



IAEA's technical support and integration of medical uses of radiation into global initiatives

Enhancing Radiotherapy for Cancer Care in Singapore

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National Cancer
Centre Singapore
SingHealth

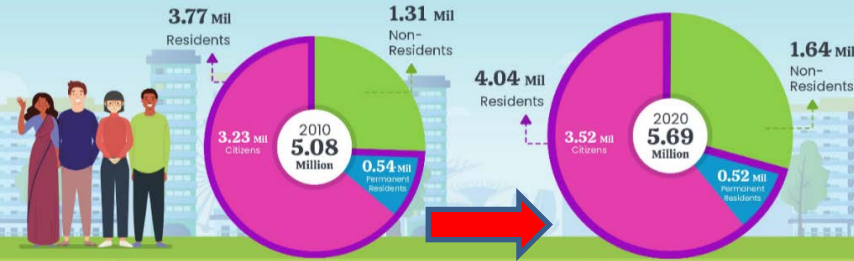
2022

Singapore

CENSUS OF POPULATION 2020

Population

Between 2010 and 2020, Singapore's total population grew by around **1.1 per cent** a year.



Singapore:

- a) Multi-racial, multi-cultural and multi-religious
- b) Resident population: 4.04 mil (3.52+0.52 mil)
- c) Aging population – increasing healthcare needs

<https://www.population.gov.sg/media-centre/publications/census-of-population-2020>



Median age of resident population **increased** from 2010 to 2020.

2010

37.4 Years

2020

41.5 Years



Resident old-age dependency ratio **increased** from 2010 to 2020.

2010

13.5

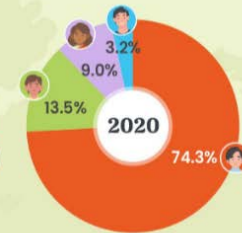
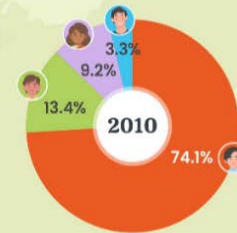
2020

23.4

* Residents aged 65 years and over per 100 residents aged 20–64 years.



Resident ethnic distribution **remained stable**.



Chinese Malays Indians Others

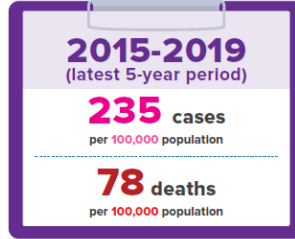
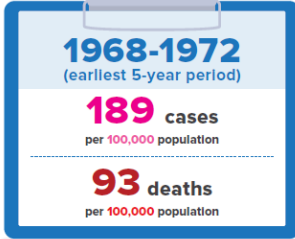
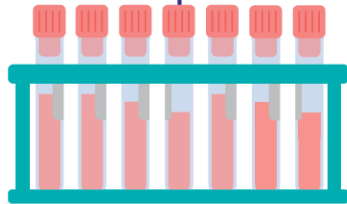
Singapore Cancer Statistics (2015-2019)



Cancer trends 1968-2019

Singapore Cancer Registry Report 2019

Cancer statistics 1968-2019



Cancer statistics 2015-2019 (latest 5-year period)

	All	Male	Female
Incidence & mortality	New cancer cases	38,077 (49%)	40,127 (51%)
	Cancer deaths	15,605 (55%)	12,940 (45%)

3 most common cancer diagnoses

MALE

Colon & rectum



6,436 cases

2,264 deaths

61% 5-year survival rate*

Prostate



5,875 cases

989 deaths

88% 5-year survival rate*

Lung



5,218 cases

3,997 deaths

16% 5-year survival rate*

FEMALE

Breast



11,805 cases

2,208 deaths

82% 5-year survival rate*

Colon & rectum



5,253 cases

2,015 deaths

61% 5-year survival rate*

Lung



3,074 cases

2,008 deaths

29% 5-year survival rate*

*5-year age-standardised relative survival rate.

