Treatment, Not Terror

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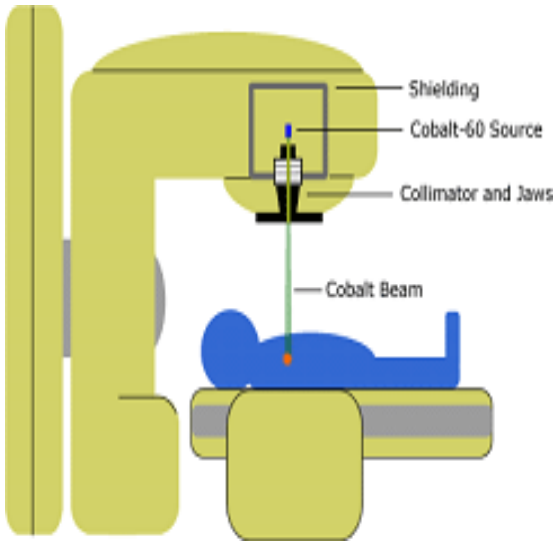
Cancer Treatment: External Radiation

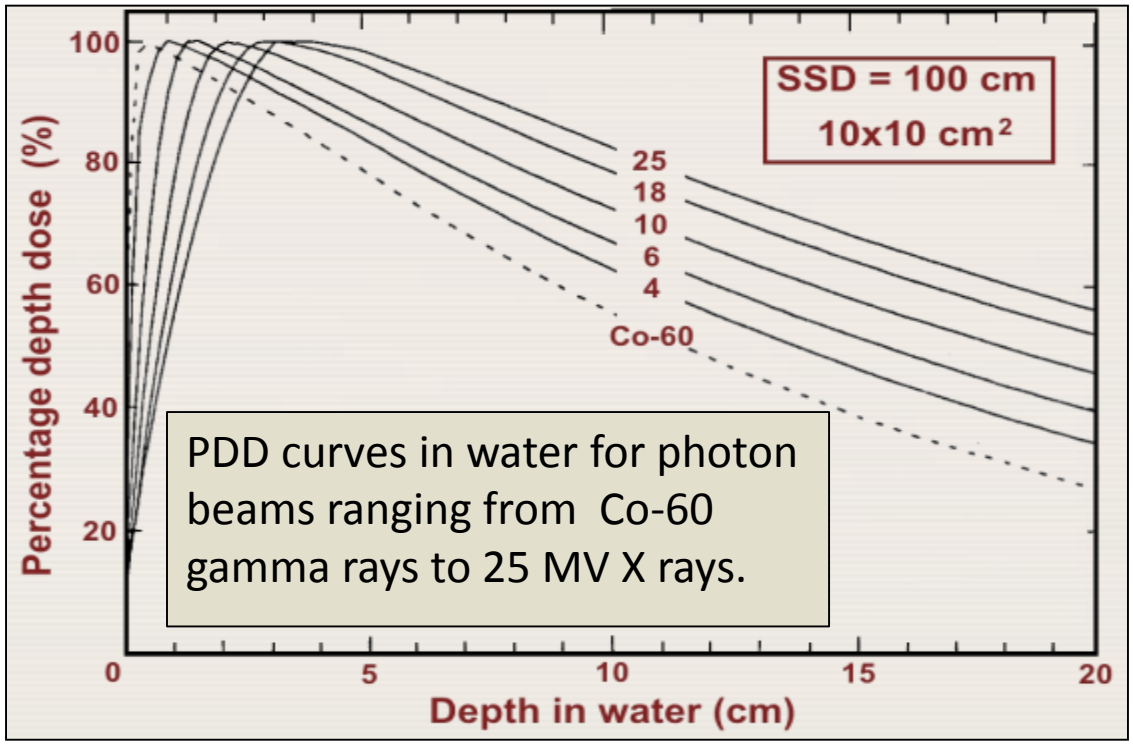
- Teletherapy machines that employ Co-60 sources can treat cancer
- In high-income states, teletherapy machines have been replaced with LINACs
  - Can Provide Better Treatment
- LINAC use less widespread in developing states because of higher costs, complexity and need for stable power sources
  - Use of LINACS varies directly with GDP/capita
  - Widespread use HMIC, medium LMIC, less LMIC

