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GLOBAL TASK FORCE ON RADIOTHERAPY FOR CANCER CONTROL

Global demand for radiotherapy and chemotherapy

G Delaney, S Jacob, K Wong, T Hanna, J Shafiq, S Thompson, ML Yap, M Barton

CCORE
Collaboration for Cancer Outcomes Research and Evaluation

UNSW
AUSTRALIA

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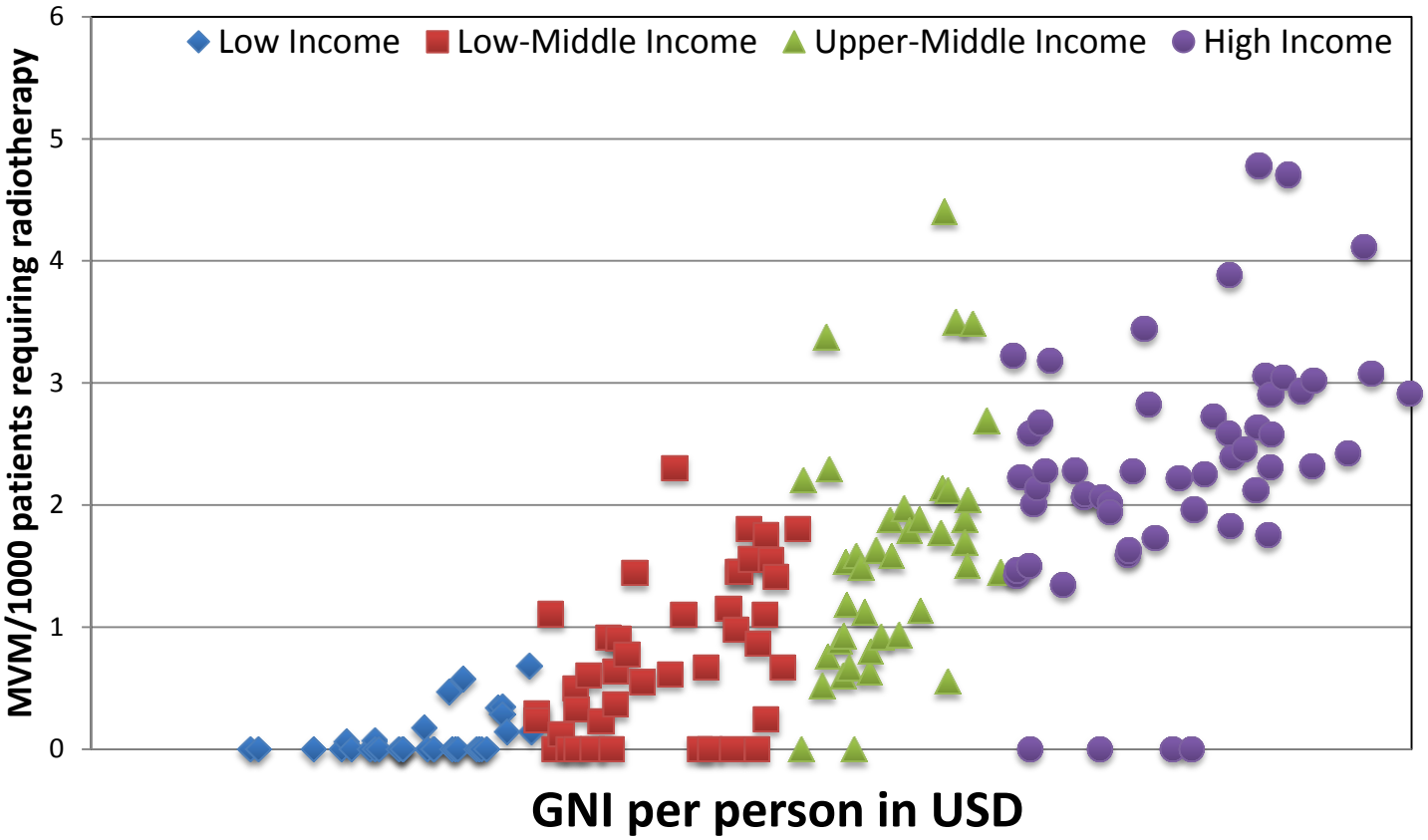
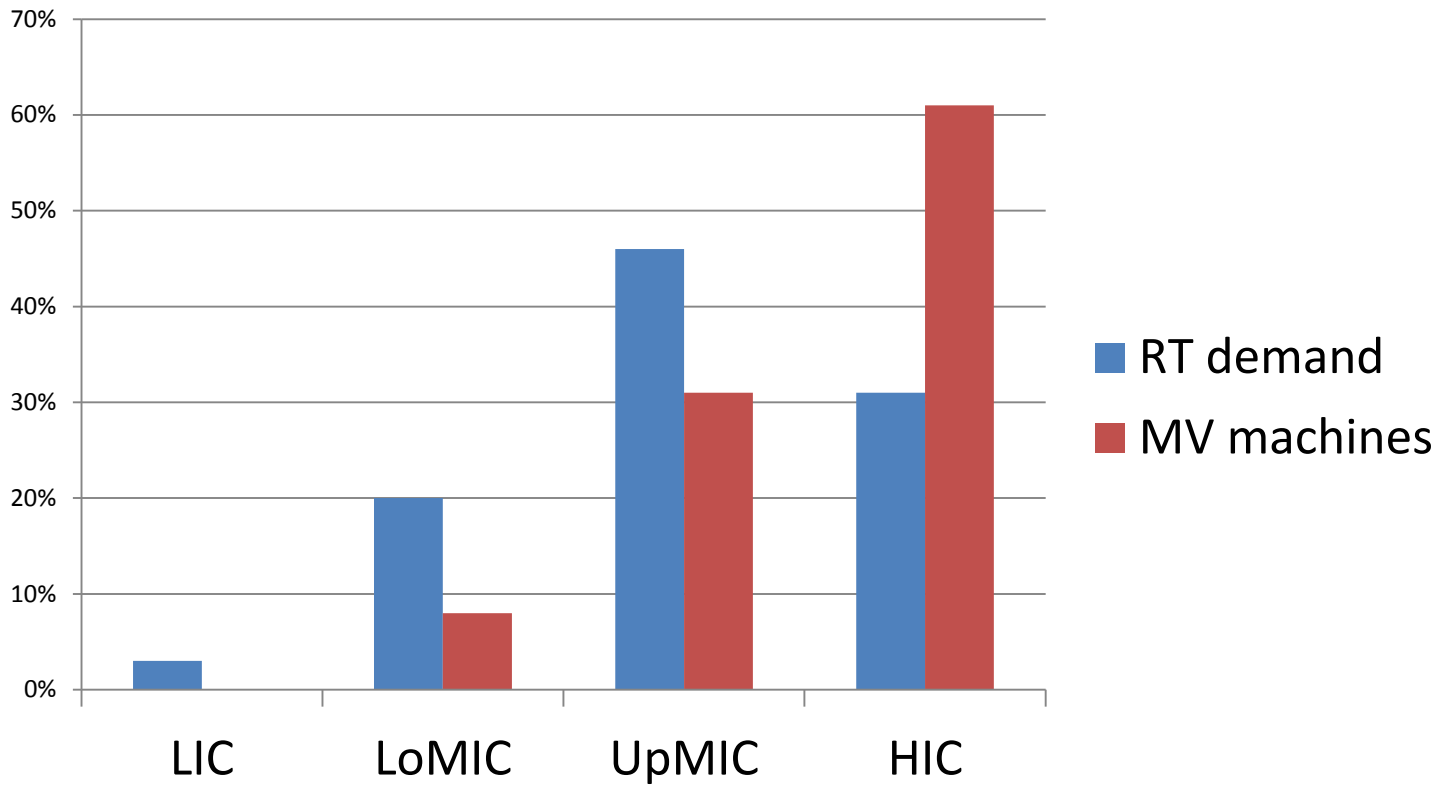
Access to radiotherapy

