CHALLENGES IN INTRODUCING NEW TECHNOLOGY IN THE DEVELOPING WORLD

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Geneva, 8 November 2016

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Summary

1. LMICs face additional challenges to provide RT vs developed countries (DCs), related also to missing key elements of the RT ecosystem.
2. Past 10 years of evolutionary improvements in LINAC design & SW have addressed **at least in part** many LMIC issues – with developed countries also benefiting.
3. Anticipated HW/SW advances can further benefit LMICs but will further evolutionary LINAC HW changes significantly impact product costs?
4. Recent experience suggests other factors more important than LINAC cost/complexity as limiting factors to proliferate RT delivery in LMICs – not least FINANCING.
5. Recent experience in Africa and India suggest **(1)** comprehensive & phased RT cancer plans; **(2)** systematic approaches to addressing all elements of delivering RT and **(3)** innovation in financing, market access & partnerships – can also improve RT access/uptake in LMICs.

LINAC Operations
What are additional challenges LMICs face?

- Inconsistent power availability; overall power consumption
- Operation in non-constant temperature, high humidity/dust environments
- High duty cycle, high patient throughput
- Staff with (relatively) limited skills
- Bunker size/design
- Reliability requirements
- Supply chain and logistics secured for spare parts; and access to service.

- "Design for Reliability"
- "Design for Serviceability"
- "Design for Learnability"
- "Design for 'Installability'"

What other obstacles do they face?
How can they be overcome?

Source: Varian analysis.

What are the (increasingly well-known) challenges to better RT access in LMICs?

- **(Sustainable) Financing:** lack of financing for NCDs - the 'elephant in the room'
- **Human resources**: a gap of 7,500 oncologists, 6,000 physicists and 20,000 technicians in LMICs (**Africa**: 1600 medical oncologists, 1000 medical physicists and 4000 technicians)
- **Market Access**: lack of installed base capacity; highly variable ability to pay between countries & population segments
- **Ecosystem**: lack of self-reinforcing enabling conditions – (Finance/ Human resources / service/energy/infrastructure)
- **Health coverage**: lack of universal coverage or critical density of private insurance
- **Other**: legal; regulatory, bureaucratic and other obstacles

GTFRCC provides a compelling case to address the gap – but how to make it happen?

Lancet Commission Calls to Action

Action 1: population-based cancer control plans

- Target: by 2020, 80% of the countries to have cancer plans that include radiotherapy.

Action 2: expansion of access to radiotherapy

- Targets: at least one cancer center in each LMIC by 2020; 25% increase in radiotherapy treatment capacity by 2025.

Action 3: Human resources for radiotherapy

- Target: 7500 radiation oncologists, 20 000 radiation technologists, and 6000 medical physicists to be trained in LMICs by 2025.

