



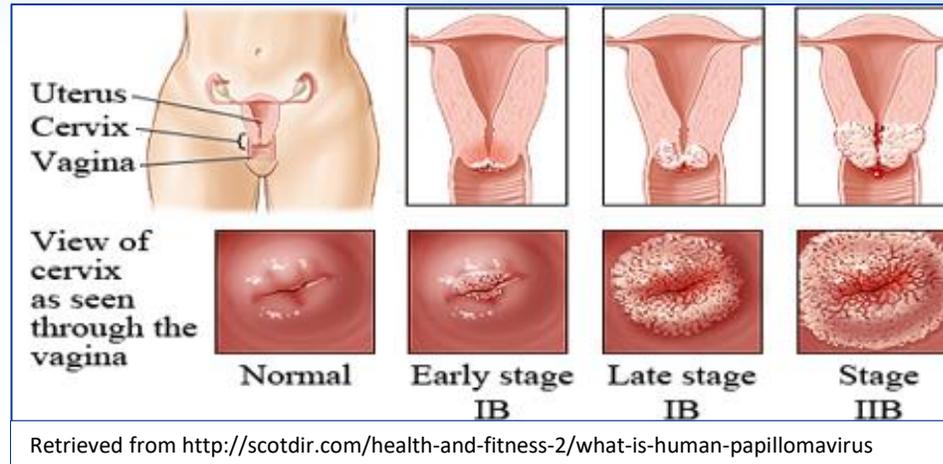
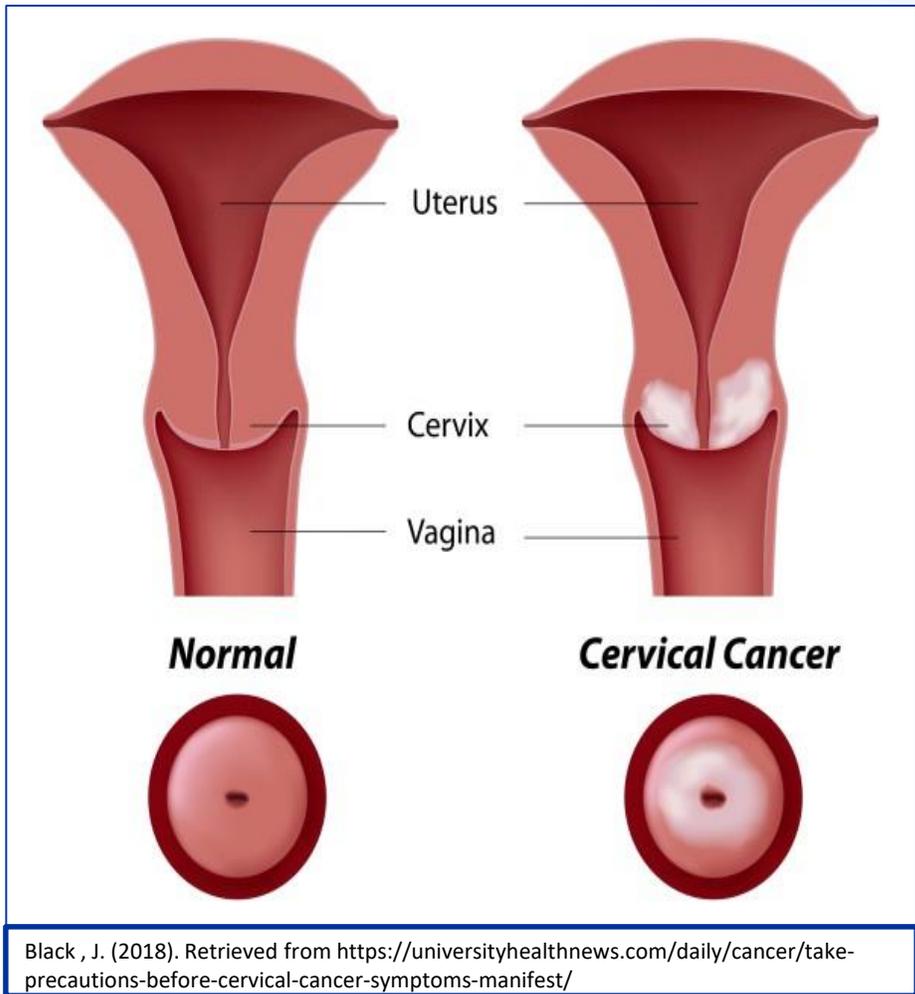
IAEA

International Atomic Energy Agency

Opportunities for Improving Access to Staging and Treatment of Invasive Cervical Cancer in LMICs: the Role of the IAEA

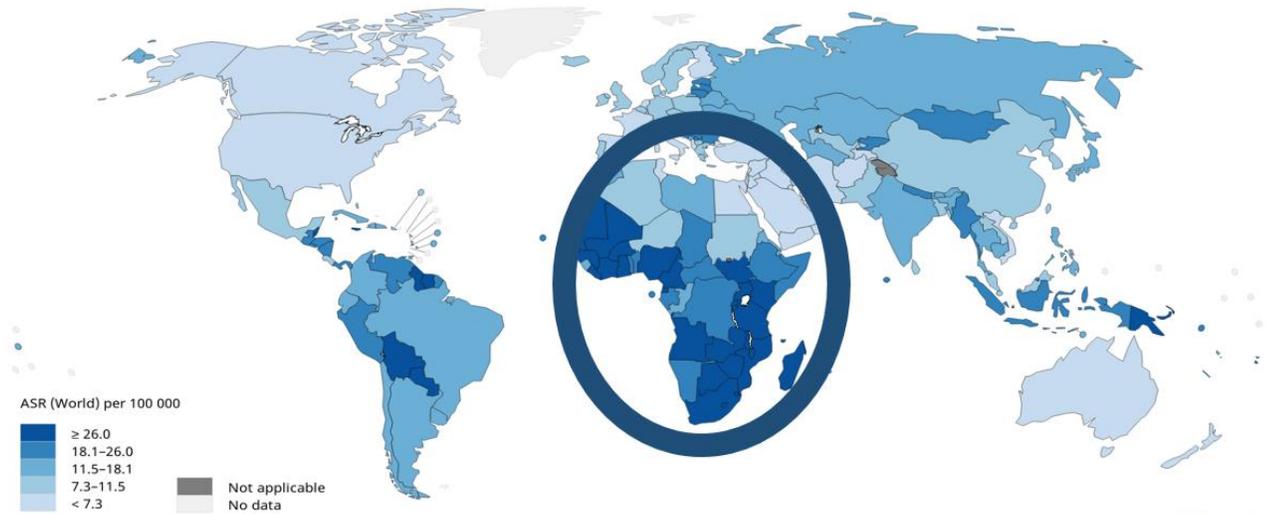
May Abdel-Wahab, MD, PhD
Director, Division of Human Health, IAEA

Cervix Cancer



Histopathology

Estimated age-standardized incidence rates (World) in 2018, cervix uteri, all ages



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Data source: GLOBOCAN 2018
Graph production: IARC
(<http://gco.iarc.fr/today>)
World Health Organization



Fourth most common cancer among women globally

570 000 new cases

311 000 deaths

Based on IARC Global Cancer Observatory GLOBOCAN 2018 data (available from <http://gco.iarc.fr/>)

Treatment Options

- **Surgery**

Stages IA, IB, IIA

- **Radiotherapy**

Stages IB2, II, III, IVA

- **Chemotherapy**

Concomitant with radiotherapy

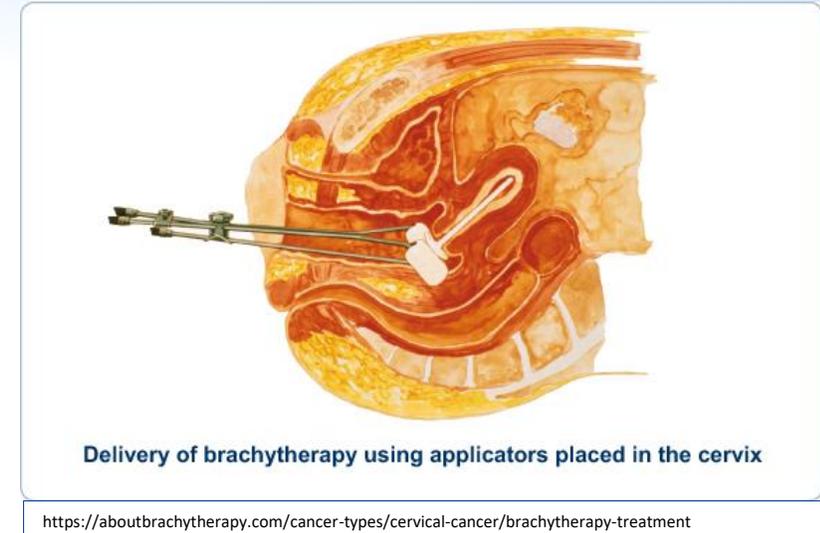


71% of cases require radiotherapy¹

- Improves disease control, survival²⁻⁶

1. Barton et al. 2014
2. Lanciano, Won et al. 1991
3. Hanks, Herring et al. 1983
4. Coia, Won et al. 1990
5. Montana, Martz et al. 1991
6. Logsdon and Eifel 1999