Cancer in Singapore
a) **Social and Economic Impact**
b) **Leading Cause of death**
- growing and aging population
~12000 cases (1968-1972)
~78000 cases (2015-2019)



Overall Aim:
Quality and affordable
medical services for all

Radiotherapy in Singapore

National Specialist Centres (Public, ~80%)



Medical Linear Accelerator (LINAC): 14
Brachytherapy: 2
CT Simulator: 6
Proton Therapy Gantry: 4

Private (~20%)

7 Hospitals/Medical Centres

Medical Linear Accelerator (LINAC): 11
Brachytherapy: 2
CT Simulator: 7
Proton Therapy Gantry: 2

Radiotherapy in NCCS

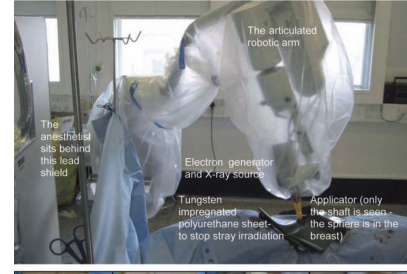


LINAC (8x)

CT Simulator (2x)



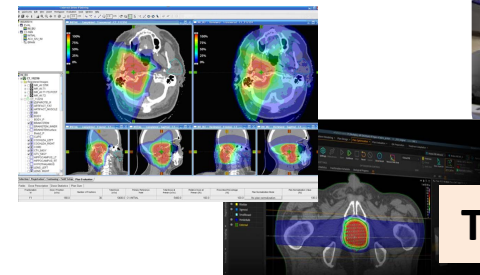
Brachytherapy (1x)



Intra-op RT (1x)



Seed implant



Treatment Planning Systems



Proton Beam Therapy (2022)

NCCS Medical Physics Research

Received: 27 July 2021 | Revised: 27 December 2021 | Accepted: 29 January 2022

DOI: 10.1002/acm2.13560

RADIATION ONCOLOGY PHYSICS

JOURNAL OF APPLIED CLINICAL
MEDICAL PHYSICS

A transit portal dosimetry method for respiratory gating quality assurance with a dynamic 3D printed tumor phantom

Hong Qi Tan¹ | Calvin Wei Yang Koh¹ | Lloyd Kuan Rui Tan¹ | Kah Seng Lew¹ | Clifford Ghee Ann Chua¹ | Khong Wei Ang¹ | James Cheow Lei Lee^{1,2} | Sung Yong Park^{1,3}

Medical Physics Research Focus:

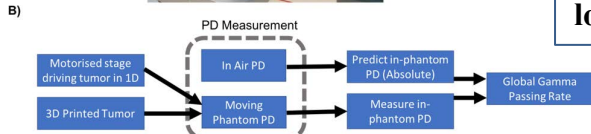
1. Improving QA and radiation dose accuracy for treatment
2. Study of motion effects in radiotherapy
3. Tumor changes and adaptive treatment

Recently completed:

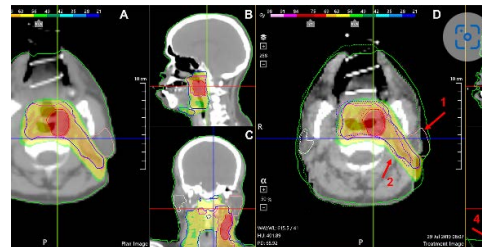
1. Statistical method to predict RT treatment plan quality for treatment

Ongoing:

1. Adapting to tumor changes during treatment (Adaptive RT)
2. CT calibration study for radiation dose accuracy
3. Moving platform for quality assurance of moving targets



Completed
New QA method for respiratory motion target localization



e.g. Adaptive RT (ref. only)

Front. Oncol., 30 June 2022

Sec. Radiation Oncology

<https://doi.org/10.3389/fonc.2022.777793>

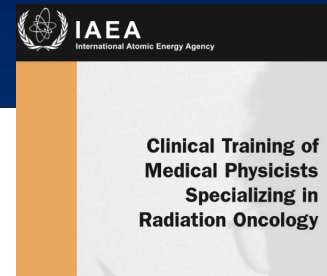
Education and Clinical Training Resources