2012



ML Yap et al; Journal of Global Oncology March 16, 2016

Increase from 2002 to 2012



ML Yap et al; Journal of Global Oncology March 16, 2016

Global Task Force for Radiotherapy in Cancer Care

WG#1 &3

Burden and Demand

GLOBAL BURDEN OF CANCER
Current and Future Requirement for Radiotherapy

Outputs

Outcomes
- Lives Saved
- Patients Palliated

Survival (5yr)

Demand (#fx/yr)

WG#2

Cost to Build Capacity and Treat ($/fx)

Health Systems Readiness

Education

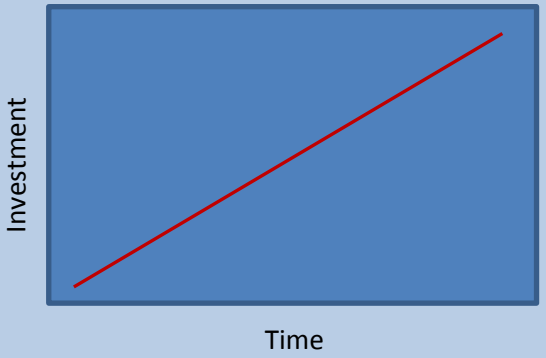
CORE INVESTMENTS
- Facilities
- Equipment
- Personnel

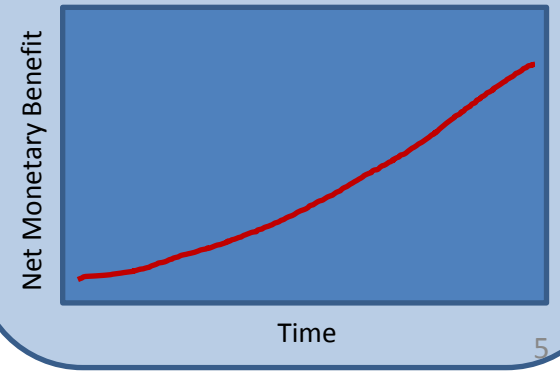
ENABLING SERVICES
- Pathology
- Radiology
- Surgery
- Primary Care

CONTEXTUAL READINESS
- Infrastructure
- Finances
- Awareness

Investment Framework

- Top ten cancers (75%) and benefits
- Scale by Total Cancer Burden
- Group countries by GNI
- Markov Model of rolling populations
- Cost for investment and treatment





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Estimating demand and benefits