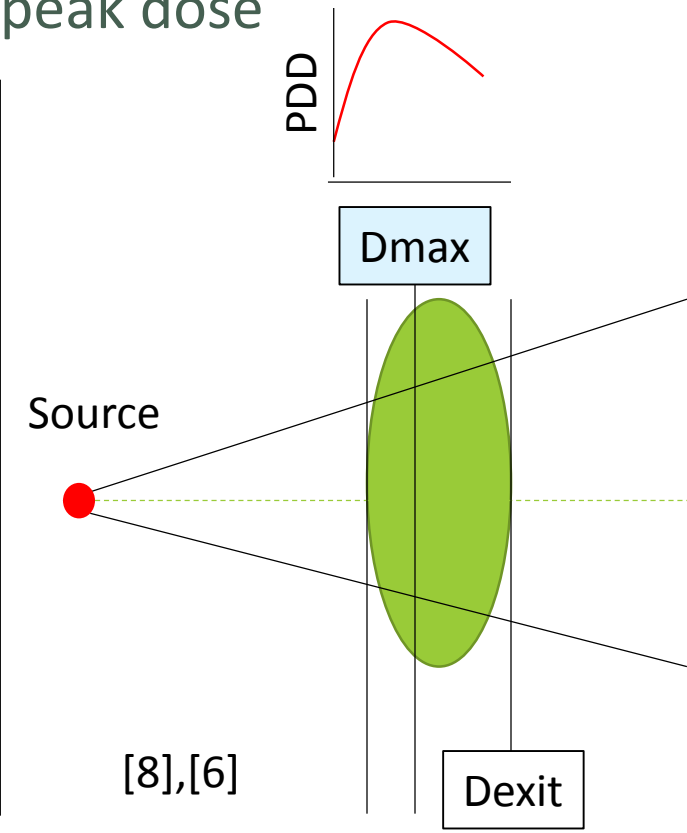


Factors Effecting Effectiveness External Beam Radiotherapy Technologies

- **Goal: provide precise, well defined dose**
- Depth dose depends energy (see figure)
- Depth is expressed in terms of PDD (Percentage Depth Dose)

dose at various depths normalized to the peak dose





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Factors affecting the Quality of Treatment for Co-60 vs LINAC

Aspect	Cobalt-60 (88)	LINAC (189)
Buildup (Zmax)	0.5 cm	1.5 (6 MV), 3.5 cm (18 MV)
Skin Dose	50%	25% (6 MV), 15%-25% (18 MV)
Penetration @ 10 cm	54%	67% (6 MV), 77% (18 MeV)
Penumbra	90%-10% is 1.5 cm	Sharp beam field
Isodose Contours	Rounded	Flattened by filter
Energy	Low (1.25 MV)	High (>6 MV)

Source: Adapted from R. Ravichandran, "Has the Time Come for Doing Away With Cobalt-60 Teletherapy for Cancer Treatments," *Journal of Medical Physics*, Vol. 34, No. 2, 2009, p. 63

Practical Differences Between Machines

Aspect	Cobalt-60	LINAC
Maintenance	Replaced every 5-7 years (5.27 Yr Half Life)	Frequent quality assurance necessary
Safety	Leakage radiation when beam is off is significant = 0.01 mSv/hr; exposure varies as the source is rotated into place and needs to be taken into account	Labor intensive quality assurance procedures
Security	Sources need to be transported to be disposed of; constant security risk requiring around-the-clock security; terrorism risk.	No radioactive source used; no terrorism risk; however, will need to be guarded
Staffing	Easier to perform quality assurance and to operate the machine	Requires more training
Cost	Cobalt-60 much less expensive than LINACs. However similar when IMRT/MLC's are added	Ongoing maintenance is expensive