IAEA Support:

1. Produces reference resources (e.g. technical reports, implementation guides, online training platform, handbooks)
2. Workshops and meetings (education and training, guide to certification/accreditation)
3. Audits for quality and safety

Benefits:

1. Increased knowledge and competency
2. Best practices (quality audit, certification)
3. Ready reference guides
4. Residency training within career framework



IAEA HUMAN HEALTH SERIES
No. 25

Roles and Responsibilities,
and Education and Training
Requirements for Clinically
Qualified Medical Physicists

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



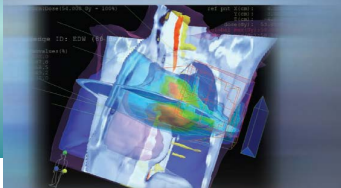
Endorsed by the International Medical
Physics Certification Board (IMPCB)
and the International Organization
for Medical Physics (IOMP)

VIENNA, 2021 TRAINING COURSE SERIES **71**

Radiation Oncology Physics:
A Handbook for Teachers and Students

**Comprehensive Audits of
Radiotherapy Practices:
A Tool for Quality Improvement**

Quality Assurance Team for Radiation Oncology (QUATRO)



Clinical and Technical Trainings

Benefits:

1. Increased and deepen knowledge via expert lectures and consultation
2. Acquiring relevant skill-sets (clinical techniques, practicals)



IAEA/RCA Regional Training Course on Clinical Applications of Stereotactic Body Radiotherapy (SBRT) in Lung and Liver Cancers

Subject: C7-RAS-6.038-012- IAEA/RCA Regional Training Course on Radiotherapy Techniques with Emphasis on Imaging and Treatment Planning (3-7 September 2012) in Beijing, People's Republic of China

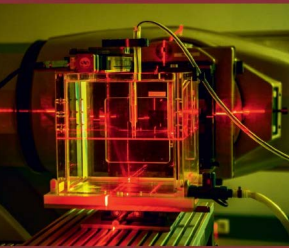
Regional Training Course on TRS 483: IAEA/AAPM Code of Practice on Small Static Fields Used in External Beam Radiotherapy

Subject: Regional Training Course on Clinical Applications of Stereotactic Body Radiotherapy (SBRT) in Lung and Liver Cancers, Mumbai, India, 22-26 May

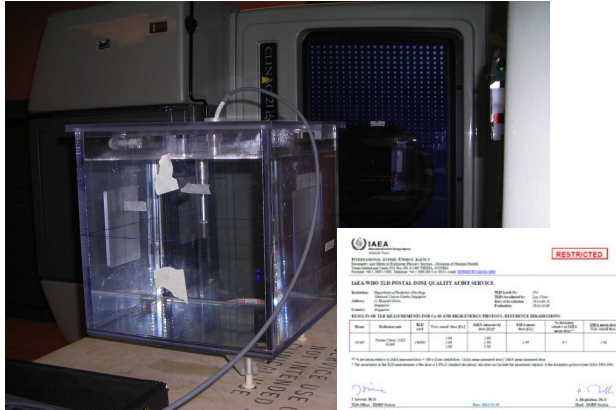


NCCS and SGH attend and host IAEA regional/international training courses, fellowships and meetings

**SSDL
NETWORK
CHARTER**



Quality Audits and SSDL



IAEA Support:

1. NCCS Designated a Secondary Standard Dosimetry Laboratory with help of WHO (1970s)
2. Actively participates in the IAEA/WHO SSDL Postal TLD Quality Audit program
3. Training courses and reference document for Quality Assurance Teams for Radiation Oncology (QUATRO)



IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Interregional Training Course on Quality Assurance Teams for Radiation Oncology

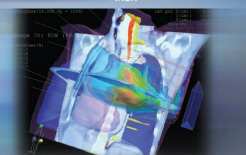
Hosted by

The International Atomic Energy Agency
IAEA Headquarters
Vienna, Austria

17 to 21 January 2022

**Comprehensive Audits of
Radiotherapy Practices:
A Tool for Quality Improvement**

Quality Assurance Team for Radiation Oncology (QUATRO)