- Radiotherapy utilisation models
- Estimating benefit
- Projections to 2035

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Global cancer burden

- Cancer incidence 2012
  - 184 Countries
  - 27 tumour types
  - Total incidence
- Projections to 2035
  - Demographic change

http://globocan.iarc.fr/Default.aspx

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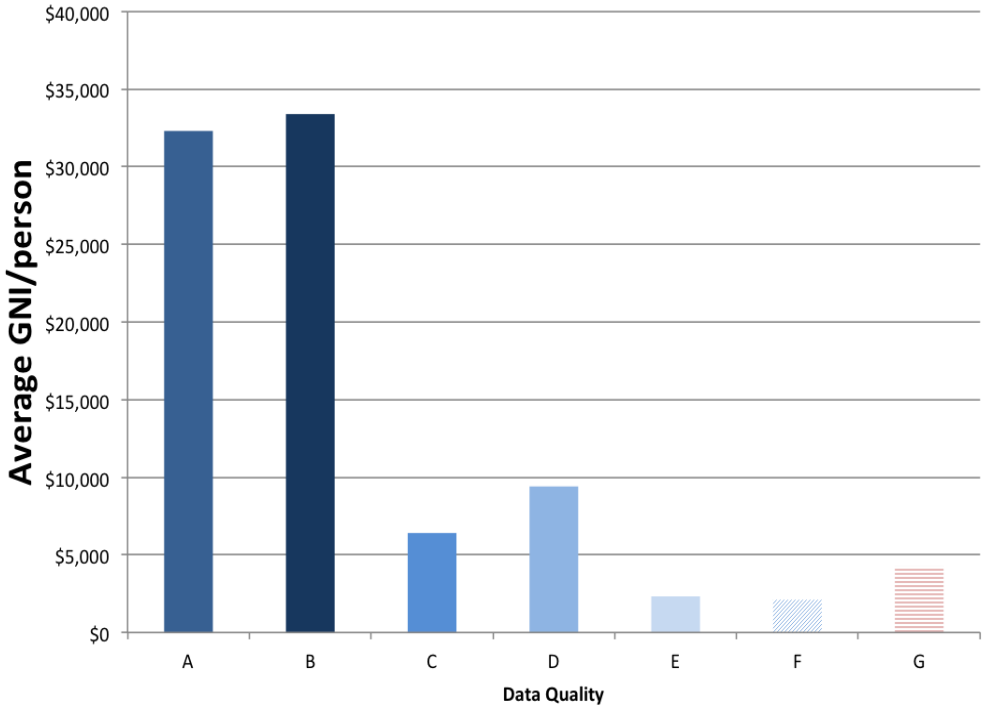
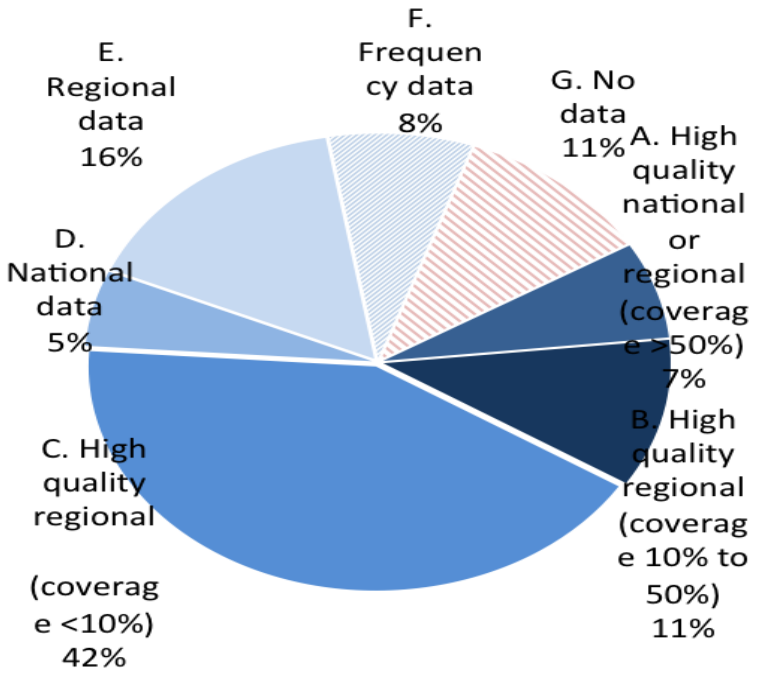
Globocan data quality





Globocan data rating

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Global cancer burden is increasing

- 14 million new cancer cases in 2012
- 24 million new cancer cases in 2035
- Steepest rise in LMIC

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What proportion of cancer cases benefit from XRT?

- Define XRT indications
- Proportion of population with indications
- Sensitivity analysis

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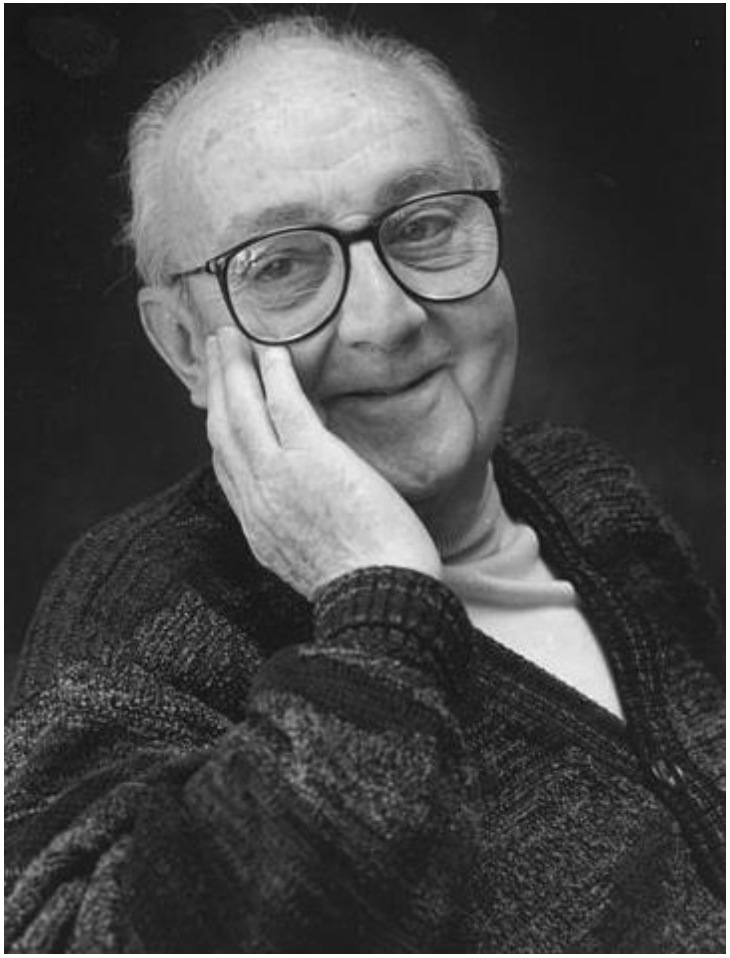
Radiotherapy Utilisation rates



