Alternative technologies to high activity radioactive sources for radiation therapy

WINS 6th Regional Review Meeting
Colombo, Sri Lanka

Michael Sandhu, VP MARKET ACCESS & INTEGRATION
Growing Global Cancer Burden
Lancet Oncology Report 2015 – Calls to Action

**The Global Cancer Burden Continues to Grow...**
- **2025**
  - 19.6M new cases
  - 11.5M deaths
- **2012**
  - 14.1M new cases
  - 8.2M deaths

LMIC = Low/middle income country
Currently LMICs account for 80% of the global cancer burden

**...And the Burden is Highest in LMICs**

**Radiotherapy (RT) is “A Critical Component” of Cancer Treatment and Care...**
- **By 2025,**
  - 2M people would derive a clinical benefit
  - 1M people would survive cancer with access to RT
- **More than 50%** of patients benefit from radiotherapy treatment (source 1)

Comprehensive state-of-the-art cancer care requires multidisciplinary treatment and palliation (incl. surgery, radiation therapy and chemotherapy)

**...But LMICs Have the Least Access to RT**
- **LMICS only have...**
  - 5% of global radiotherapy resources
  - 90% of patients have no access to radiotherapy

**5 Keys to Expanding Global Access to RT**

1. **Planning**
   - Incorporate RT into the population-based cancer control plans of 80% of countries by 2020
   - "25 X 25" Increase RT treatment capacity 25% by 2025

2. **Training**
   - Train thousands more RT professionals in LMICs by 2025

3. **Financing**
   - Invest US$46 billion by 2025 to establish RT infrastructure and training in LMICs

4. **Affordability**
   - Include RT services as part of the universal health coverage plans in 80% of LMICs by 2025

**The Lancet Oncology Commission:**
- **Quantifies** the inequities and economic advantages of universal access to radiotherapy
- **Recommends** next steps for expanding adoption of radiotherapy
Greatest Incidence and Survival Benefit in LMICs

Fig 4. Survival benefit from radiotherapy according to country income classification.
Diseases treated with Radiation Therapy

50-60% of cancer patients need radiotherapy

Curable Cancers with RT ALONE:
- Prostate Ca
- Head & Neck Ca
- Lung Ca
- Cervical Ca
- Skin Ca

Curable Cancers with RT as part of treatment (adjuvant):
- Breast Ca
- Brain Tumors
- Testicular Ca
- Adv. Lung Ca
- Rectal Ca
- Sarcomas
- Adv. Cervical Ca
- Endometrial Ca
- Pediatric Ca
- Adv. Head & Neck Ca
- Bladder Ca

Metastatic disease: Bone / Brain / Other…
### Global Radiation Therapy Gap

<table>
<thead>
<tr>
<th>What is Needed</th>
<th>2015</th>
<th>GAP</th>
<th>2035</th>
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<tbody>
<tr>
<td>Radiation Oncology Centers</td>
<td>7,700</td>
<td>3,200</td>
<td>10,900</td>
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<tr>
<td>Linear Accelerators</td>
<td>13,100</td>
<td>21,800*</td>
<td>21,800</td>
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<tr>
<td>Radiation Oncologists</td>
<td>23,200</td>
<td>22,300</td>
<td>45,500</td>
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<tr>
<td>Medical Physicists</td>
<td>10,000</td>
<td>29,300</td>
<td>39,300</td>
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<tr>
<td>Radiation Technologists</td>
<td>33,300</td>
<td>96,900</td>
<td>130,200</td>
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</table>

*8,700 new machines plus 13,100 replacements = 21,800 additional machines needed

** KEYS TO CLOSING GAP **

- Automation
- Simplification
- Productivity

Expanding global access to radiotherapy. Lancet Oncol. Vol 16, Sept. 2015
Current Practices in Radiation Treatment for Cancer
Evolution of Radiation Therapy Techniques

Improving Precision

**Delivery Techniques**
- Conventional 2D radiotherapy
- Conformal radiotherapy
  1. 3DRT
  2. IMRT

**Localization Techniques**
- In-room Guidance:
  - US, X-rays, CT, Optical, RF

**Dose Evaluation Techniques**
- Dose recalculation
- Dose reconstruction

**Dose Modification Techniques**
- Off-line re-optimization
- On-line re-optimization

Image-Guided Radiotherapy

Dose-Guided Radiotherapy

Adaptive Radiotherapy
# Development of Radiation Therapy Delivery

## Technological Evolution

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<tbody>
<tr>
<td><strong>Beam shaping devices</strong></td>
<td>MLCs</td>
<td></td>
<td></td>
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<tr>
<td><strong>In-room image guidance</strong></td>
<td></td>
<td>IGRT</td>
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<tr>
<td><strong>Partially integrated systems</strong></td>
<td></td>
<td></td>
<td>Dedicated devices</td>
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<tr>
<td><strong>End to End Integrated RT Platforms</strong></td>
<td></td>
<td></td>
<td></td>
<td>SRS / SBRT / SABR / ART</td>
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<tr>
<td><strong>Hypofractionation Adaptive RT</strong></td>
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<td></td>
<td>Need for increased integration and/or interoperability</td>
</tr>
</tbody>
</table>