Action 4: sustainable financing to expand access to radiotherapy

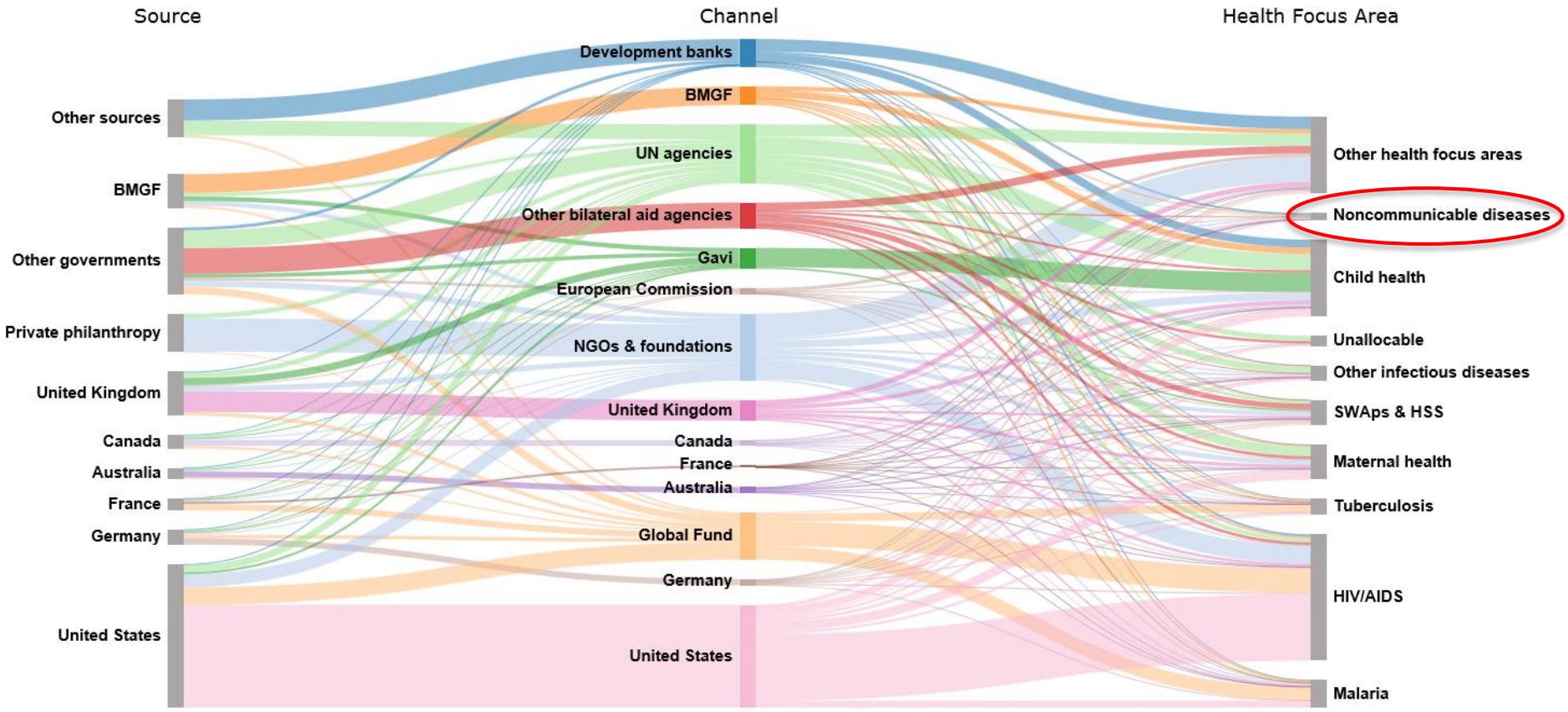
- Target: $46 billion of investment by 2025 to establish radiotherapy infrastructure and training in LMIC countries.

Action 5: align radiotherapy access with universal health coverage

- Target: 80% of low-income and middle-income countries to include radiotherapy services as part of their universal health coverage by 2020.

THE LANCET Oncology

Foreign aid to NCDs in 2014

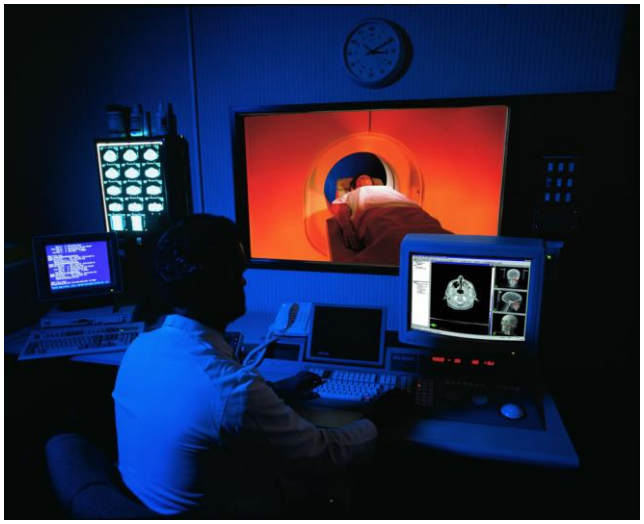


Source: University of Washington Institute for Health Metrics and Evaluation

Learnings

What have we learned via recent practice?

Learnings
Ecosystem – Immediate RT center environment



Clarity on provision of all elements

1. **Providing Modern Equipment** – Full turnkey supply including the treatment equipment, the patient management and treatment planning software, quality control.
2. **Commissioning of Equipment & implementation support**– assist in sourcing resources to commission equipment.
3. **Education & Training**– Training of local clinical professionals and staff to fully qualified status needed to deliver quality radiation oncology treatment.
4. **Maintenance**– A optimal performance regime and maintenance package to ensure full operational use.
5. **Building–** Support provision of facilities to accommodate a radiation oncology suite; all related elements
6. **(Management and Operation)** – full set of point of care solutions (treatment planning, delivery & management, site specific operations management, site specific analytics, resource management),