George EP Box (1919-2013)

All models are wrong
but some are useful

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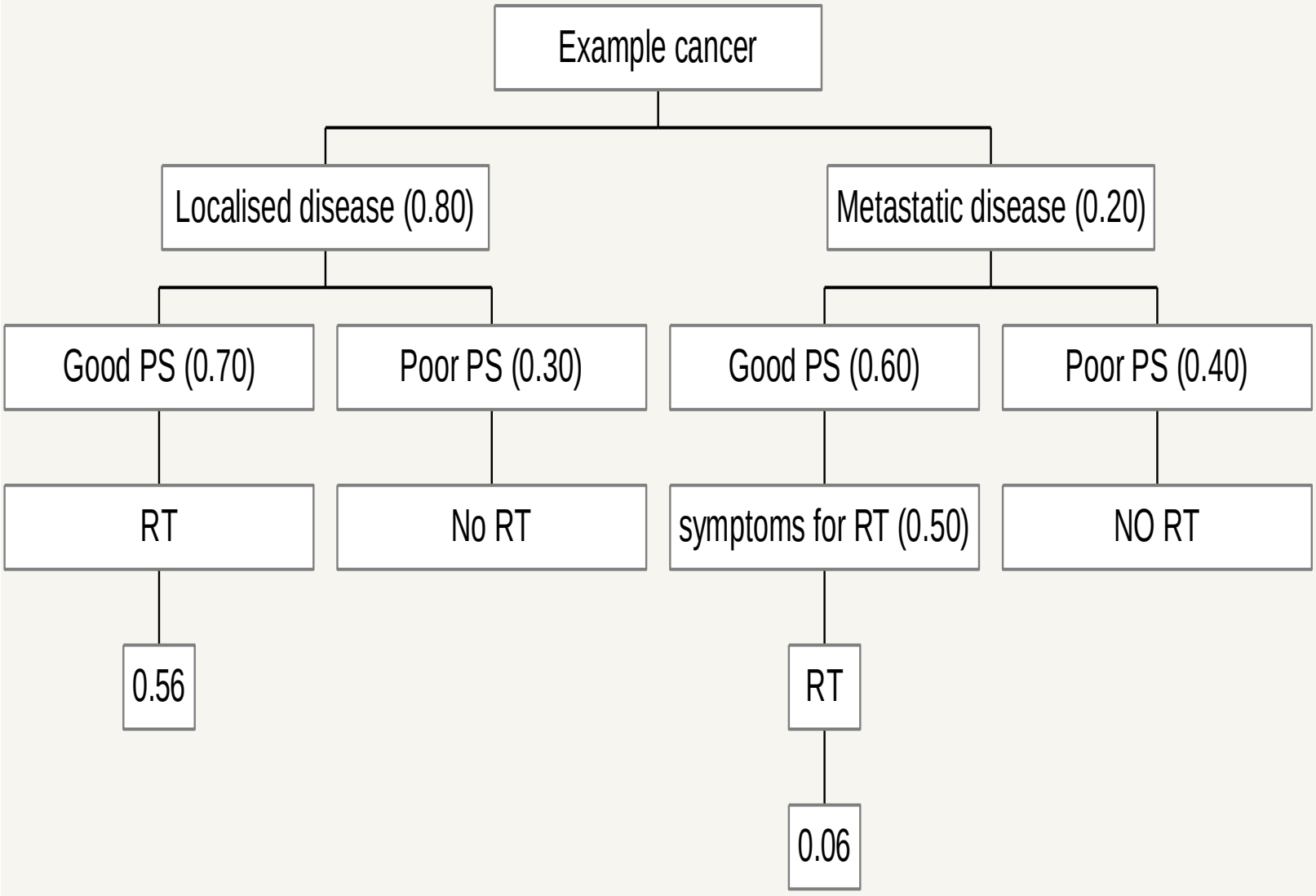
Indications for radiotherapy