## Technology

- **IMRT**
- **IGRT**
- **Dedicated devices**
- **Multivendor environment**
- **SRS**
- **SBRT / SABR**
- **ART**
- **Need for increased integration and/or interoperability**

## Clinical Impact

- **Head/Neck**: improve saliva / swallowing
- **Pelvis**: less bowel toxicity
- **Allows safer chemotherapy administration**
- **Prostate Cancer**: Enable dose escalation: improve cure
- **Reduce traditional set-up errors**
- **Increased complexity**
- **Decrease throughput**
- **Increase safety concerns**
- **Lung Ca SBRT**: improve cure
- **Frameless CNS radiosurgery**
- **Partial breast accelerated irradiation**
- **Faster, better, safer treatments**
- **Global access**: Simpler set-ups
- **Education & training**
Radiation Therapy Today

Seeing More Accurately

- Cone-Beam CT
- kV radiographs
- Electromagnetic transponders

Treating More Accurately

- Dynamic Beam Shaping
- Intensity Modulated Radiotherapy (IMRT)
- High dose rate delivery
- Advanced planning and delivery
- Comprehensive software systems
Development of Linear Accelerators for Radiation Therapy
Integrated In-Room Features
Simplified Operations

Operational Excellence

- Advanced Treatments in fewer Operator steps
  - Minimal key presses to deliver

- In-Built Machine Performance Checks
  - QA checks
  - Self-diagnostics

- High Reliability
Smaller Footprint – Fast and Simple to Install

2.6 m

3.4 m

2.8 m
High Quality Care

- Fast and sharp images
- kV and MV CBCT
- Imaging dose taken into account in Treatment Planning

Phantom images acquired on prototype system
Training Needs for Radiation Therapy
Initiatives to Educate in LMICs

Adding machines is one part of the solution. Building human capital is the other part of the solution.

LäraNära AB, Lund & Umeå University

Global Network of Experts

Local Reference Centers

Varian

Local Associations

Access to Care

- Competences
- Skills
- Knowledge
From Simple 2D to 3D

Groote Schuur Hospital, Cape Town

• Collaboration between local Universities and Varian

• 3 Weeks at Groote Schuur followed by 10 weeks of follow up by teachers

• Two class rooms
  - First VERT™ Radiotherapy Simulation System in Africa
  - Cloud based training TPS (14 stations)

• Complete teams are trained from Sub-Saharan Africa
  - 1 Radiographer, 1 Physicist and 1 Oncologist per site

• Aim
  - Empower teams to deliver high quality 3D Conformal Radiotherapy Treatment
  - Development of evidence based clinical protocols at site
  - Implementation of QA/QC protocols at site
In Conclusion
Radiation Therapy is cheap!

the administration of radiotherapy, when evaluated per fraction throughout the lifetime of a machine, is actually a relatively cost effective procedure. Even after factoring in all levels of costs related to the procurement, maintenance and operation of a machine, estimates place the cost per fraction for a $^{60}$Co machine at a median of US $4.87 and for linear accelerators (linacs) at a median of US $11.02, which, compared with chemotherapy costs which can reach over US $600 per treatment, are comparatively inexpensive [1.11].

Cobalt-60 teletherapy units have been replaced almost completely by medical linacs in North America, Western Europe [30.13], Australia and Japan. However, in many developing countries, cobalt-60 units still represent the workhorse for the provision of radiotherapy due to their relative sturdiness, and their simpler servicing and maintenance needs. The replacement of a cobalt-60 source, which must ideally be done every five years, has become an insurmountable obstacle for many limited resource centres. Security concerns lead to restrictions on the international transport of radioactive sources, which in turn result in higher costs. In this scenario, many centres opt to replace their old cobalt units with single energy linacs. A decline is foreseen in the use of cobalt-60 teletherapy units in the future as they continue to be replaced by single energy linacs in developing countries.
Misconceptions on costs are changing

MISCONCEPTIONS ABOUT RADIO THERAPY COSTS PERSIST...

The continuing geographic disparity in access to radiotherapy is being perpetuated by the misconception that it is too costly or impractical to successfully implement in LMICs.

— LANCET ONCOLOGY COMMISSION REPORT

Cost of care is less expensive in LMICs compared to global average

$2000 per course globally vs $1260 per course in LMIC

*Average cost per fraction for LMICs and globally — assuming 20 fractions per course of treatment

...YET COST/BENEFIT ANALYSIS REVEALS HIGH RETURNS

Cost of scaling up access by 2035 approx. $184B U.S.

CUMULATIVE BENEFITS

CUMULATIVE COSTS

This investment would save 26.9M life years with a net economic benefit of $278.1B

Models suggest that during normal use these costs are recouped within 10-15 years
Thank You