Global Medical Physics: Challenges and Opportunities

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Disclosures

• None related to this presentation
Objectives

• To highlight trends in medical physics around the globe
• To review variations in medical physics around the globe related to training, technologies, organization, diseases, and resources
• To consider some options for addressing these variations
Growth in No. of Medical Physicists

Projected increases are significant! ~3%/year

From Tabakov (2016) and Tsapaki (2018)

Tsapakia et al, Med Phys 55:33-39; 2018
Tabakov, Med Phys Int 4: 78-80; 2016
Medical Physicists: Composition

<table>
<thead>
<tr>
<th></th>
<th>Global (Tsapaki et al, 2018)</th>
<th>AAPM (2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>~29,000</td>
<td>~8,000 ~30%</td>
</tr>
<tr>
<td>Radiation Oncology Physics</td>
<td>67%</td>
<td>76%</td>
</tr>
<tr>
<td>Imaging &amp; Health Physics</td>
<td>33%</td>
<td>24%</td>
</tr>
<tr>
<td>Male/Female</td>
<td>70/30</td>
<td>69/31</td>
</tr>
</tbody>
</table>
Education and Training Pathways

Adapted from IAEA HHS No. 25
Time to Become CQMP

Surveys: EFOMP 2006
IAEA 2011

77 Countries

3-9 years
Time to Become CQMP

Surveys: EFOMP 2006
IAEA 2011

77 Countries

3-9 years

Undergrad ~4 yrs
Grad ~2 yrs
Clinical ~2 yrs
Number Variations by Country

- Health Economics in Radiation Oncology Project of the European Society for Radiotherapy and Oncology (ESTRO-HERO)
  - Variations by country (44 countries in Europe)

<table>
<thead>
<tr>
<th>Item</th>
<th>Variation Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV machines/1 Million people</td>
<td>6</td>
</tr>
<tr>
<td>ROs/1 Million people</td>
<td>15</td>
</tr>
<tr>
<td>MPs/1 Million people</td>
<td>20</td>
</tr>
</tbody>
</table>

Note: Significant variation in professional roles
# Training Availability Globally

<table>
<thead>
<tr>
<th>Program Description</th>
<th>No. Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured Education and Training Program(s) for RO</td>
<td>104</td>
</tr>
<tr>
<td>Structured Academic Program(s) for MP</td>
<td>80</td>
</tr>
<tr>
<td>Structured Clinical Training Program(s) for Radiotherapy MP</td>
<td>74</td>
</tr>
<tr>
<td>Structured Education and Training Program(s) for RTT</td>
<td>89</td>
</tr>
<tr>
<td>Structured Education and Training Program(s) for ON</td>
<td>56</td>
</tr>
</tbody>
</table>

Out of 214 countries
Uganda's only radiotherapy machine used for treating cancer is broken beyond repair, the country's main cancer unit says.

BBC News, 8 April 2016
(Population 42 Million)

Update...2022-05-12. IAEA DIRAC: 7 centers, 8 MV machines
RT Equipment (EBRT & Brachy) in South East Europe

• Density of RT units/100K popul.
• 3 data sources
• Different numbers highlight ...
  • Variation from country to country (factor of ~6)
  • Challenges in gathering accurate data (factor of ~2)

Dosanjh et al. Clin & Translat Radiat Oncol 34: 57-66; 2022
Example: Recent data from Ukraine (GCR)

- 27 April 2022
- 52 RT centers
  - 86 cobalt-60 machines
  - 20 linacs
- Population: 44 Million
- World Bank definition: UMIC
- Compare
  - Canada: 38 Million, HIC, 52 centers, 298 MV machines

Very different machine mix compared to HICs
Overcoming Challenges in Providing Radiation Therapy to Patients With Cancer in Nigeria and Experience in the National Hospital Abuja, Nigeria

Simeon Chinedu Aruah\textsuperscript{1}, Obinna Chizoba Aruegbu, MS\textsuperscript{1}, Fatima I. Uba\textsuperscript{2}, MD, MBBS\textsuperscript{2}, Nandul Nimark Maurice, MBBS\textsuperscript{3}, Rasheed Oyegun, MD, MBBS\textsuperscript{3}, Tasheef A. Ige, PhD\textsuperscript{4}, C. Norman Coleman, MD\textsuperscript{5}, Manjit Dosanjh, PhD\textsuperscript{5}, and David Pisterman, MD, PhD\textsuperscript{5}