Learnings
Education as a key Component

Access to Care

French and English Educational "Hubs" both linked to Varian's 'Låra Nåra' virtual education environment

Examples:

Ghana

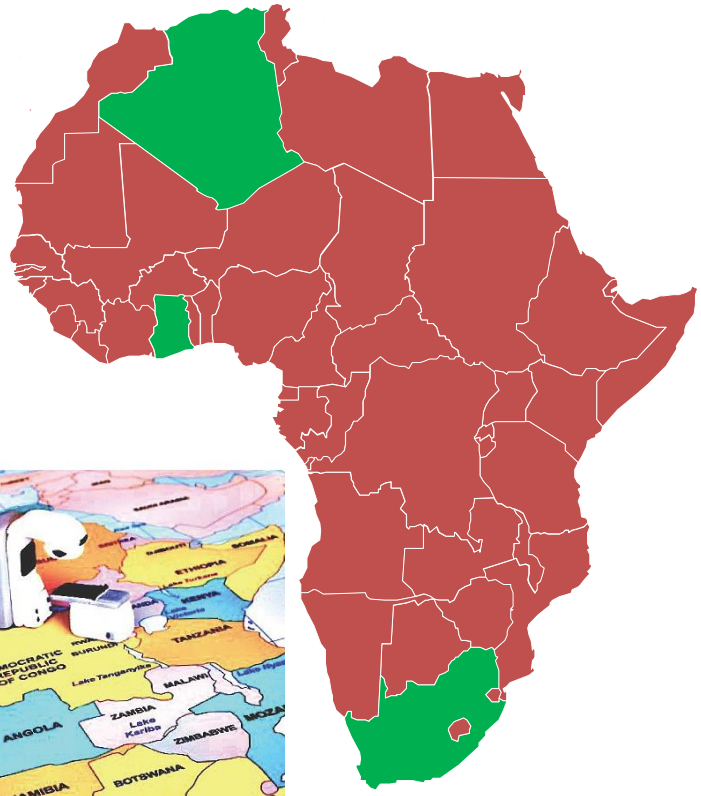
- Korle Bu Hospital
- Core Program

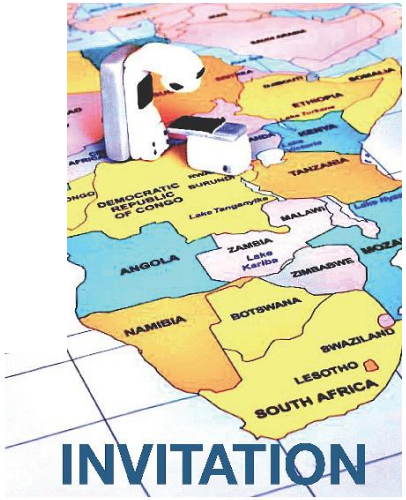
South Africa (Groote Schuur Hospital)

- 2D to 3DCRT Program
- 3DCRT to Dynamic Techniques Program

Algeria

- RTT Track
- Internship for Physicists
- SRS/SRT Implementation Program





Systems, the University of Cape Town and the Cape Peninsula University of Technology.

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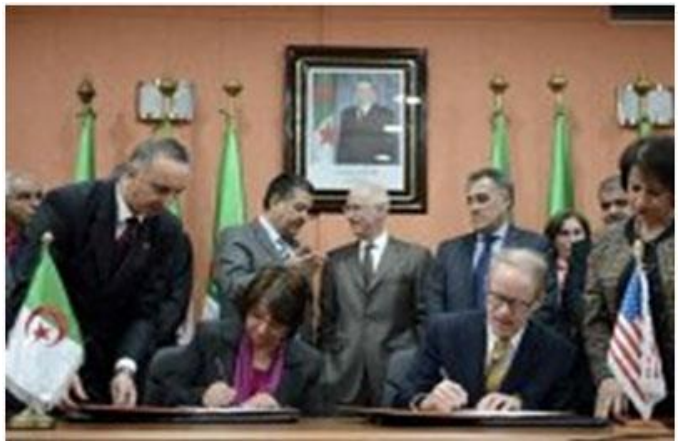
Cape Peninsula University of Technology