Brachytherapy



Teletherapy-EBXRT



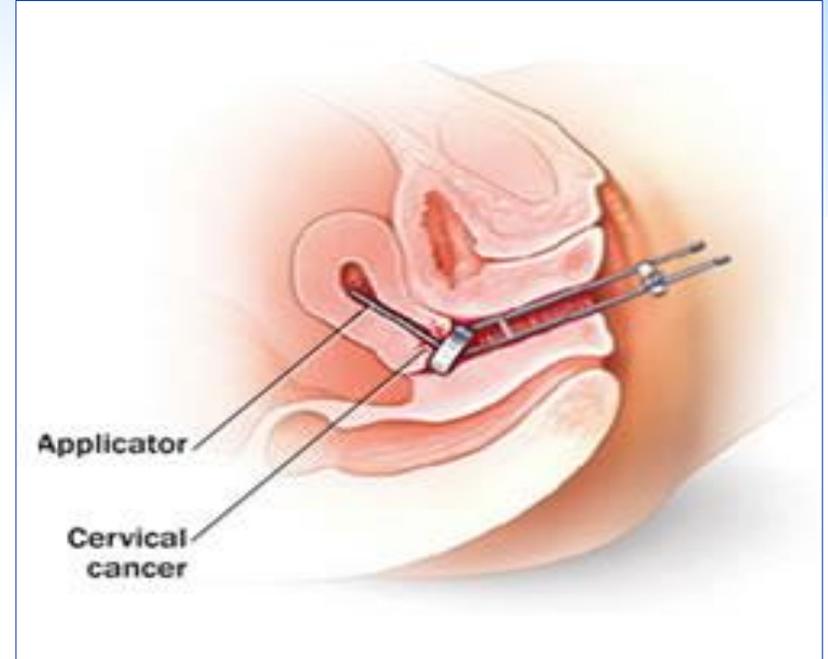
Radiation Techniques



<https://www.iaea.org/newscenter/news/iaea-receives-medical-linear-accelerator-under-partnership-from-manufacturer>

Teletherapy

Brachytherapy is a mandatory component of curative RT*



Brachytherapy . (2013). Retrieved from http://www.simballc.org/brachy_therapy.html

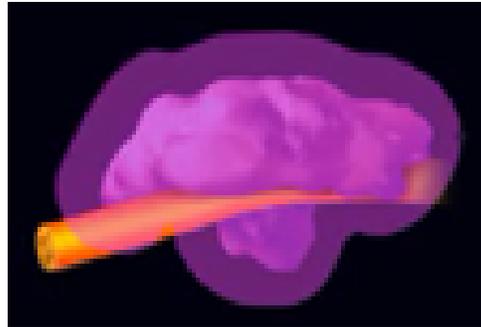
Brachytherapy

*Comprehensive Cervical Cancer Control, WHO guidelines, 2006-2014

Added value of the Nuclear Applications



2-D



3-D Conformal & IMRT



Radiosurgery

	Radiotherapy utilisation rate (%)	Mean radiotherapy fractions per course	5-year local control benefit (%)	5-year overall survival benefit (%)
Breast	87	16	15	2
Cervix	71	21	35	20
Colorectal	19	23	5	2
Haematological	48	8	7	4
Head and neck	74	22	34	20
Liver	0	0	0	0
Lung	77	16	9	6
Oesophagus	71	15	5	2
Prostate	58	28	25*	1
Stomach	27	19	2	1
Total	50	18	10	4

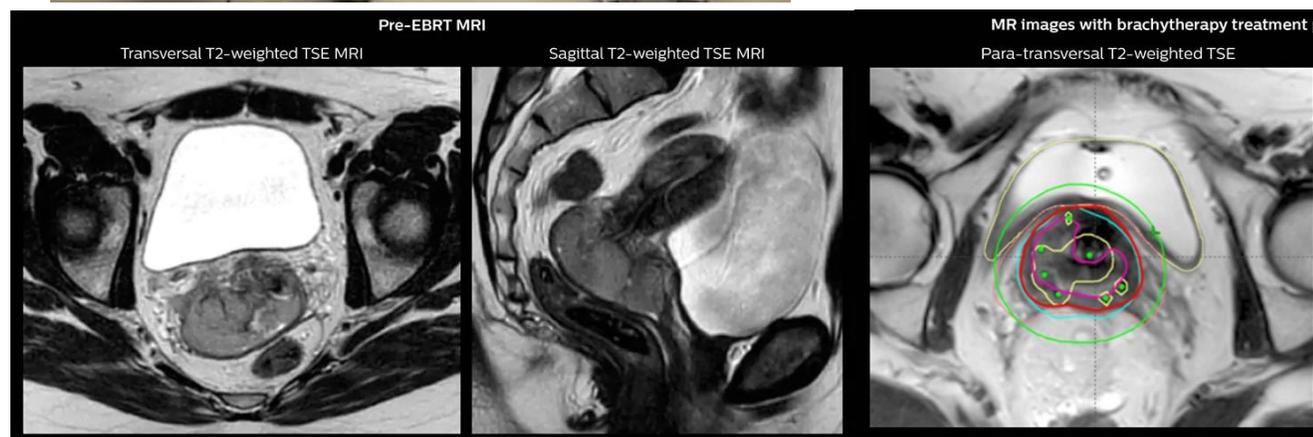
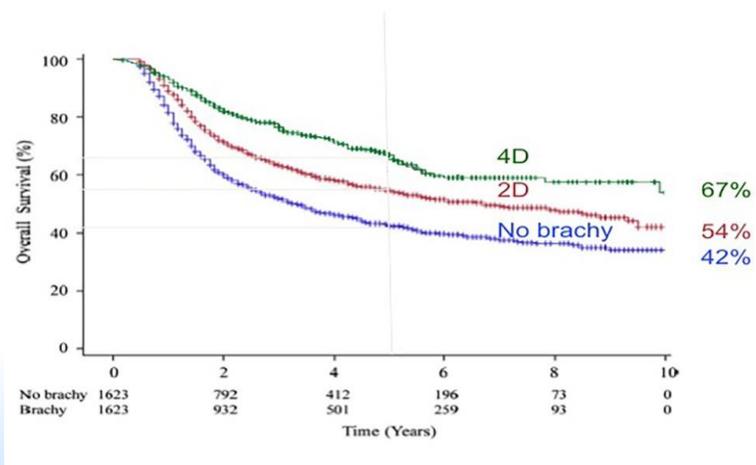
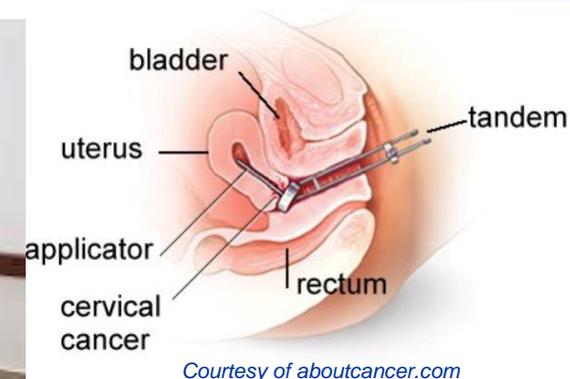
Radiotherapy utilisation rate is the number of patients for whom radiotherapy is the treatment of choice according to guidelines and evidence, divided by the number of new cases in one year. Haematological cancers include leukaemia, Hodgkin's lymphoma, non-Hodgkin lymphoma, and multiple myeloma. *5-year biochemical disease-free survival for curative cases only.

Table 1: Radiotherapy utilisation rate, mean fractions, and outcome benefits (absolute proportional) for top ten cancers globally by incidence

Technology and knowledge transfer

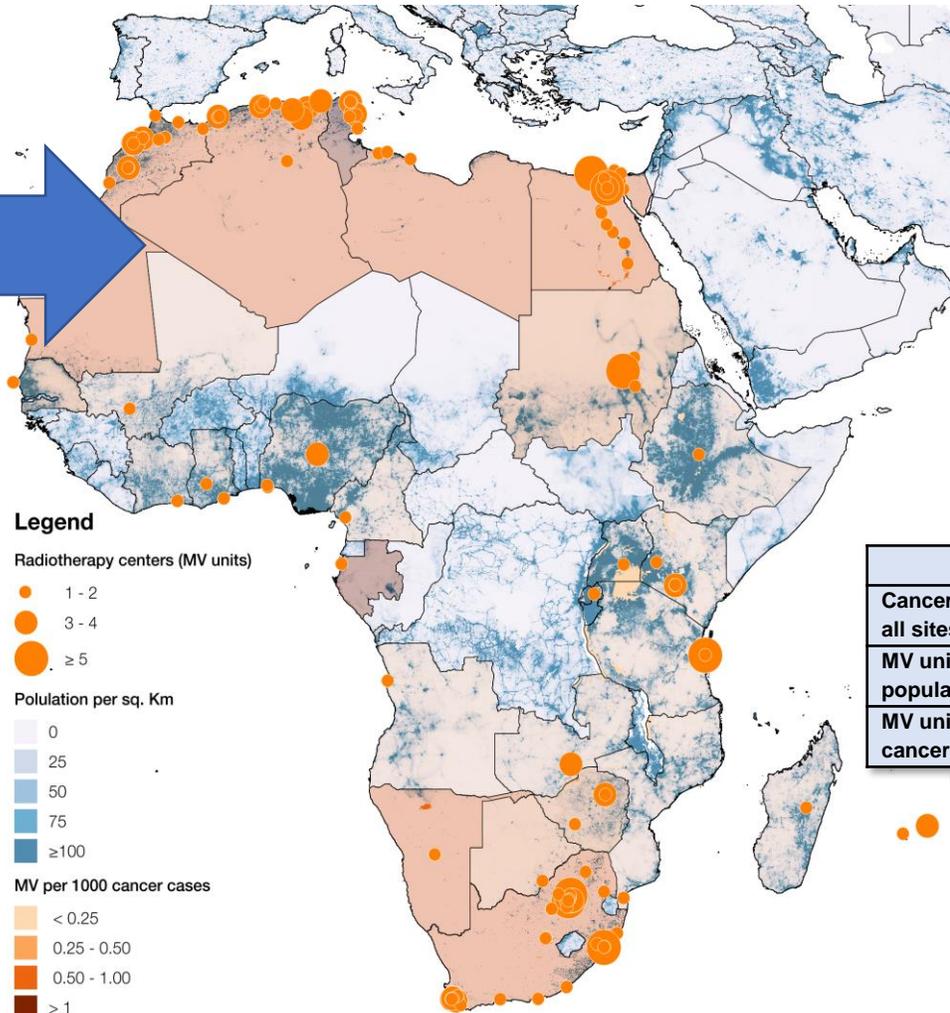
BRACHYTHERAPY IN LOWER-MIDDLE INCOME COUNTRIES
(IAEA MODELLING STUDY)