Benefits

1. External radiation dosimetry audit to monitor accuracy of radiation dose to RT patients for NCCS and Singapore via inter-comparison
2. Improves and strengthens NCCS QA program and clinical processes via benchmarking best practices
3. Singapore QUATRO team for the region

Technical Expert Assistance

Radium Conditioning 2002 (Long term storage for legacy radioisotopes)

**IAEA Support:
Identify and sent expert team**

Benefits:

- 1. Safe long-term storage of long half-life radioisotopes**
- 2. Accountability and ownership**



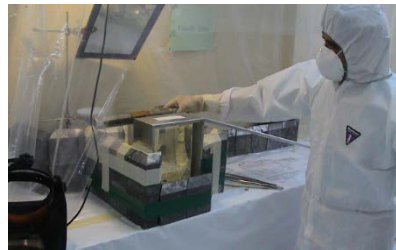
With the Expert Lead and Team



Source Storage



Source Containment (welding)



Source Containment (leak test)



Radiation Survey

Proton Beam Therapy Training

IAEA Support:

1. Education workshops
2. Short visits (2 weeks)
3. Fellowships (3 to 4 months)

Benefits:

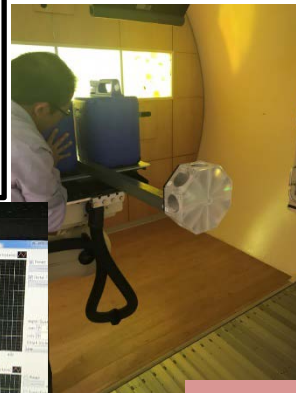
1. Increased knowledge
2. Technical skill-sets
3. Clinical experience
4. Future reference site for region



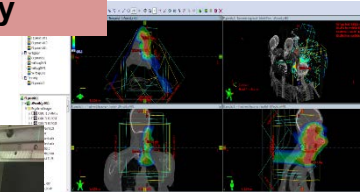
System Operation and Treatment Delivery



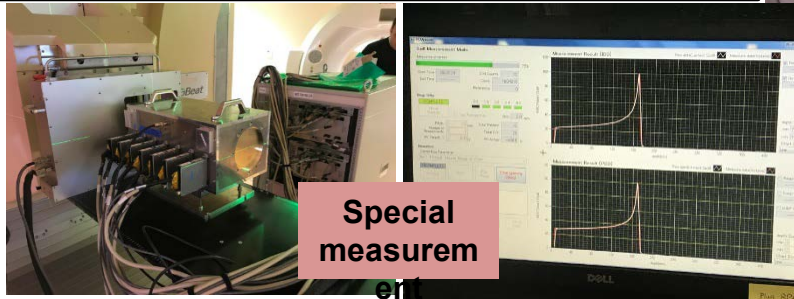
Certification



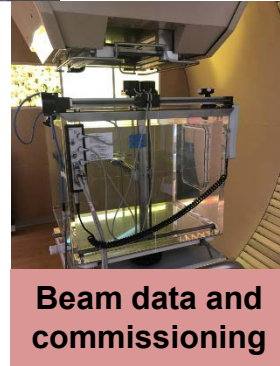
QA and Calibration



Treatment Planning



Special measurement



Beam data and commissioning

Summary

- 1. Cancer care and Radiotherapy (RT) is a growing need in Singapore.**
- 2. NCCS is the largest academic comprehensive cancer centre in Singapore.**
- 3. RT professionals must be well trained to provide high quality and safe treatment for patients.**
- 4. IAEA's technical support has been continuous and invaluable in building capabilities for Singapore's RT program. This support also extends to Nuclear Medicine and Diagnostic Radiology.**
- 5. With IAEA's strong support, Singapore's Radiation Medicine will continue to be strengthened.**
- 6. This has in turn enabled us to contribute to the region through regional trainings and expert input.**

Thank you for your kind attention!