Learnings - Benefits of Scale & Planning
Algeria Cancer Program

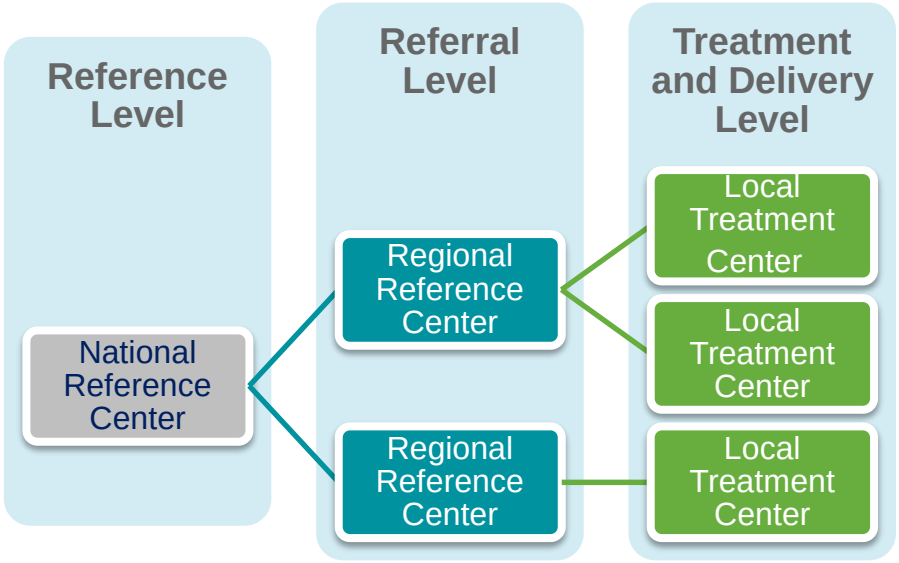
PLAN NATIONAL CANCER 2015 2019

13 new governmental centers
39 linear accelerators



Equipping Public Hospitals

Learnings - Benefits of Scale & Planning
Organization of care - Hub & Spoke Model + HIT



Aligned with key cancer policy objectives & best practices:

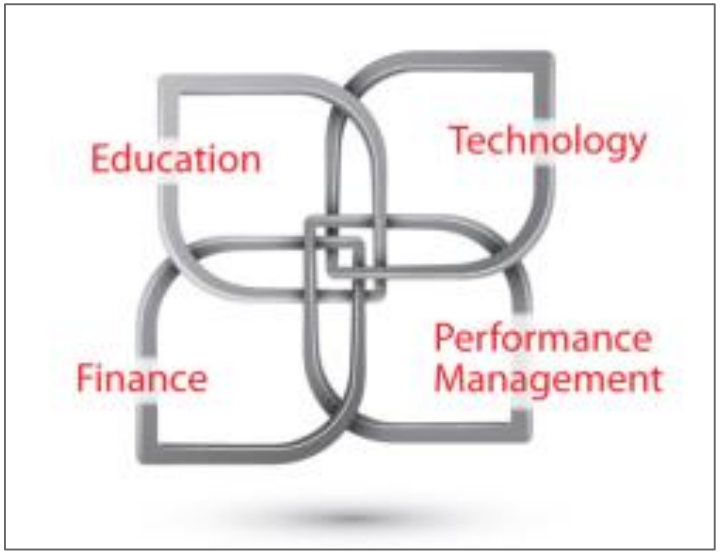
- Phased expansion of RT along a 'hub & spoke model" leveraging HIT / AI / distance & network solutions
- In line with social/eco objectives (BPL population, mixed payment models)
- Leverage new commercial models (PPP) to overcome capital constraints
- Can be accompanied by **national knowledge reference network; national decision support platform; care management network** (a.w.a. point of care solutions)

Learnings – Financial Innovation
PPP "light'/MES Model

Analysis
- Demographics
- Incidence
- Coverage
- Recommendation

Technical Solution
- Education
- Service levels
- Equipment
- Updates, upgrades and optional replacement

Proposal
- 8 year MES
- Min. fixed payment
- Variable availability payment
- Performance based on uptime