	EBRT only	EBRT + 3DBT
Cost (\$ per patient)	1606\$	2316\$
Effect (5yOS)	42 %	69 %



- Han, Ket al(2013). IJROBP, 87(1), 111-119.
- Sturdza, A et al: (2016) Radiother Oncol 120(3), 428-433.

Challenges in Access: Limited Resources



External beam Radiotherapy in Africa in 2020
Unpublished IAEA data*

	2012	2018	2020	Variation*
Cancer cases, all sites	844279	1055172	1122495	+32%
MV units/ million population	0.26	0.28	NA	+12%
MV units/1000 cancer cases	0.34	0.32	0.35	+3%

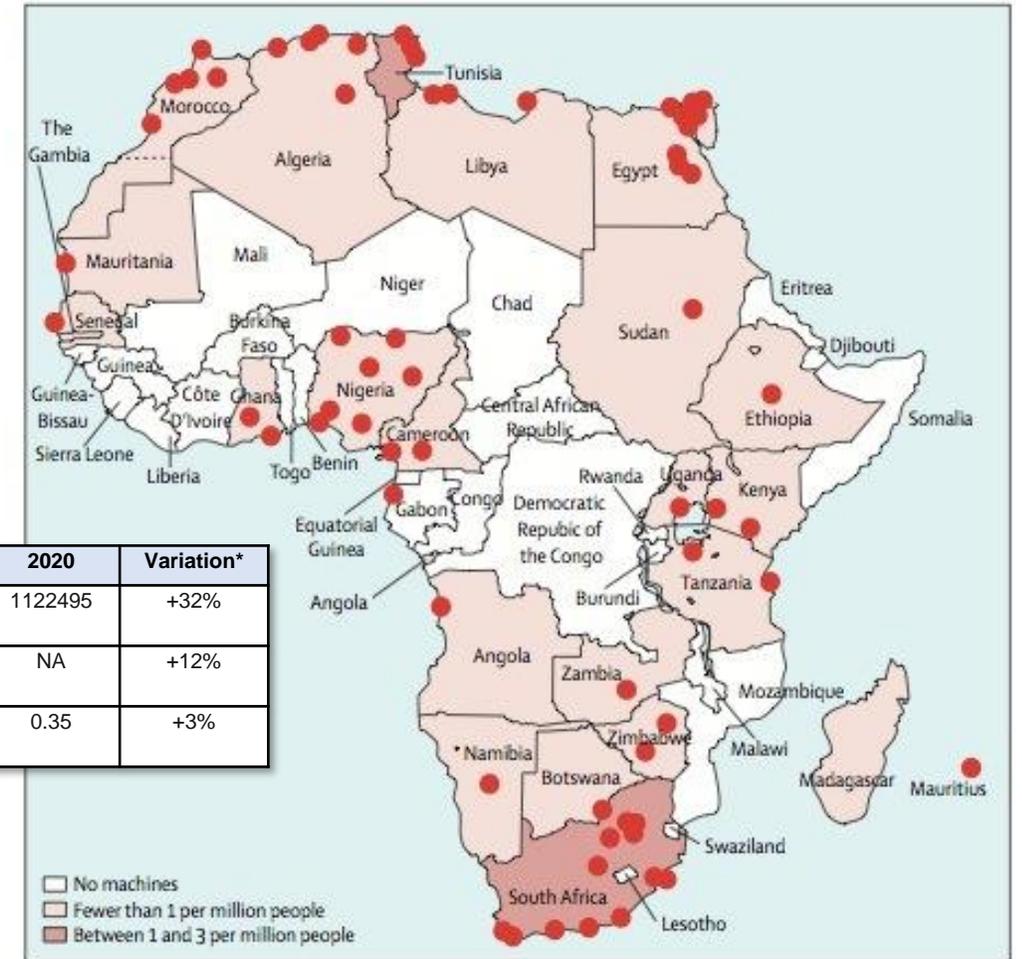


Figure 2: External beam radiotherapy machines in Africa in 2010
Dots represents radiotherapy centres. Comoros, São Tomé and Príncipe, and Cape Verde (all of which have no machines) are not shown.

Abdel-Wahab et al Lancet Oncology, 2013;14:168-75

Imaging

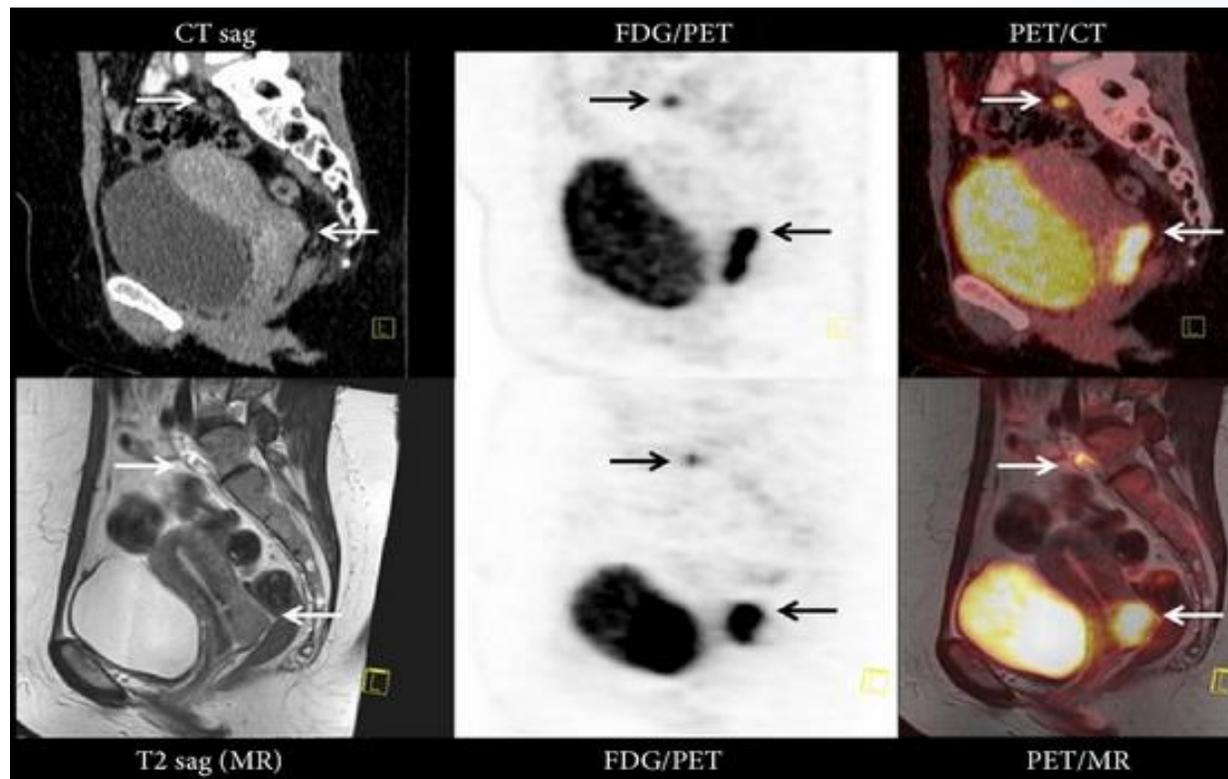
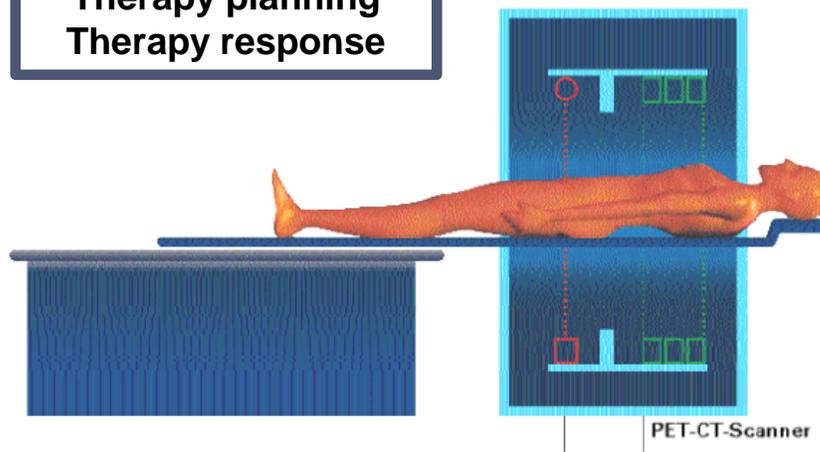
Structural Information:

Size Shape Location

Uptake Information

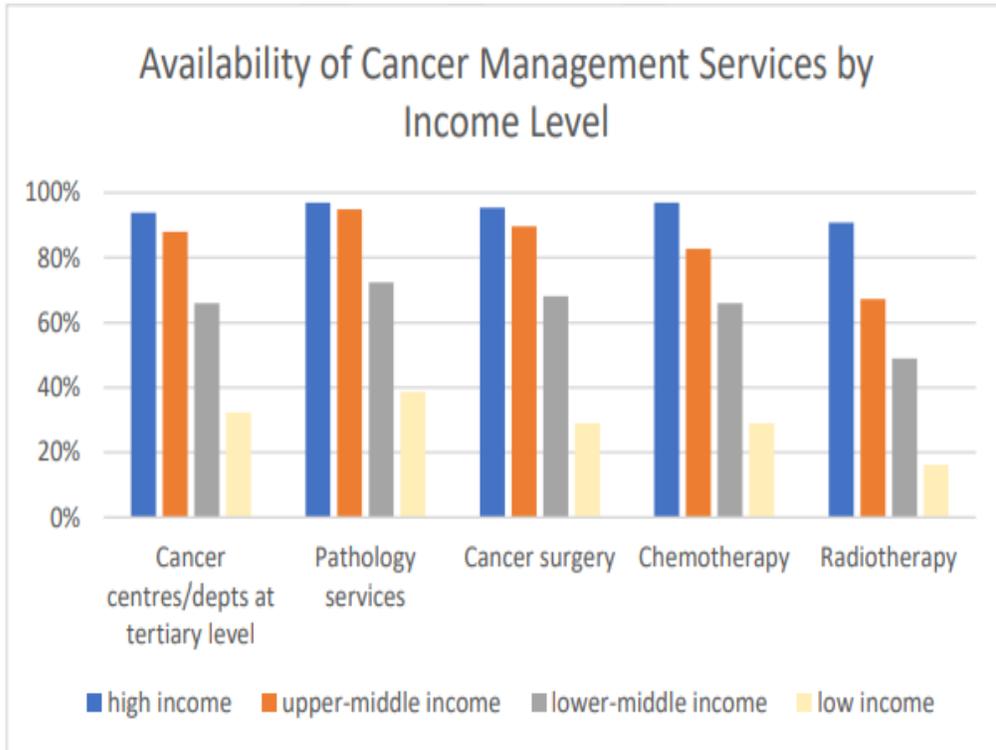
Activity Function Localization

CT or PET/CT:
Staging
Restaging
Therapy planning
Therapy response



(Kjær, Loft et al. 2013)

Investing in Treatment



Source: WHO Country Capacity Survey 2019

WHO (2019, December 16). Draft: Global strategy towards eliminating cervical cancer as a public health problem. Retrieved from <https://www.who.int/docs/default-source/cervical-cancer/cerv-cancer-elimn-strategy-16dec-12pm.pdf>.

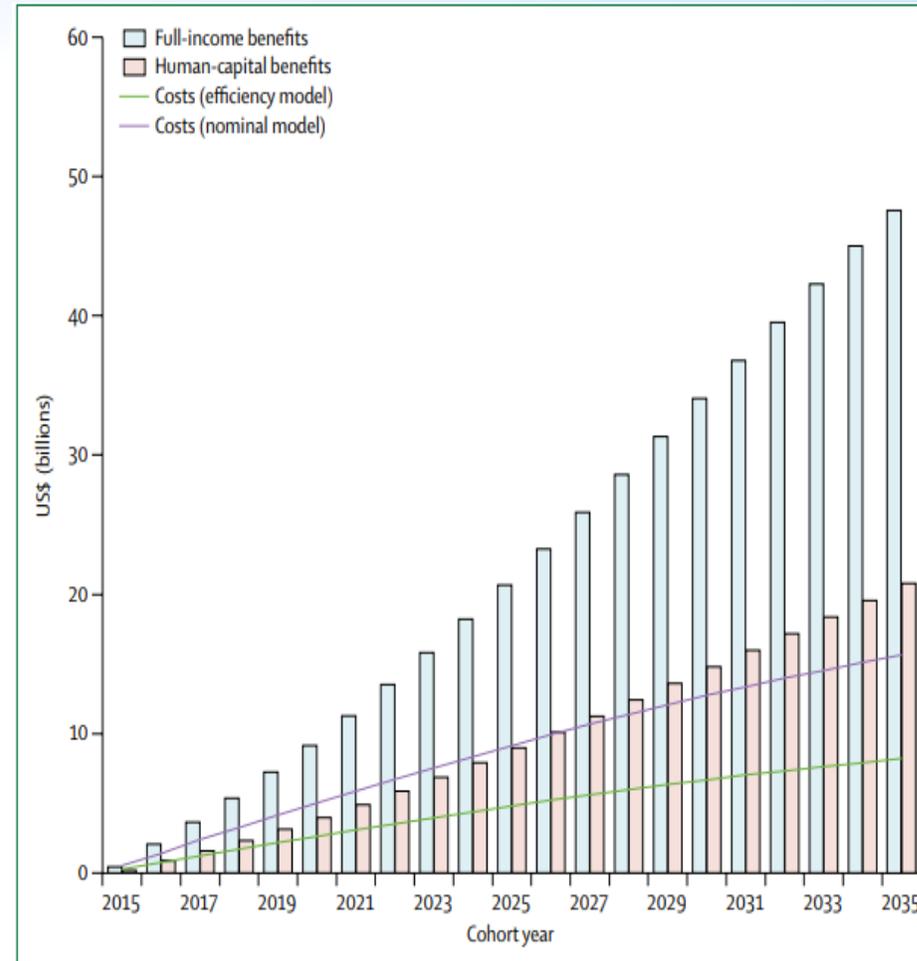


Figure 11: Cost and benefits of investments to scale up radiotherapy services in low-income and middle-income countries, 2015-35 (Atun, Jaffray et al. 2015)

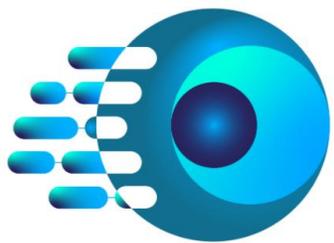
The costing models are described in the text and include both operational and capital costs.

Actions to address Global Radiotherapy Access:

- Population-based Cancer Control Plans
- Expansion of Access to Radiotherapy
- Human Resources for Radiotherapy
- Sustainable Financing to Expand Access to Radiotherapy
- Align Radiotherapy Access with Universal Health Coverage

Atun et al Lancet oncol 2015
Abdel-Wahab M et al Clin Oncol 2017

Data collection: IAEA Medical imAGING and Nuclear mEDicine global resources database



IMAGINE

IAEA Medical Imaging and Nuclear Medicine Global Resources Database



CT

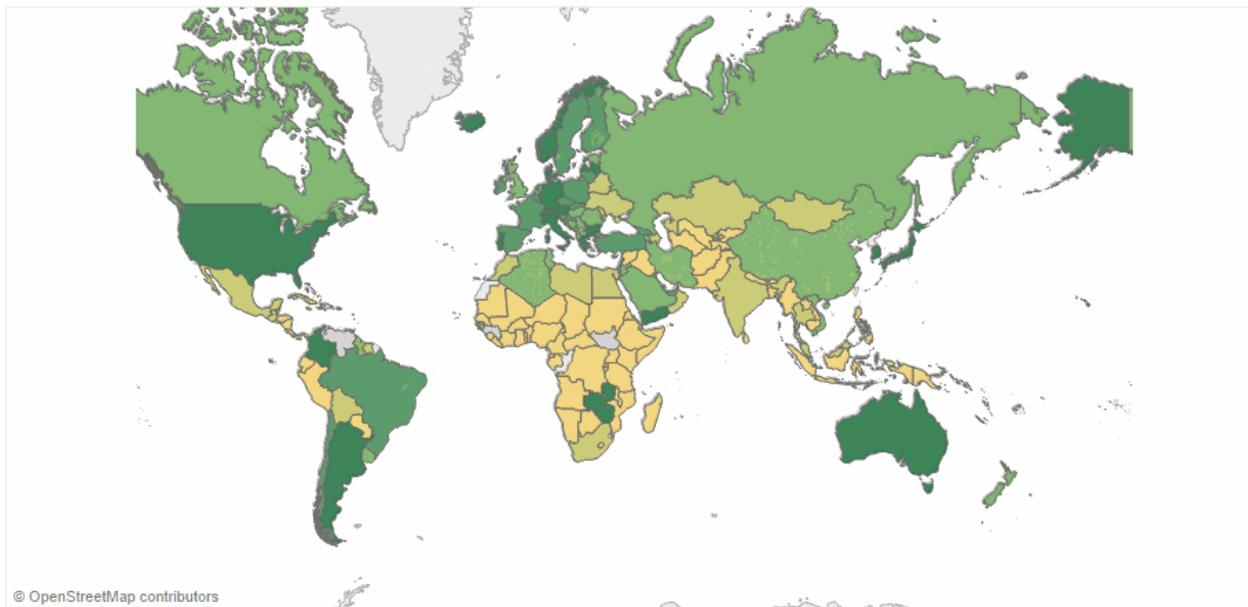
MRI

PET

SPECT

< CT scanners MRI Units PET scanners SPECT scanners >

CT scanners (per 1 mil)