Medical Physics Education: Global Issues

• Variation in ...
  • Basic educational backgrounds
    • Undergraduate and graduate education
      • Diploma, B.Sc., M.Sc., Ph.D.
  • Residency ... or on-the-job training
  • Available technologies
  • Available training programs
  • Available resources
  • Instructors with practical experience
    • And good teaching skills
  • Interdisciplinary relationships
  • Professional certification procedures
• Development of infrastructure ... takes time
Medical Physics Education: Global Issues

• Concerns about education abroad
  • Different diseases
  • Different infrastructure
  • Potential for “brain drain”
Different Disease Incidence

- Highest incidence per country
  - Globocan data

<table>
<thead>
<tr>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>Breast</td>
</tr>
<tr>
<td>Lung</td>
<td>Liver</td>
</tr>
<tr>
<td>Colorectum</td>
<td>Cervix</td>
</tr>
<tr>
<td>Kaposi sarcoma</td>
<td></td>
</tr>
<tr>
<td>Lip/Oral</td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td></td>
</tr>
</tbody>
</table>

Sung et al. CA Cancer J Clin 71: 209-249; 2021
“One size does not fit all!”

Africa

Latin America
Different Infrastructure

Cost drivers

- Facilities
- Equipment
- Salaries
Different Infrastructure

Relative Component Costs

Atun et al, Lancet Oncol, 16: 1153-1186; 2015
Global Radiotherapy: Current Status and Future Directions—White Paper

May Abdel-Wahab, MD, PhD¹; Soehartati S. Gondhowiardjo, MD, PhD²; Arthur Accioly Rosa, MD³; Yolande Lievens, MD, PhD⁴; Noura El-Haj, MSc¹; Jose Alfredo Polo Rubio, PhD¹; Gregorius Ben Prajogi, MD¹; Herdis Helgadottir, MA¹; Eduardo Zubizarreta, MD¹; Ahmed Meghzifene, PhD¹; Varisha Ashraf, BSc¹; Stephen Hahn, MD⁵; Tim Williams, MD⁶; and Mary Gospodarowicz, MD⁷

THE IMPORTANCE OF RESEARCH IN GLOBAL RADIOThERAPY

Research is a key pillar for the long-term improvement of cancer control, along with clinical and education or training activities, ensuring progress and scientifically based management in radiotherapy. However, the nature and implementation of research activities may vary according to the resources available locally and the interaction with the
Benefits

- Improves problem-solving skills
- Fosters an interest in caring for underserved populations
- Develops broader future interest in choosing a career that involves global health
- Incorporated an elective one-month international rotation into their CAMPEP-accredited medical physics residency program in Vietnam – joint RO & MP
Partnering in Medical Physics!

- Training
- Education
- Mentoring!
  - Virtually!
Virtual Mentoring Global Survey

• ePoster: PO-GePV-E-14
• 510 responses

GUIDANCE IN DEVELOPING MENTORING PRACTICE FOR MEDICAL PHYSICISTS

1. Organizers: Develop mentoring handbook to outline details of total process

2. Obtain applications from potential mentors and mentees
   a. Include details on technical expertise, technologies in use, job role, expectations, ...

3. Match mentor and mentee
   • Personal connections, • Local healthcare facility • University

4. Mentor and mentee jointly document a formal mentorship agreement
   a. Define expectations
   b. Define expected frequency, length, and format of meetings
   c. Define review process
      i. Timing and frequency of reviews
      ii. Assess successes and shortcomings
      iii. Criteria for continuation or termination

5. Organizers: Review total mentorship program on an annual basis and make amendments as needed
Conclusions

• As medical physicists ...
  • We need to be educated about
    • Global situation
    • Local partner circumstances
  • We need to understand
    • Needs and wants as defined by local partners
  • We need to communicate, coordinate, and collaborate with local partners and other entities
    • With humility and sensitivity
    • With an open mind
    • With perceptiveness and wisdom