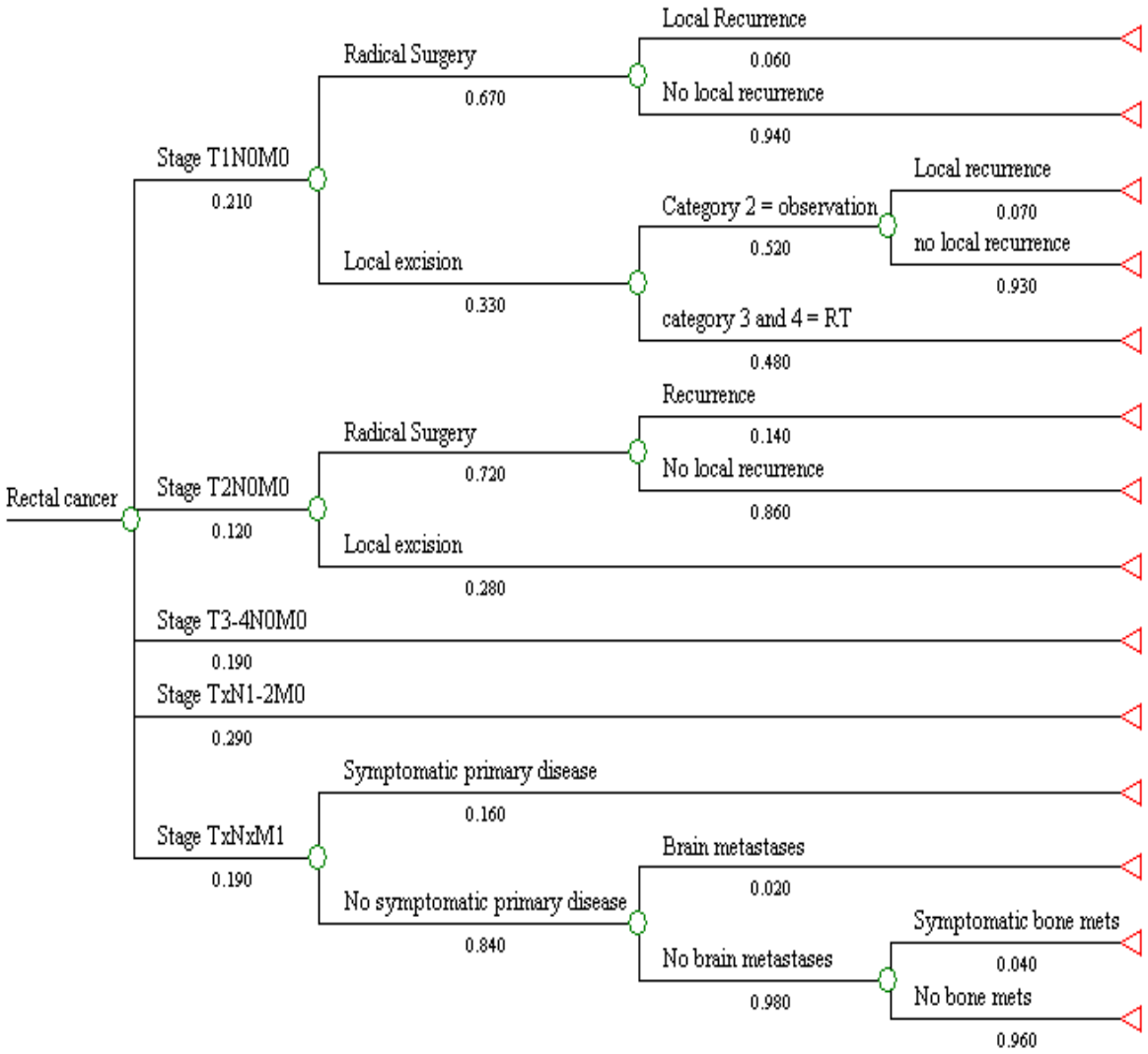
Indications

- Superior clinical outcome
  - survival
  - local control
  - toxicity profile
- The patient is suitable
  - performance status
  - co-morbidities.

Exclusions

- Non-melanomatous skin cancer
- Benign tumours
- Benign conditions


Example cancer
Localised disease (0.80)
Metastatic disease (0.20)
Good PS (0.70)
Poor PS (0.30)
Good PS (0.60)
Poor PS (0.40)
RT
No RT
symptoms for RT (0.50)
NO RT
0.56
RT
0.06



	RT (1 = yes, 0 = no)	Total Proportion
Local Recurrence	1.00	0.008
No local recurrence	0.00	0.132
Local recurrence	1.00	0.003
no local recurrence	0.00	0.034
category 3 and 4 = RT	1.00	0.033
Recurrence	1.00	0.012
No local recurrence	0.00	0.074
Local excision	1.00	0.034
Stage T3-4N0M0	1.00	0.190
Stage TxN1-2M0	1.00	0.290
Symptomatic primary disease	1.00	0.030
Brain metastases	1.00	0.003
Symptomatic bone mets	1.00	0.006
No bone mets	0.00	0.150

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RTU 2003

- 1000+ pieces of evidence examined
- RTU trees on 23/23 cancers
- 98% of all cancer by incidence
- 52% of all cancers need RT at least once

Cancer. 2003 Nov 1;98(9):1977-86

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Optimal RTU 2012 update

SITE	RTU
Bladder	47%
Brain	80%
Breast	87%
Cervix	71%
Colon	4%
Gall bladder	17%
Head and Neck	74%
Kidney	15%
Leukaemia	4%
Liver	0%
Lung	77%
Lymphoma	73%
Melanoma	21%
Myeloma	45%

SITE	RTU
Other	19%
Oesophagus	71%
Ovary	4%
Pancreas	49%
Prostate	58%
Rectum	60%
Stomach	27%
Testis	7%
Thyroid	4%
Unknown Primary	61%
Uterus	38%
Vagina	94%
Vulva	39%
ALL	48%

Radiother Oncol. 2014 Jul;112(1):140-4 ,or tinyurl.com/pwkua34

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Optimal chemotherapy utilisation

Tumour Site	Optimal CT (%)
Prostate	15
Breast	68
Colon	55
Melanoma	19
Lung	73
Rectum	64
Head and Neck	36
Unknown Primary	65
Leukaemia	85
Pancreas	35
Urinary Bladder	66