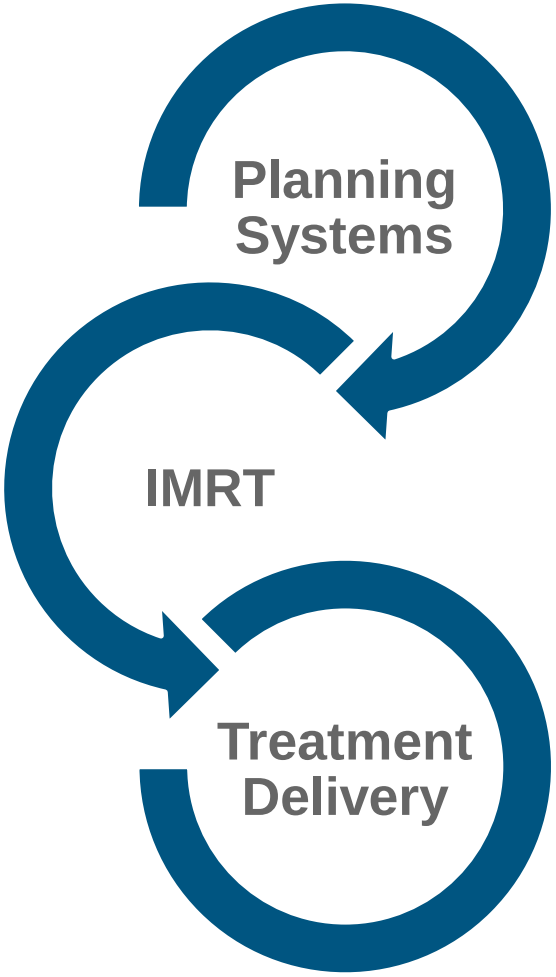
Learnings – Innovation in Access
Kenyan Voucher Program

- Public sector wait time: >18 months for over 1,400 patients
- Partnership between American Cancer Society, Kenyatta National Hospital & Nairobi Hospital, local NGO with Varian support
- Private treatment available at public rates ($5/session patient copay; voucher

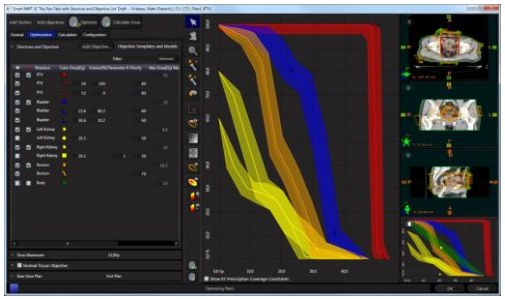
Bridge gap between private & public sectors – leverage unused RT capacity at lower cost