CT Scanners Ranges

- More than 30
- Between 20 and 30
- Between 15 and 20
- Between 10 and 15
- Between 5 and 10
- Between 0 and 5
- None

© OpenStreetMap contributors

Income Group

Income Group	Population	Total Number Of CT scanners	Total Number Of MRI scanners	Total Number Of PET Or PET/CT Scanne..	Total Number Of SPECT Or SPECT/CT Scan..	Avg. CT scanners (per 1 mil)	Avg. MRI units (per 1 mil)	Avg. PET scanners (per 1 mil)	Avg. SPECT scanners (per 1 mil)
High Income	1 172 976 721	46 392	32 736	4 061	21 715	23.034	14.936	1.661	6.976
Upper-Middle Income	2 645 169 730	34 772	15 576	828	3342	11.008	4.450	0.304	1.524
Lower-Middle Income	2 972 367 090	12 962	3 141	344	662	3.079	0.910	0.099	0.260
Low Income	698 660 034	381	115	5	26	0.512	0.192	0.007	0.024
NC	374 780			1	2	0.000	0.000	2.668	5.336

In high-income countries



25,000 are served by 1 CT scanner

In upper-middle income countries



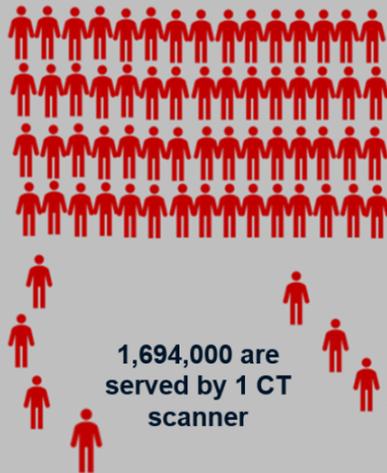
79,000 are served by 1 CT scanner

In lower-middle income countries



227,000 are served by 1 CT scanner

In low-income countries



1,694,000 are served by 1 CT scanner

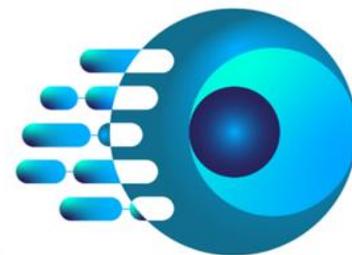
<https://humanhealth.iaea.org/HHW/DBStatistics/IMAGINE.html>

PET scanners in Africa/ million inhabitants (2020, IMAGINE)



PET-CT Scanners	#	/ Million
Cape Verde	1	1.84
Morocco	12	0.33
Tunisia	3	0.26
South Africa	14	0.24
Egypt	20	0.20
Libya	1	0.15
Algeria	6	0.14
Kenya	1	0.02
Sudan	1	0.02
Tanzania	1	0.02

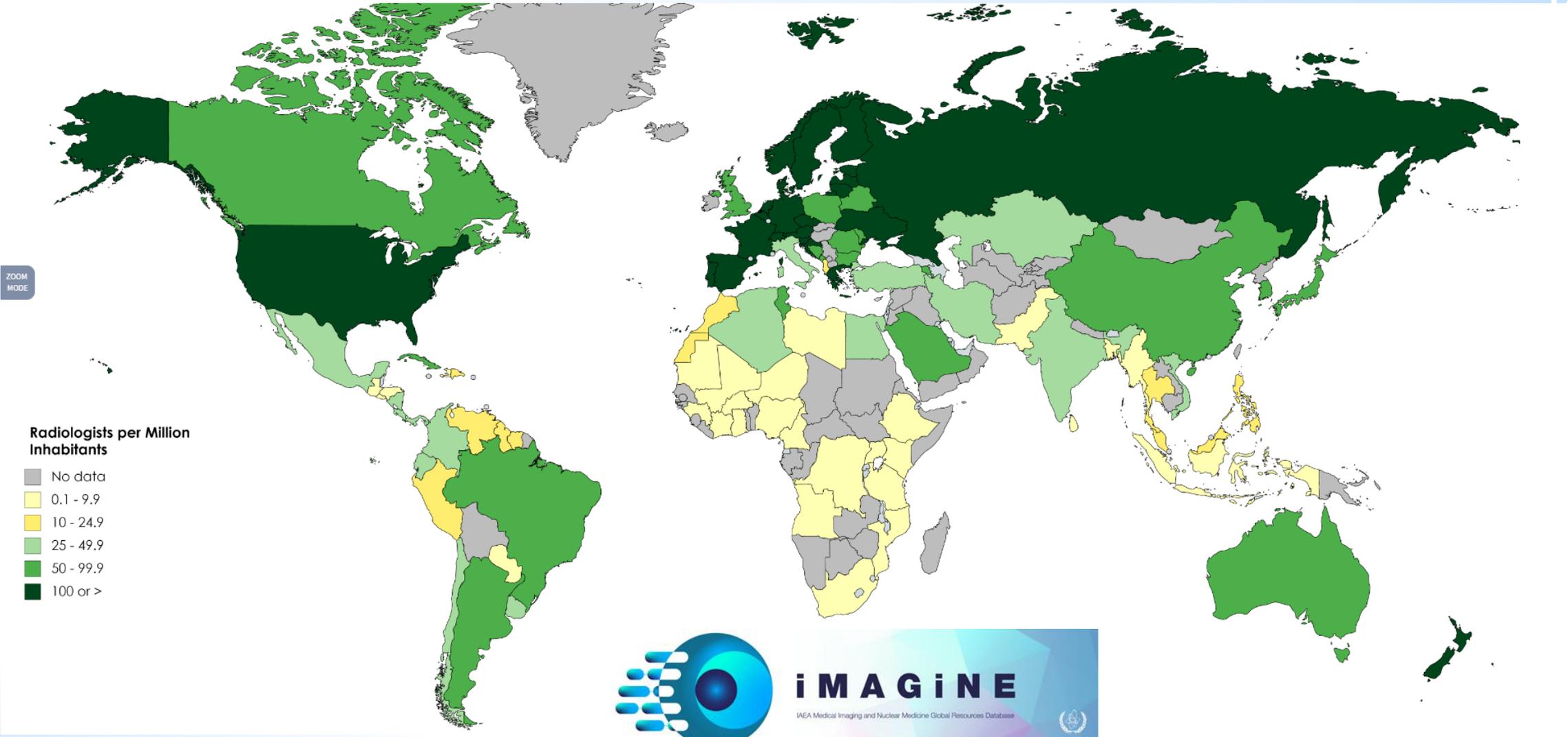
**59 PET-CT Scanners
in 10 out of 54 countries**



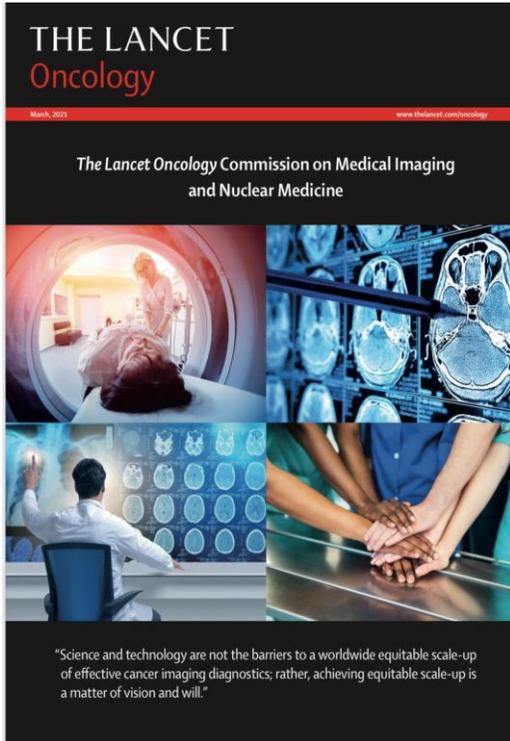
iMAGiNE

IAEA Medical Imaging and Nuclear Medicine Global Resources Database

Radiologists per country (IMAGINE)



Lancet Commission



THE LANCET Oncology

Lancet Oncol 2020; 21: 1077–88

Including cervical cancer

Estimating the impact of treatment and imaging modalities on 5-year net survival of 11 cancers in 200 countries: a simulation-based analysis

Zachary J Ward, Andrew M Scott, Hedvig Hricak, May Abdel-Wahab, Diana Paez, Miriam Mikhail Lette, Fernando Alberto Vargas, T Peter Kingham, Rifat Atun

Simultaneous expansion of treatment, imaging, and quality of care could improve 5-year net survival by more than ten times in low-income countries (3.8% [95% UI 0.5–9.2] to 45.2% [40.2–52.1]) and could more than double 5-year net survival in lower-middle-income countries (20.1% [7.2–31.7] to 47.1% [42.8–50.8]).