Tumour Site	Optimal CT (%)
Kidney	33
Thyroid	13
Brain	72
Endometrium	20
Oesophagus	79
Gallbladder	80
Liver	27
Testis	70
Myeloma	94
Ovary	84
Cervix	51
Other	50
Total	**50.8**

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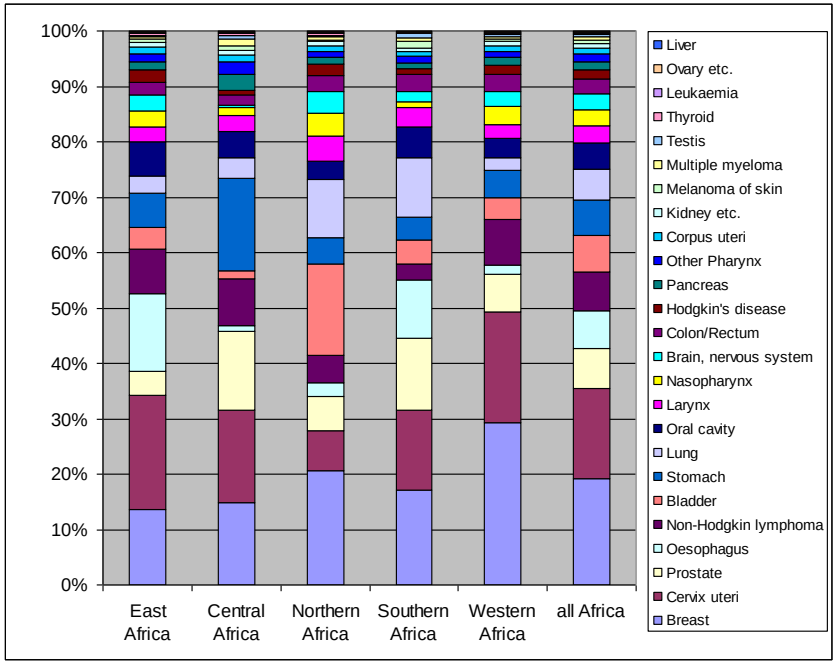
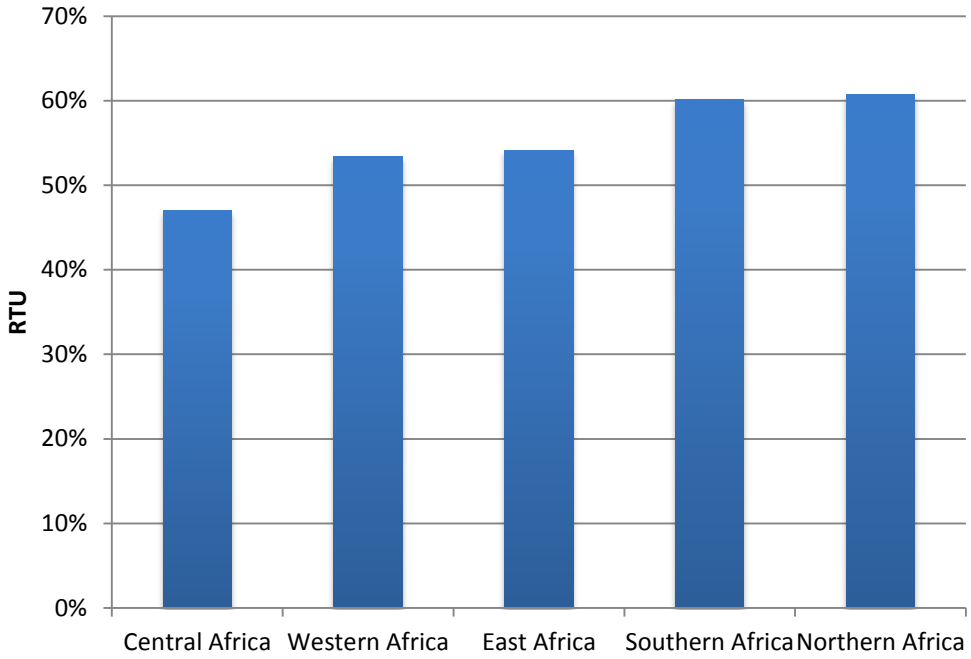
Application to different countries





