Challenges in Pediatric radiotherapy

Thurandrie Naiker and Jeannettes Parkes
Why is there a need?

World

- 2018: 18.1 million
- 2040: 29.5 million

Africa

- 2018: 1.055 million
- 2025: 1.315 million
- 2030: 1.544 million
- 2040: 2.123 million
What cancers do kids get?

Estimated age-standardized incidence rates (World) in 2018, worldwide, both sexes, ages 0-14

Data source: GLOBOCAN 2018
Graph production: Global Cancer Observatory (http://gco.iarc.fr/) © International Agency for Research on Cancer 2018
Improved survivals are largely due to carefully planned Paediatric research protocols.

Bits should not be extracted and used in isolation.

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Radiotherapy is an essential part of the treatment of cancer.

Over 30 African and Asian countries have no access to radiotherapy.

There is a shortfall of over 5000 radiotherapy machines in the developing world.

IAEA has initiated PACT to comprehensively address this urgent problem.

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**Accessibility of Radiotherapy**

Number of people served by a single radiotherapy centre (latest available data 1995–2003)

- Below 500,000
- 500,000–999,999
- 1–4.9 million
- 5–9.9 million
- 10–19.9 million
- 20 million and above
- No centre
- No data
Where are the children?
From a radiation perspective... How do children differ from adults?

- Different diseases
- Survive longer
  - Severity of late effects
- Techniques of radiotherapy
- Anaesthesia
- Time

Disease incidence and epidemiology
What is the impact of providing radiotherapy?
Where do radiation Oncologists fit into things?

Adults
Children
Radiation
Chemo
Palliative care
Haematology
## How is radiotherapy delivered?

### Planning process
- Sedation
- Immobilization
- Localization
  - Simulation
  - CT
  - Clinical
- Planning
  - 2D
  - 3D

### Treatment process
- Type of RT?
- Energy required
- Set up
- QA

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**Children need time, time, time!**
Sedation vs. anesthesia

Who needs it?
- Anyone who can’t lie still!
  - Almost all kids < 5 years old
  - Most kids 5-6 yrs old
  - A few kids > 6 yrs

- Maximum sedation is necessary for cast making/planning.

- Less sedation may be possible at subsequent treatment dates.

- Anesthesia is seldom easily available
Cancer is more deadly in the LMICs!
At least 179,000 children < 15 years are diagnosed with cancer each year:

- HIC Incidence = 140/1m  Mortality 30/1m
- LMIC Incidence = 70-100/1m  Mortality 50-70/1m

80% live in LMICs, and these children account for most of the 90,000 deaths that occur.

Lancet Oncol 2013;14:e104–16
So why haven’t LMICs prioritised children’s cancer?

- More than 80% of children with cancer who live in LMIC don’t have access to modern treatment and enjoy much lower survival rates.
- Before 2000 more than 10 million children died annually ... (90% of them in 42 countries ...)

- Prematurity
- Intrapartum death
- Pneumonia
- Diarrhoea
- Malaria

And health priorities are focused on these conditions.
...But we are getting better.....

Global Under 5 Mortality

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2010</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>9.9m</td>
<td>7.6m</td>
<td>6.3m</td>
</tr>
</tbody>
</table>

So that is very encouraging!

Sub-Saharan Africa 49.6%

South Asia 32%

Lancet. 2012;379:2162-72
Lancet. 2015;385:430-40
Adapting treatment regimens for use in LMIC

