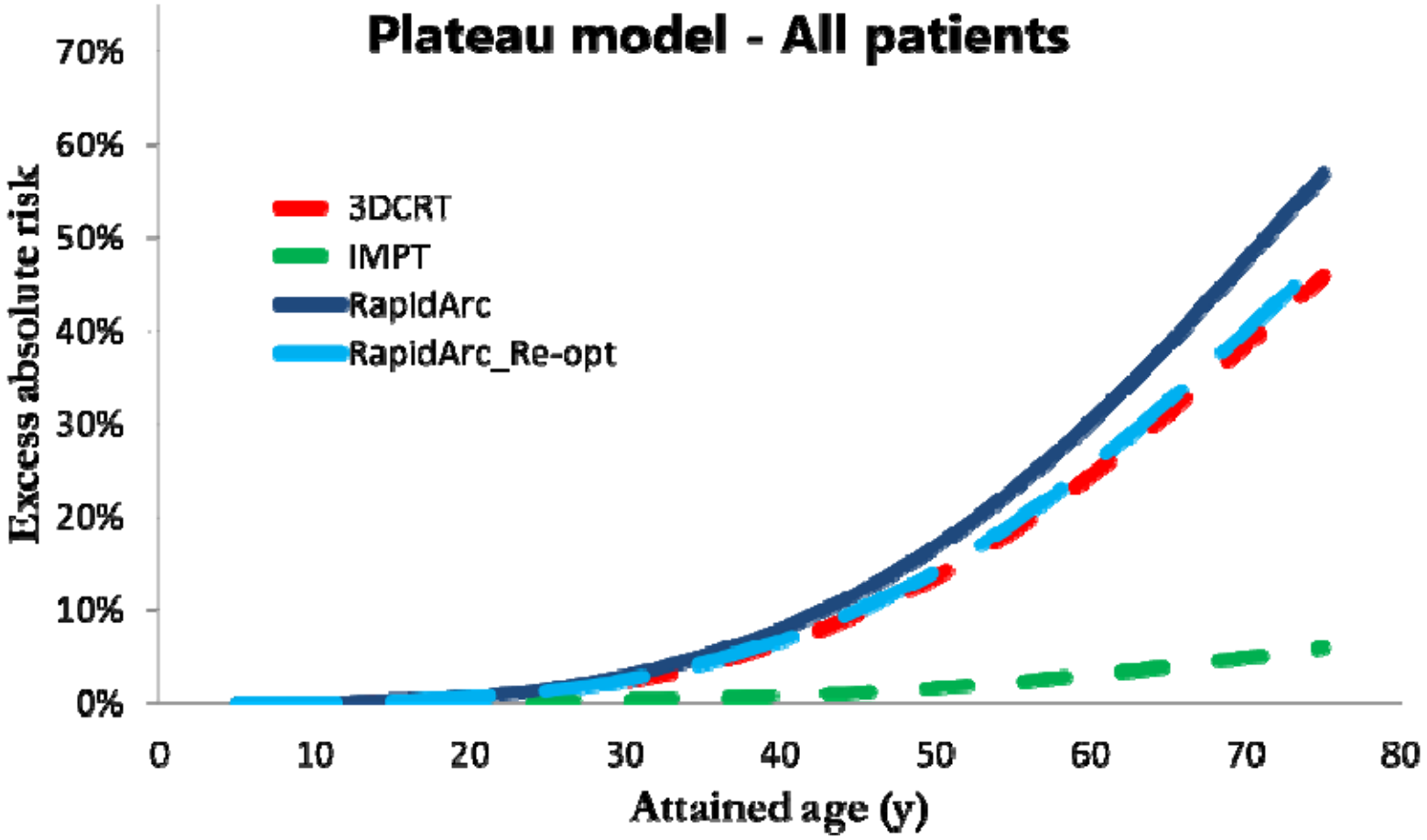

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Optimizing with respect to secondary cancer risk

- Promising results, the risk can be manipulated
- PTV coverage remained the same
- But…
- The coverage of the spinal part of the PTV was somewhat deteriorated

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Conclusions and future prospects

- Optimizing treatment plans for medulloblastoma patients appears promising
- Not enough to look at only tumor control or only late effects, consider the big picture
- Integrating it into the treatment planning would allow for direct risk based optimization – Visionary, but we are working on it

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Thank you for your attention!

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Även ett stort tack till Børnecancerfonden!