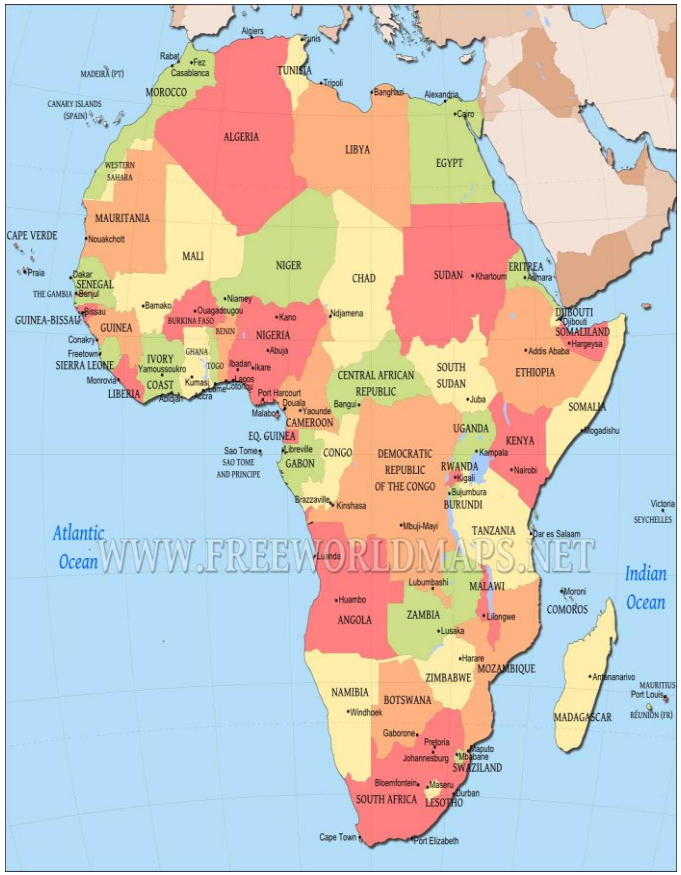
MAKING LINACS MORE ACCESSIBLE TO LOW AND MIDDLE INCOME COUNTRIES

Develop LINACs for Challenging Environments

- Ability to function despite regular interruptions to power supply and air temperature control
- Highly modular, so that parts are easily exchanged
- Self-diagnosing, in case machine becomes nonfunctional
- Achievable through cooperation with diverse parties such as NASA, Silicon Valley, and India (which already has developed some models)
- Fund a global competition, similar to the XPRIZE, to design a better LINAC

Encourage Bulk Purchases

- Bulk purchases could drive down costs by 16-23%
- A regional group of countries could jointly purchase many machines for a lower cost and cooperate with manufacturers to support training of health personnel
- Versions of this idea have already been started in South Africa and Brazil



Vendors Lease Equipment

- LMICs currently encounter maintenance challenges as well as problems with disposal
- Leasing model would address the financial and operational challenges LMICs face
- Purchasers provide assurance of payment for disposal through bonds or escrow arrangements
- Vendors required to provide service for machines in a timely manner and take back disused equipment

Explore New Funding Sources

- Broad range of public and private stakeholders should fill funding gap
  - Governments, international development banks, private foundations, financiers, nongovernmental organizations
- Explore new financing mechanisms
  - Potential Models: Airline taxes, debt forgiveness, long-term purchase commitments by governments for vaccines, diaspora and social-impact banks, and development-bank guarantees
- WHO, IFIs (World Bank) should direct more funding to treatment, not just prevention

Study Improvement in Training and Education

- Currently, most guidelines are written for developed countries
- Establish regional centers of excellence to train oncologists and related health workers locally
- Offer online cancer training and education to healthcare professionals. Could be done in coordination with radiotherapy machine manufacturers.
- Train health workers to perform minor surgical procedures to alleviate shortage of physicians.
- Could also train individuals to repair radiotherapy equipment.

Use Better Screening to Improve Radiotherapy Treatment in Africa (LMICs)

- Survival rates for many cancers are lower for Africans than developed countries.
- This is because cancer is usually not detected and diagnosed until much later in the disease in Africa.
- Could use new technology to improve screening process.
- Would reduce need for radiation treatment and improve survival rates.

Need for IAEA Action

- IAEA PACT and Nuclear Security should include "Security Objectives" as well as "Cancer Care Objectives" in order to address both challenges and support LINACs
- Need for DG to bring together various IAEA offices or divisions to come up with a unified program to deal with replacing sources, safe and secure disposal, and support for development and/or transfer of alternate technologies to LMICs

Proposed:
Cancer Care/Risk Reduction Initiative

- Appropriate LINACS and servicing for LMICs
- Maximum Safety and Security
- Concerted plan for IAEA, to decommission, repatriate, and store/reprocess safely and securely all existing cobalt and other spent/disused sources in LIMIC cancer centers
- Helps meet Sustainable Development Goals
- **Assist any participating country to acquire a LINAC for each Co-60 machine decommissioned and use it safely and securely**

Required:
Cancer Care/Risk Reduction Initiative

- Appropriate LINAC designs
- Initial funding from existing IAEA and donor funds (TC, PACT, Nuclear Security Fund, etc)
  - For sustainability seek additional funds including non-state funds
- Increased internal coordination within IAEA
  - Most programs are already operational and adequately budgeted
  - Some small program adjustments may be required