	Cancer deaths averted		Projected life-years saved, millions
	Number	% of total deaths	
Imaging only	2,463,500	3.2%	54.92
Treatment only	4,095,600	5.4%	103.28
Treatment + quality	5,369,100	7.0%	134.96
Comprehensive	9,549,500	12.5%	232.30

Comprehensive Assessment of Technology Needs

Databases, missions,
Health economics
research

Role of IAEA

Expert Scientific Management

Procurement specifications
Bunker design

1382 144 74 2000 8 286 28 475
Projects Countries Staff Since Activities Participants

TC Projects

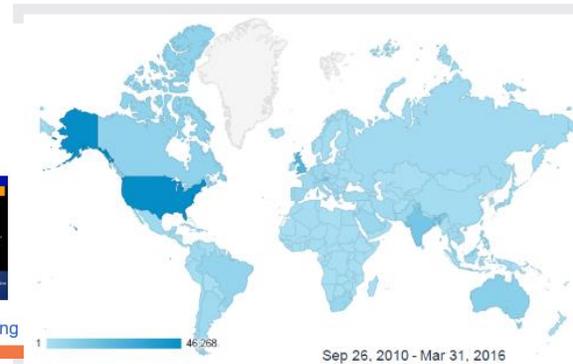
Last Update: 2020-02-16 18:47:02



- To promote...
- To support implementation...
- To educate and train...



Education and Training



Assessing Treatment Needs



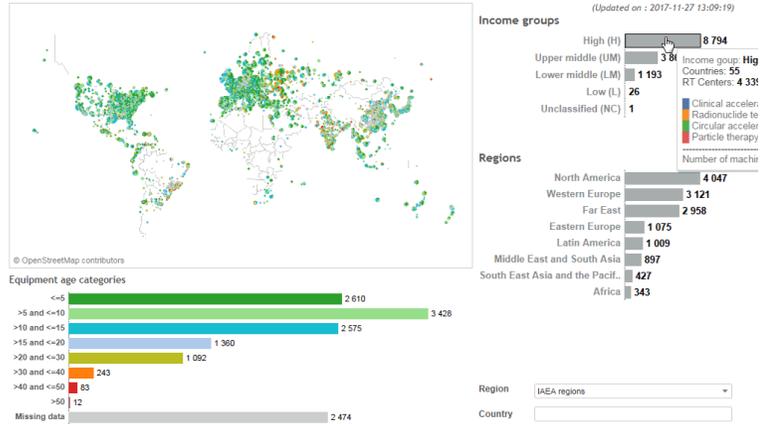
Equipment Age

<https://dirac.iaea.org/> DIRAC (Directory of Radiotherapy Centres)



Click on equipment type, Income groups or Regions to create your own view. Ctrl+click to select multiple. *click here*

(Updated on : 2017-11-27 13:09:19)



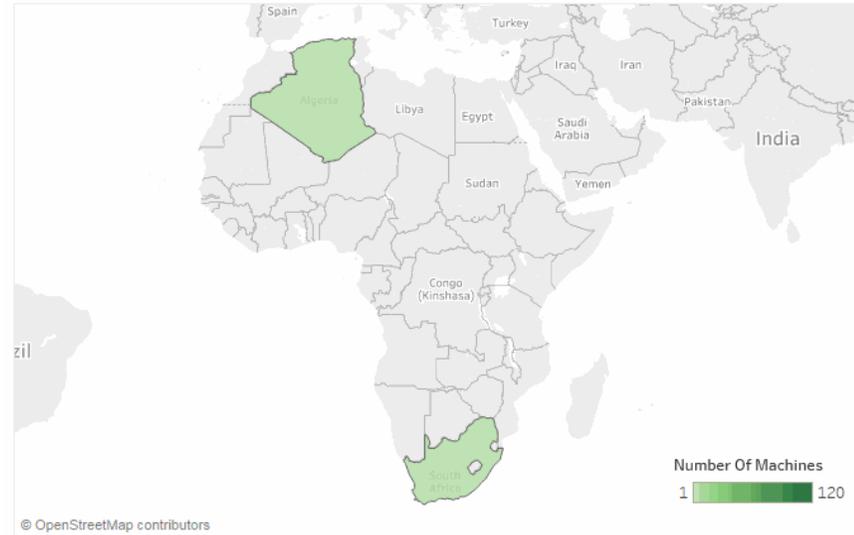
151 Countries
7,565 Radiotherapy centers

- 14,217 Teletherapy units
- 3,345 Brachytherapy units
- 6,965 TPSs
- 3,634 Simulators
- 3,737 CTs

2020-02-20

- **DIRAC Database**
- **imPACT Missions:**
 - National authorities, IAEA, WHO, IARC, other partners

Total number of external beam radiotherapy machines in 1959



Year - 1959

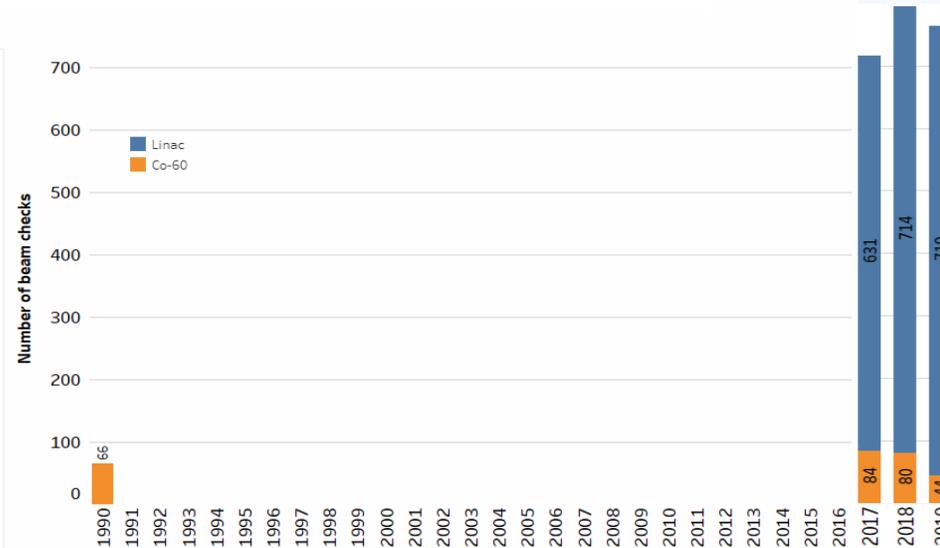
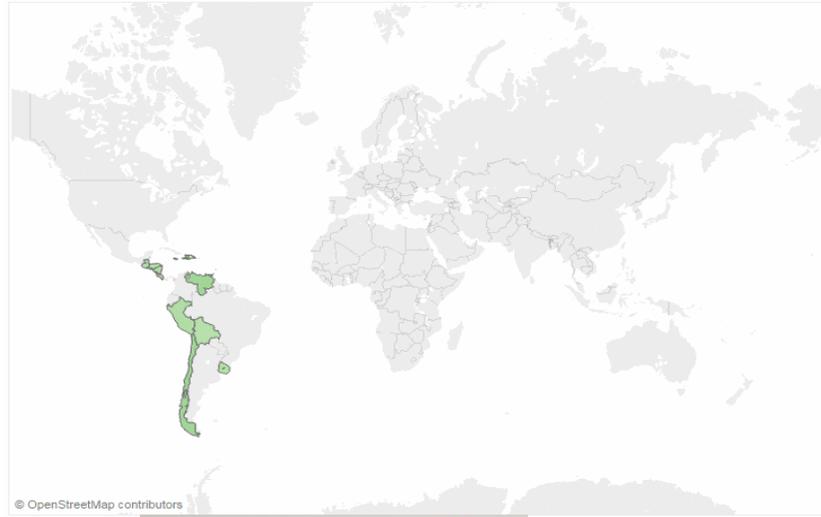


Quality Assurance: IAEA/WHO TLD audits of Radiotherapy centres



120 Countries 2089 Hospitals 9738 Units 12675 Beam checks 1990 Since

Number of beam checks - 1990



Dose audit service:

- >13000 beam checks
- ~2300 centres in 133 Member States

Calibration services to IAEA/WHO SSDL labs

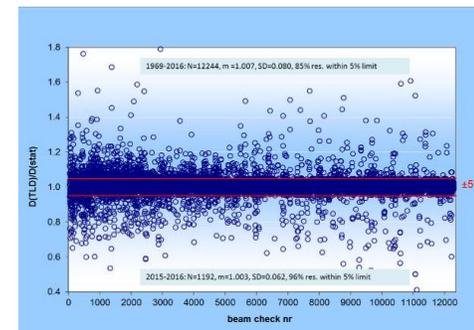
- 78 MS
- 110 centers
- 1150 certificates

QUATRO audits:

- 51 MS



The IAEA DOL helps MS maintain accurate, consistent medical dosimetry.