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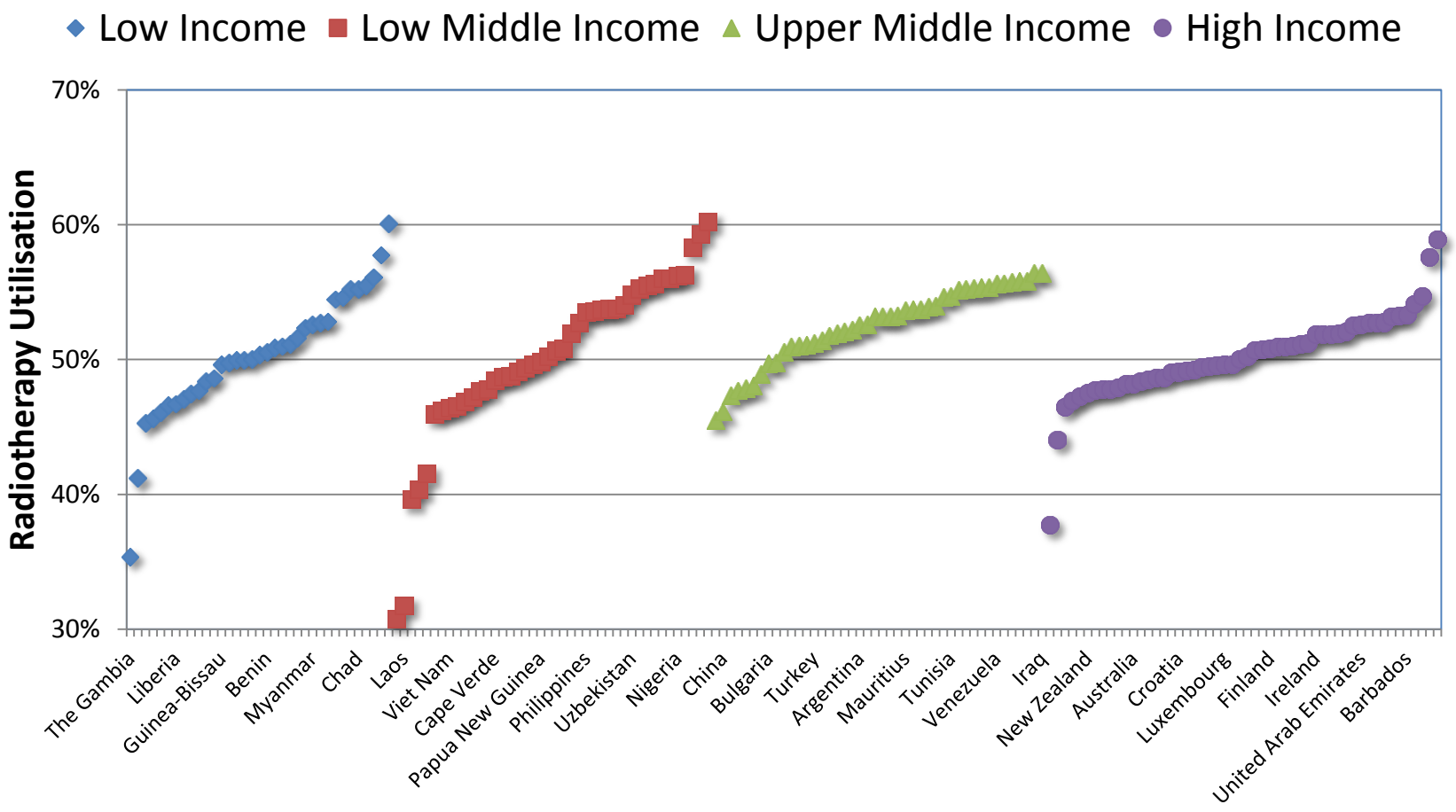
Optimal Radiotherapy Utilisation