Future of Cancer Care

Technology for quality, efficiency, cost effectiveness



Further Leverage Knowledge



Further Efficiency & effectiveness

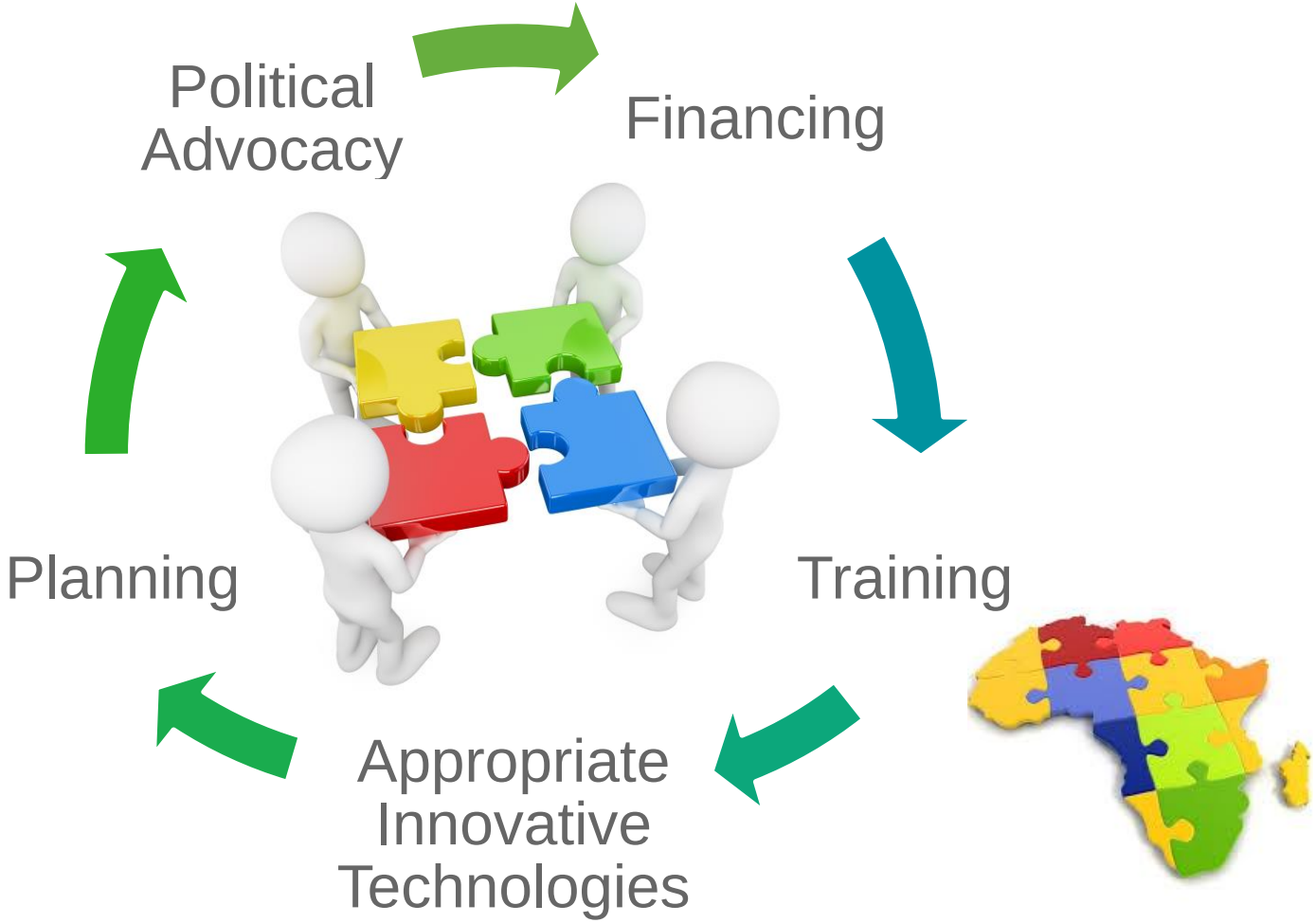
Further improve cost effective care at international standards

History of Reliability

98.9% Average System Uptime

Interdependence

Together we can complete the puzzle ...




OUR VISION
A WORLD WITHOUT FEAR OF CANCER.

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Recent advances in RT technology
Do they address all needs?

Issue/ hypothesis – LMIC needs	Associated characteristic	Impact LINAC Cap cost	Benefits	Examples	Challenges / Opportunities
Lower Capex cost	Mature technology may limit production cost reduction*	?	LMICs ☺ Others: ☺	Brazil 'winner take all' tender 80 LINACs TK large-scale PPP projects	Profitability LMICs Multiple system purchase commitment reduces risk Evidence Capex cost is issue
Higher reliability	"Design for Reliability"	☹	LMICs ☺ Others: ☺	Re-use of proven component designs across different LINAC product lines.	Reliability of today's designs benefited from long history / relative stability of RT technologies. High-reliability components typically have increased production cost
Lower power consumption	Single/low energy systems	☺	LMICs ☺ Others: ☺	Offered by all manufacturers	LMIC association: quality ⇔ complexity
Robust against Power availability inconsistency	Prevent damage; maximize uptime	☹	LMICs ☺	Battery backup to prevent hard shutdowns	Backup generator power as alternative Local optimization UPS systems

Recent advances in RT technology
Do they address all needs?

Issue/ hypothesis – LMIC needs	Associated characteristic	Impact LINAC Cap cost	Benefits	Examples	Challenges / Opportunities
Robust Against Temperature variations	Built in cooling of LINAC	☹	LMICs ☺ Others: ☺	High heat/humidity environments	Remote diagnosis & analysis Higher service requirements
High duty cycle, high patient throughput	Simplicity of LINAC user operation & treatment planning.	Neutral	LMICs ☺ Others: ☺	Decreases the number of user interactions with the system. Knowledge-based software products (AI)	Networks – centralized treatment planning High reliability ➔ multiple shifts ➔ lower /patient cost
Limited staff knowledge/ resources	"Design for Learnability" Increased automation of workflows	neutral	LMICs ☺ Others: ☺	. Automation of well-established workflows	Learnability helps addresses the challenges of staff turnover.
Serviceability	“Design for Serviceability”	Marginal	LMICs ☺ Others: ☺	Remote diagnostics. Predictive analytics.	Reliable internet connection Maturity of technology