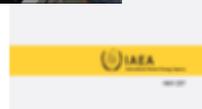
Quality Assurance

Quality Assurance Team for Radiation Oncology

- Radiation oncologist
- Medical physicist
- RTT
- Safety specialist (local)



IAEA dosimetry travel kit used for QUATRO missions



QUATRO

<https://dosimetry-audit-networks.iaea.org/Home/Quatro>

IAEA Safety Standards for protecting people and the environment

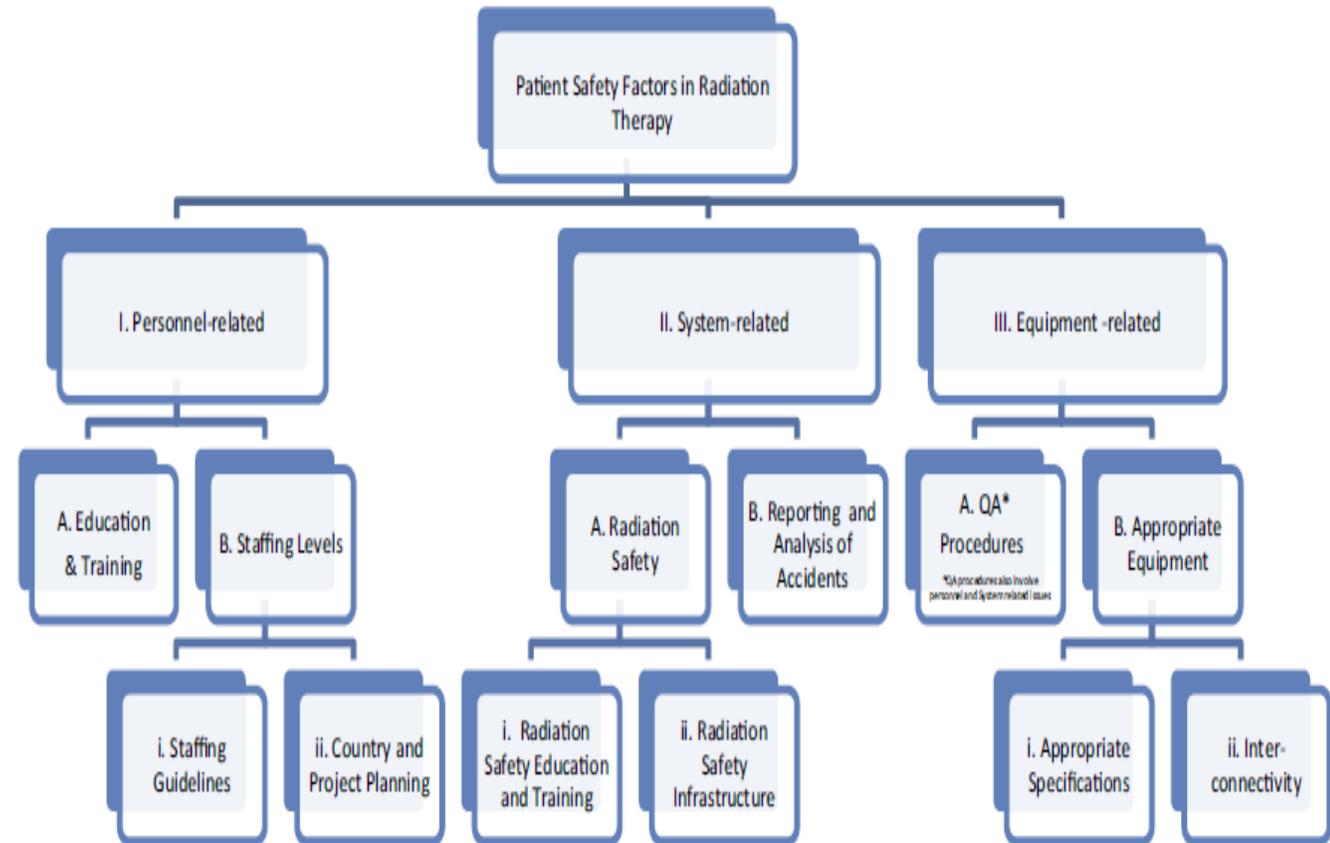
Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards



General Safety Requirements Part 3
No. GSR Part 3

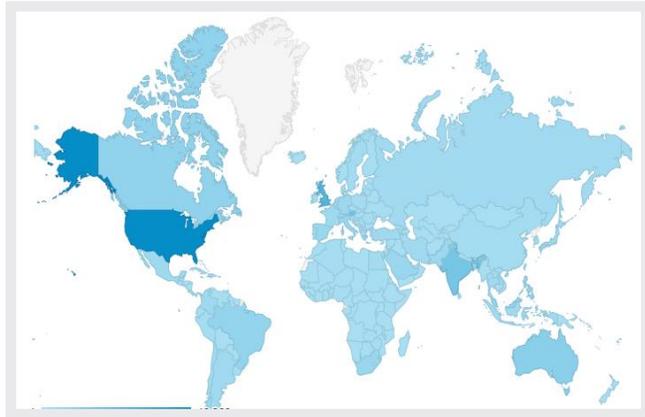


- Education in Radiation protection
- Radiation Protection Training for prevention of accidental exposure in radiotherapy
- SAFRON
- RASIMS



Abdel-Wahab M et al J Am Coll Radiol. 2011

E-Learning Resources



Background
Cancer is one of the leading causes of mortality worldwide, with approximately 14 million new cases and 8 million deaths annually. Technological cancer management is a diverse group of research originating in the basic reproductive organ. It is estimated that every year over a million new cases and half a million deaths worldwide are due to gynaecological cancers.

To ensure a fighting chance for patients diagnosed with this disease, a multidisciplinary team approach is crucial for the quality of diagnosis and treatment, involving close cooperation across the gynaecology, oncology, radiology and medicine and radiation oncology fields.

One of the major challenges faced by clinicians is to determine the most effective therapy for their patient, ensuring optimal conditions at minimal risk. Cancer staging is central to the modern management of cancer patients.

The purpose of the FIGO staging system is to provide uniform terminology for better communication among health professionals and to provide appropriate prognosis to the patients which results in treatment improvement. This interactive app provides cancer staging so be available and it has the potential to improve cancer management around the world.

How to use the mobile app?

A Web Page

CeLP-RT

Breast Cancer, early

Treatment

Quality Assurance

General tips

- TRS-398 – Setting up the dosimeter (Video)
 - This video provides tips on setting up your dosimeter to ensure accurate measurement results.
 - 21 MP
 - Access Resource
- IMRT Patient Specific QA (Video)
 - This video provides an overview of patient specific QA for IMRT.
 - 21 MP
 - Access Resource

Essential skills (e-Learning)

- In-vivo dosimetry (e-Learning)**
 - This e-learning module provides an overview theoretical background and practical tips for TLD based in vivo dosimetry.
 - Number of modules: 1
 - Estimated completion time: 1 hour
 - 21 MP
 - Access Resource
- Developing a Clinical Quality Assurance Program (e-Learning)**
 - This e-learning module provides an overview theoretical background and practical tips for calibration of linear and electron beams.
 - Number of modules: 1
 - Estimated completion time: 1 hour
 - 21 MP
 - Access Resource
- Quality Assurance Program for Linear Accelerators (PDF)**
 - A ready to use program applicable to common 60 Co and 60Ir linear accelerators. An optional written report is included.
 - 21 MP
 - Access Resource
- Quality Assurance Program for Cobalt-60 Teletherapy Units (PDF)**
 - A ready to use program applicable to Cobalt-60 teletherapy units.
 - 21 MP
 - Access Resource

E-learning material-Medical physics

Video training tutorial for participants in the IAEA/WHO Funded Basic Adult Service

Support the correct procedure of TLDs irradiation by Centres

Reduction of errors in irradiation

Optimization of adult services

Video training module: IAEA Series No. 398

Testicular relapse

IAEA Learning Management System

Open LMS English (en)

10 70 28 13 175 13

10 Countries 70 Sessions 28 Participants 13 Courses 175 Cases 13 Tumor locations

World 28
Europe 19
Africa 11
Asia 11
North America 11
South America 11
Oceania 11
Middle East 11
Other 11

The Africa Radiation Oncology Network (AFRONET) was founded in June 2012 as an IAEA pilot innovative project for Anglophone Africa.

Due to lack of sufficient radiotherapy centres in many low income countries, isolated equipment and a shortage of training opportunities for professionals, centres often have to work in isolation and have limited access to up-to-date published literature. International meetings and expert opinion. AFRONET has provided a unique opportunity for participating centres to present and discuss cases with experts from other and outside Africa. This activity has benefited not only training professionals, but also radiation oncology residents through early and periodic exposure to high quality lectures and experienced case discussions. Using a multi-disciplinary Virtual Tumor Board (VTB) where cancer professionals present, discuss and review challenging cancer cases. The network has helped strengthen clinical decision-making in radiotherapy centres across Anglophone Africa.

Applied Sciences of Oncology

Distance Learning Course

Version 2.1.1

Applied Sciences of Oncology (ASO) is a 12-month course designed to provide a comprehensive overview of the latest developments in radiation oncology. The course is delivered through a combination of self-paced e-learning modules and live webinars.