- Adapted diagnosis
- Adapted staging
- Adapted risk stratification
- Adapted treatment
- Adapted response evaluation
- Adapted follow-up
<table>
<thead>
<tr>
<th>Service line</th>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>General description</td>
<td>Pilot project</td>
<td>Some basic oncology services</td>
<td>Established pediatric oncology program with most basic services and a few state-of-the-art services</td>
<td>Pediatric oncology program with all essential services and most state-of-the-art services</td>
<td>Pediatric oncology center of excellence; state-of-the-art services and some highly-specialized services (e.g. photon or proton beam radiation therapy, MIBG therapy, phase I studies)</td>
</tr>
<tr>
<td>Typical settings</td>
<td>Centers in LIC in disadvantaged areas</td>
<td>Centers with relatively greater resources in LIC, disadvantaged areas in lower MIC</td>
<td>Centers with relatively greater resources in lower MIC, disadvantaged centers in upper MIC</td>
<td>Many centers in upper MIC, most centers in HIC</td>
<td>Selected super-specialty centers that offer very advanced and high-quality tertiary and quaternary care</td>
</tr>
<tr>
<td>Radiation therapy</td>
<td>Radiation therapy facilities</td>
<td>None</td>
<td>Cobalt machine</td>
<td>Cobalt machine*/Linear accelerator *Cobalt machine with 3-D planning capability in areas with poor electricity supply</td>
<td>Linear accelerator with fully integrated planning system</td>
</tr>
<tr>
<td></td>
<td>Radiation therapy planning tools</td>
<td>None</td>
<td>2D planning</td>
<td>3D planning available to most patients</td>
<td>3D planning, full conformal radiation therapy available, intensity-modulated RT and/or VMAT available to some patients</td>
</tr>
<tr>
<td></td>
<td>Radiation Oncologists</td>
<td>None</td>
<td>Radiation Oncologists with adult expertise</td>
<td>Radiation Oncologists with some pediatric experience</td>
<td>Radiation Oncologists with pediatric expertise</td>
</tr>
<tr>
<td></td>
<td>Anesthesia for RT</td>
<td>None</td>
<td>Sedation only</td>
<td>Sedation/anesthesia from general anesthesiologist available for some pediatric patients</td>
<td>Sedation/anesthesia from Pediatric anesthesiologist available for most pediatric patients</td>
</tr>
<tr>
<td></td>
<td>Radiation therapy personnel (Medical physicists/ RTTs)</td>
<td>None</td>
<td>Few personnel, no pediatric expertise</td>
<td>Adequate personnel with some pediatric expertise</td>
<td>Adequate personnel with advanced technique and pediatric expertise</td>
</tr>
<tr>
<td></td>
<td>Radiation therapy effective access</td>
<td>None</td>
<td>Radiation therapy available to some patients some of the time; frequent delays</td>
<td>Conformal radiation therapy available to most patients most of the time; occasional delays</td>
<td>Modern radiation therapy options reliably available to all patients in a timely way</td>
</tr>
</tbody>
</table>
Adapting the technology to available resources.....
Protocol development is critical

<table>
<thead>
<tr>
<th>Pre-treatment preparation including anesthetic requirements</th>
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</thead>
<tbody>
<tr>
<td>Pre-treatment imaging</td>
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<tr>
<td>Specification of treatment prescription:</td>
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<tr>
<td>Volume specification</td>
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<tr>
<td>Absorbed dose prescription</td>
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<tr>
<td>Fractionation and treatment time</td>
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<tr>
<td>Relation to concomitant therapies</td>
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<tr>
<td>Surgery</td>
</tr>
<tr>
<td>Drug therapy</td>
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<tr>
<td>Treatment planning</td>
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<tr>
<td>Treatment technique</td>
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<tr>
<td>Dose computation</td>
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<tr>
<td>Treatment plan evaluation</td>
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<tr>
<td>Image guidance schedule and tolerances</td>
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<tr>
<td>In-vivo-dosimetry</td>
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<tr>
<td>Quality management</td>
</tr>
<tr>
<td>Pre treatment patient-specific dosimetry</td>
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</tbody>
</table>

Once you have chosen a protocol:
- You must fastidiously use it!
- You must collect all the data
- You must audit your outcomes
- And you must adjust based on those outcomes!

As NICE in the UK points out an AUDIT CYCLE is …
- AUDIT – ADJUST – AUDIT

And then you must publish it!
# Online Networks

<table>
<thead>
<tr>
<th>Organizations</th>
<th>Education Initiatives</th>
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<tbody>
<tr>
<td>PROS LMIC Resources &amp; Forum</td>
<td><a href="http://www.intpros.org">www.intpros.org</a></td>
</tr>
<tr>
<td>Pediatric Radiation Oncology in LMIC working group of SIOP-PODC</td>
<td>Monthly meetings at <a href="http://www.cure4kids.org">www.cure4kids.org</a></td>
</tr>
<tr>
<td>Chart rounds</td>
<td>Scheduled meetings between leaders at cancer treatment institutions and physicians &amp; physicists in various locations to discuss patient management &amp; treatment plans. <a href="http://www.chartrounds.com">www.chartrounds.com</a></td>
</tr>
<tr>
<td>AFRONET</td>
<td>Multidisciplinary virtual tumor board</td>
</tr>
</tbody>
</table>

**PROS LMIC Resources & Forum**

The PROS LMIC Resources & Forum is a platform for professionals working in LMIC (Low and Middle Income Countries) to share knowledge and resources. The website, www.intpros.org, is a hub for accessing information, networking, and collaborating with peers.

**Pediatric Radiation Oncology in LMIC working group of SIOP-PODC**

This group focuses on radiation oncology in LMIC and organizes monthly meetings. The meetings are held at www.cure4kids.org, providing a platform for discussions on patient management and treatment plans.

**Chart rounds**

Chart rounds are scheduled meetings between leaders at cancer treatment institutions and physicians & physicists in various locations to discuss patient management & treatment plans. These rounds are facilitated through www.chartrounds.com.

**AFRONET**

AFRONET is a multidisciplinary virtual tumor board that connects professionals to discuss and collaborate on cases, providing a virtual space for global oncology collaboration.
Support for NGOs, advocacy groups and awareness campaigns
Thank you to Jeannette for her slides

Our Paediatric MDT at RXH/GSH

Radiotherapy team

Our patients