Challenges in implementing radiation medicine

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Global Cancer Data

New Cases (Incidence)
- 2020: 19,3M
- 2040: 28,4M

Deaths (Mortality)
- 2020: 9,9M
- 2040: 16,3M

> 60% of cancer cases and >70% of deaths are in LMIC with ~5% of oncology resources...

Source: IARC, GLOBOCAN, 2020
Radiation technologies in cancer management

- Radiation therapy is:
  - one of the 3 pillars in cancer treatment *(along with surgery and systemic treatments)*
  - Essential treatment modality in >50% of cancer patients
  - “Responsible” for 40% of cases of cure from cancer *(surgery-49%, chemotherapy-11%)*
  - Very cost effective *(5-7% of cancer treatment costs)*

- Technology driven and technology dependent
- Related fields, similar challenges...
Global shortage in radiotherapy resources

<table>
<thead>
<tr>
<th>Recommended (IAEA)</th>
<th>1 RT machine per 250,000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>High income countries</td>
<td>1 RT machine per 120,000 population</td>
</tr>
<tr>
<td>Low income countries</td>
<td>1 RT machine per &gt;2,000,000 population</td>
</tr>
<tr>
<td>Average in world</td>
<td>1 RT machine per 500,000 population</td>
</tr>
</tbody>
</table>

Developing Index Table

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Countries</th>
<th>Countries with RT</th>
<th>RT centers</th>
<th>MV Therapy</th>
<th>Light Ion Therapy</th>
<th>RT machines</th>
<th>Million population</th>
<th>Equipment per million population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Total</td>
<td>214</td>
<td>156</td>
<td>7704</td>
<td>14986</td>
<td>109</td>
<td>15095</td>
<td>7789</td>
<td>2</td>
</tr>
<tr>
<td>High income (H)</td>
<td>74</td>
<td>60</td>
<td>4550</td>
<td>9299</td>
<td>98</td>
<td>9397</td>
<td>1215</td>
<td>8</td>
</tr>
<tr>
<td>Upper middle income (UM)</td>
<td>54</td>
<td>44</td>
<td>2245</td>
<td>4100</td>
<td>10</td>
<td>4110</td>
<td>2584</td>
<td>2</td>
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<tr>
<td>Lower middle income (LM)</td>
<td>54</td>
<td>37</td>
<td>886</td>
<td>1546</td>
<td>1</td>
<td>1547</td>
<td>3324</td>
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<tr>
<td>Low income (L)</td>
<td>28</td>
<td>14</td>
<td>22</td>
<td>38</td>
<td>0</td>
<td>38</td>
<td>666</td>
<td>0</td>
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<tr>
<td>Temporarily unclassified (NC)</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

IAEA, DIRAC, 2022
Challenges

• Need to comprehend the severity and scale of the problem
• Will and commitment for long-term actions
• Need for joint multistep, multifaceted, coordinated actions

• Governments
• Regulatory bodies (Nuclear, Healthcare, Education, etc)
• International Organizations, Professional Societies, NGOs
• Business (incl. manufacturers)
• Radiation medicine specialists
• Other cancer specialists
• Society
Challenges (continued)

• Upfront substantial investments for:
  – Equipment
  – Infrastructure
  – Specialist training

…“The cost of meeting 100% of global need for radiotherapy by 2035 in LMICs is estimated at USD 184 billion”…
Challenges (continued)

• Sustainability plan
  • Infrastructure (electricity, water supply, logistics etc.)
  • Maintenance and technical service
  • Replacement
  • Operational costs (incl. consumables, QA&QC, wages etc.)
  • Specialist training
Challenges: Human resources

<table>
<thead>
<tr>
<th></th>
<th>High-income countries</th>
<th>Upper-middle-income countries</th>
<th>Lower-middle-income countries</th>
<th>Low-income countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fractions</td>
<td>76 424 000</td>
<td>77 014 000</td>
<td>40 974 000</td>
<td>13 268 000</td>
</tr>
<tr>
<td>Radiotherapy departments</td>
<td>4 600</td>
<td>3 700</td>
<td>2 000</td>
<td>600</td>
</tr>
<tr>
<td>Megavoltage machines</td>
<td>9 200</td>
<td>7 400</td>
<td>3 900</td>
<td>1 300</td>
</tr>
<tr>
<td>CT scanners</td>
<td>4 600</td>
<td>3 700</td>
<td>2 000</td>
<td>600</td>
</tr>
<tr>
<td>Radiation oncologists to be trained</td>
<td>15 500</td>
<td>16 800</td>
<td>9 900</td>
<td>3 300</td>
</tr>
<tr>
<td>Medical physicists to be trained</td>
<td>17 200</td>
<td>12 500</td>
<td>7 200</td>
<td>2 400</td>
</tr>
<tr>
<td>Radiation technologists to be trained</td>
<td>51 900</td>
<td>45 300</td>
<td>24 900</td>
<td>8 100</td>
</tr>
</tbody>
</table>

Data are n. The appendix contains more information about the CT scanner shared-use model.

*Table 5: Projected fractions and related resources needed in 2035*

**Needs for specialists by 2035**
- ROs – 45500
- MPs – 39300
- RTTs – 130200

In Total - 215 000

Challenges: Human resources

• Scarcity or lack of dedicated training programs and resources for:
  – Radiation oncologists
  – Medical physicists
  – Radiotherapy technologists (RTT)
Conclusions

• Radiation therapy is an established key component in cancer management;
• Access to this treatment modality remains unacceptably low in many countries, and the gap between demand and supply is growing
• Major challenges are:
  • Infrastructure and ecosystem;
  • Upfront Investments;
  • Sustainability provision;
  • Human resources.
• Joint multistep, multifaceted, coordinated actions are required.