CURSO DE ACTUALIZACIÓN DE TECNOLOGOS EN RADIODIAGNOSTICO

ARCAI

Online Trainings

- Diagnostic CT and PET/CT: 600 professionals worldwide received training in the key competences PET/CT and CT - IAEA (NMDI-TC) and Australia (University of Sidney, ANSTO).
- DAT-OL for NM Professionals: 39 subjects, 3 years, over 800 professionals trained worldwide.

IAEA International Atomic Energy Agency

Schematic Approach to Abdominal and Pelvic Lymph Nodes

Introduction
Measurement
Size
Relationship
Menu
Nomenclature according to vessels
Nomenclature according to organs
Quiz
References
Acknowledgments
Help

The goal of this e-learning module is to identify and review the anatomical boundaries of abdominal and pelvic node levels

Webinars are made available at the Human Health Campus

Free online educational resource for health professionals in radiation medicine that also offers a series of e-learning modules to enhance the learning experience. <http://humanhealth.iaea.org>

Virtual Tumor Boards

Complete curricula

Webinars and online training

Interactive E-Learning modules

<http://humanhealth.iaea.org>

Guidelines and Publications

- Costing and staffing calculators
- Guidelines on setting up radiation medicine infrastructure
- Guidelines on Quality Assurance & Quality Control
- Dosimetry protocols
- Training courses and Syllabi

Setting Up a
Radiotherapy Programme:
Clinical, Medical Physics,
Radiation Protection and Safety Aspects

IAEA HUMAN HEALTH SERIES
No. 14

Planning National
Radiotherapy Services:
A Practical Tool

Radiation Oncology Physics:
A Handbook for Teachers and Students

E.B. Podgorsak
Technical Editor

Supported by the IAEA and endorsed by the COMPTON, ECORP, ESTRO, ICRP, PAHO and WHO

IAEA HUMAN HEALTH SERIES
No. 30

Implementation of
High Dose Rate
Brachytherapy in Limited
Resource Settings

IAEA HUMAN HEALTH SERIES
No. 9

Appropriate Use of FDG-PET
for the Management
of Cancer Patients

IAEA HUMAN HEALTH REPORTS No. 2

Radiotherapy in Palliative
Cancer Care: Development
and Implementation

IAEA
International Atomic Energy Agency

IAEA HUMAN HEALTH REPORTS No. 12

The Transition from
2-D Brachytherapy to
3-D High Dose
Rate Brachytherapy

IAEA
International Atomic Energy Agency

National Networks for Radiotherapy
Dosimetry Audit

Structure, methodology, scientific procedures

Dosimetry in Brachytherapy

An International Code of Practice for Secondary Standards
Dosimetry Laboratories and Hospitals

IAEA
International Atomic Energy Agency

A Handbook for the Education
of Radiation Therapists (RTTs)

IAEA
International Atomic Energy Agency

A Syllabus for the
Education and Training of
Radiation Oncology Nurses

IAEA
International Atomic Energy Agency

Radiation Biology:
A Handbook for
Teachers and Students

IAEA
International Atomic Energy Agency

Clinical Training of
Medical Physicists
Specializing in
Radiation Oncology

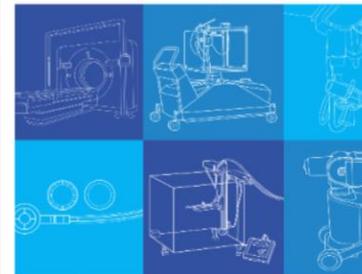
IAEA
International Atomic Energy Agency

IAEA Syllabus for
the Education and Training
of Radiation Oncologists

Endorsed by the American Society
for Radiation Oncology (ASTRO) and
the European Society
for Therapeutic Radiology and
Oncology (ESTRO)



Technical specifications
of radiotherapy
equipment for cancer
treatment



IAEA HUMAN HEALTH REPORTS No. 6

Management of
Cervical Cancer: Strategies
for Limited-resource Centres –
A Guide for
Radiation Oncologists

IAEA
International Atomic Energy Agency

IAEA Coordinated Research in Cervix Cancer



PAST

Regional hyperthermia combined with radiotherapy for uterine cervical cancers: a multi-institutional prospective randomized trial of the IAEA.

AK-2123 (Sanazol) as a radiation sensitizer in the treatment of stage III cervical cancer: results of an IAEA multicentre randomised trial.

A randomized clinical study to compare radical concomitant chemo-radiation against radical radiotherapy alone as treatment of carcinoma of the uterine cervix FIGO stages IB-IIIB in HIV infected patients

E3.30.26 Clinical/Radiobiological Study on viral-induced cancers' response to radiotherapy, with comprehensive morbidity assessment

Current

Modern radiotherapy techniques in cervical cancer

Image-based treatment planning in cervical cancer

Quality assurance in HDR brachytherapy
Develop audit methodologies end to end (national DAN)

111

CRPs

1470

Contracts

102

Countries

2000

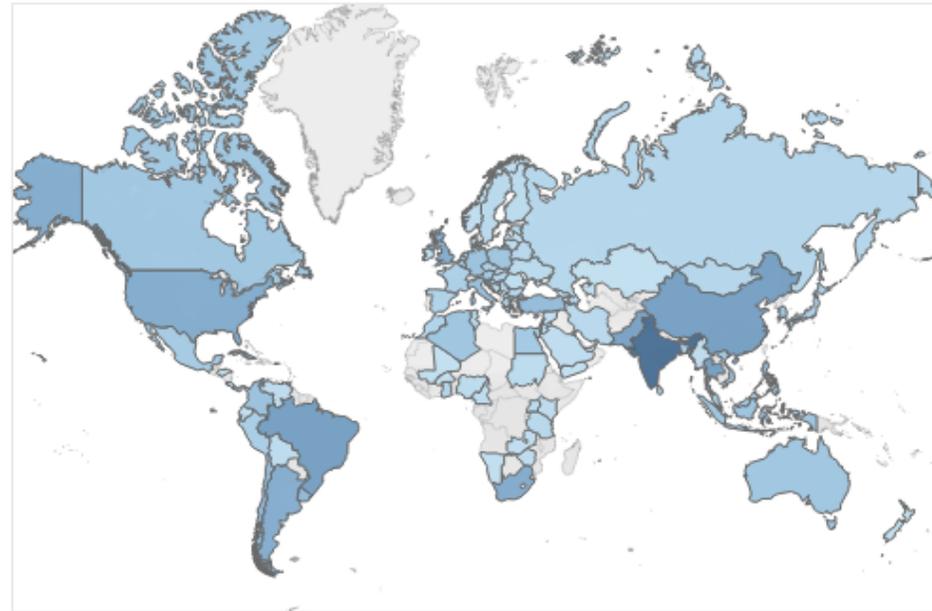
From Year

1 170

Contracts

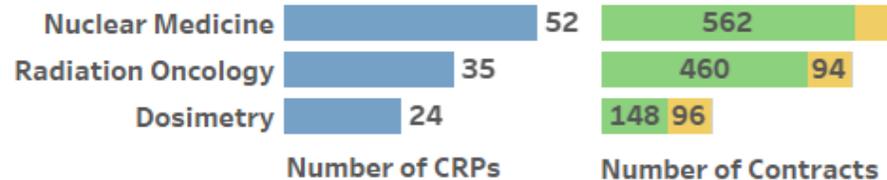
300

Agreements

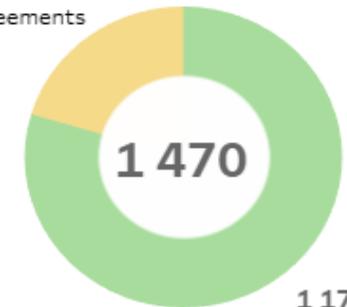


Number of CRPs and Contracts per section

Updated on (2020-06-16 18:24:28)



300
Agreements



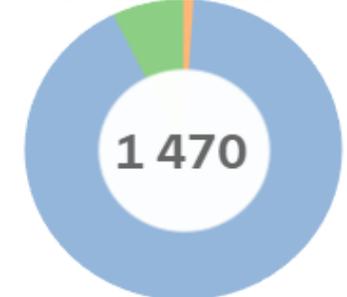
1 170
Contracts

Contracts

Agreements

107
Technical

15
Doctoral



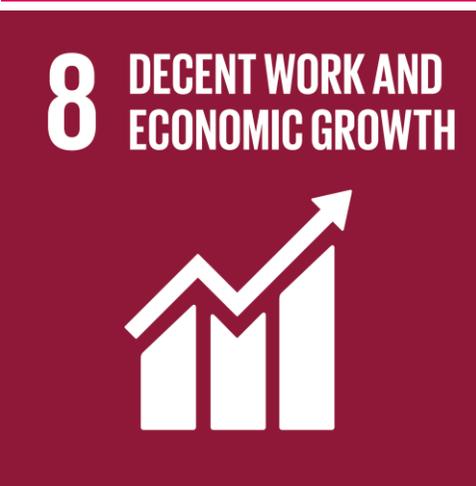
1 348
Research

Doctoral

Research

Technical

How Does Investment in Treatment help?



Additional Contribution to SDG

- Reduction in suffering, death
- Reduction in grief, economic burden among families
- Lowering of poverty levels
- Increase in primary education (higher levels of female education -> higher maternal and infant health)
- Basis of global partnerships





THANK YOU