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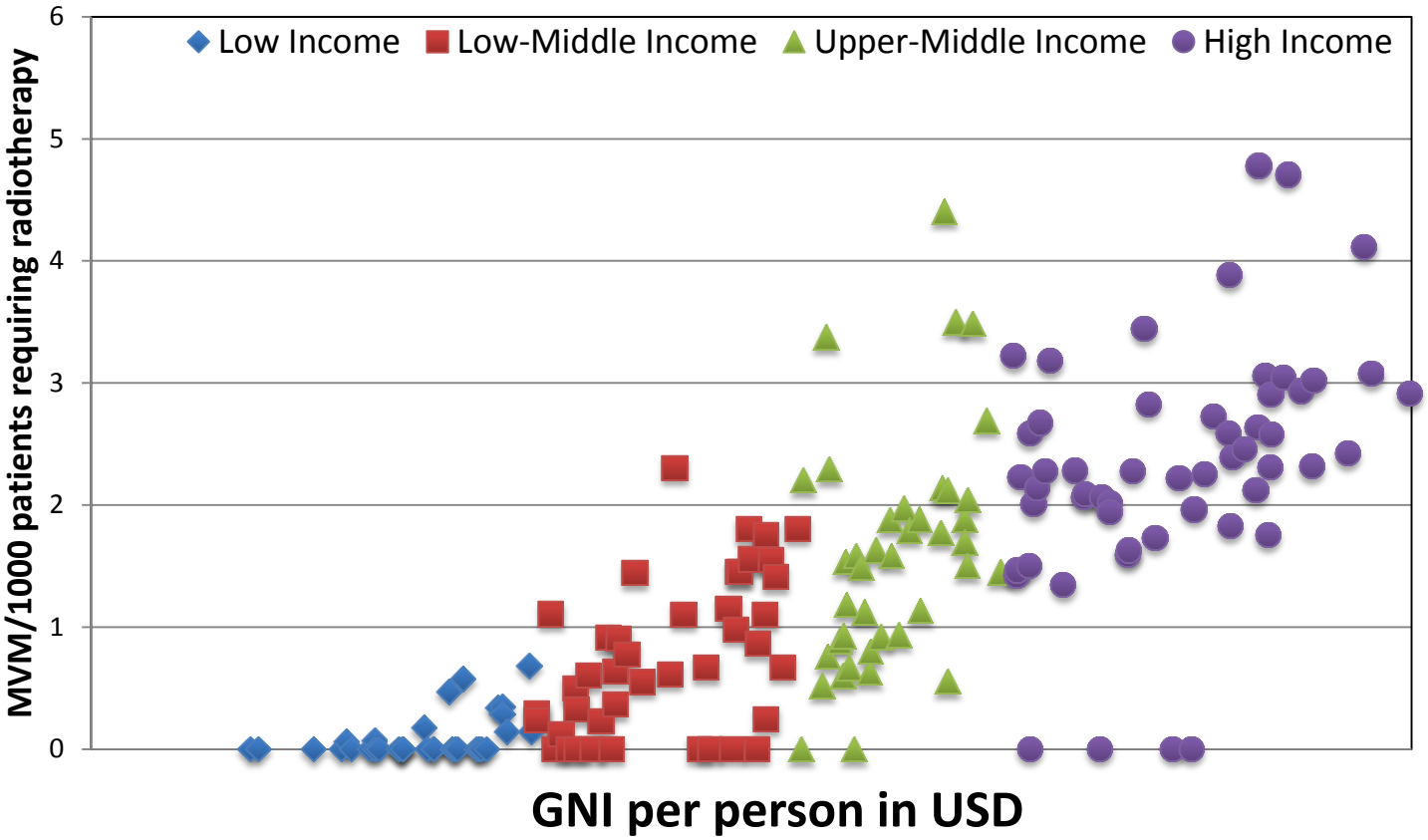
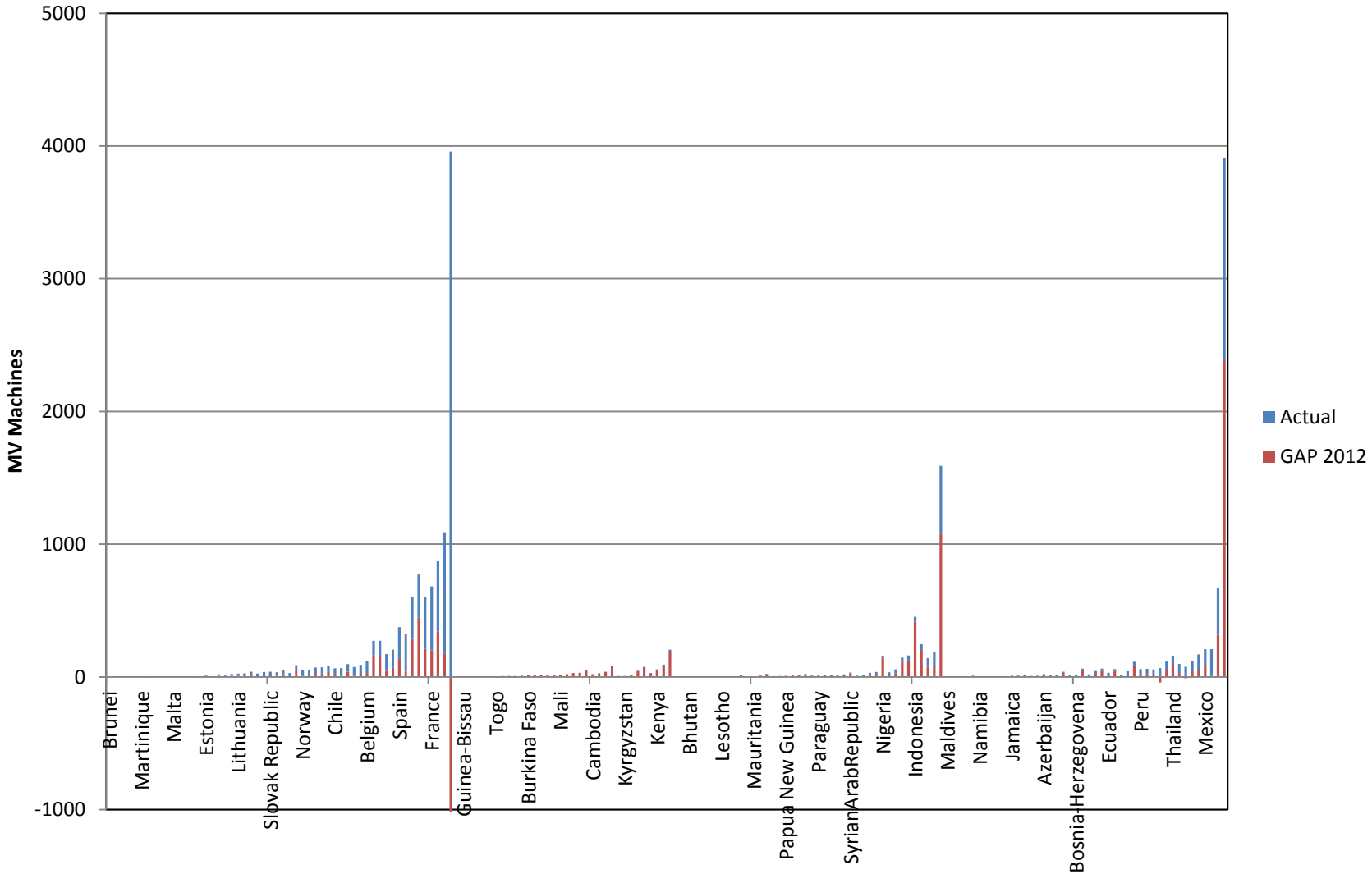
Access to radiotherapy

2012



ML Yap et al; Journal of Global Oncology March 16, 2016


MV Machines
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Brunei
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Malta
Estonia
Lithuania
Slovak Republic
Norway
Chile
Belgium
Spain
France
Guinea-Bissau
Togo
Burkina Faso
Mali
Cambodia
Kyrgyzstan
Kenya
Bhutan
Lesotho
Mauritania
Papua New Guinea
Paraguay
Syrian Arab Republic
Nigeria
Indonesia
Maldives
Namibia
Jamaica
Azerbaijan
Bosnia-Herzegovena
Ecuador
Peru
Thailand
Mexico
Actual
GAP 2012

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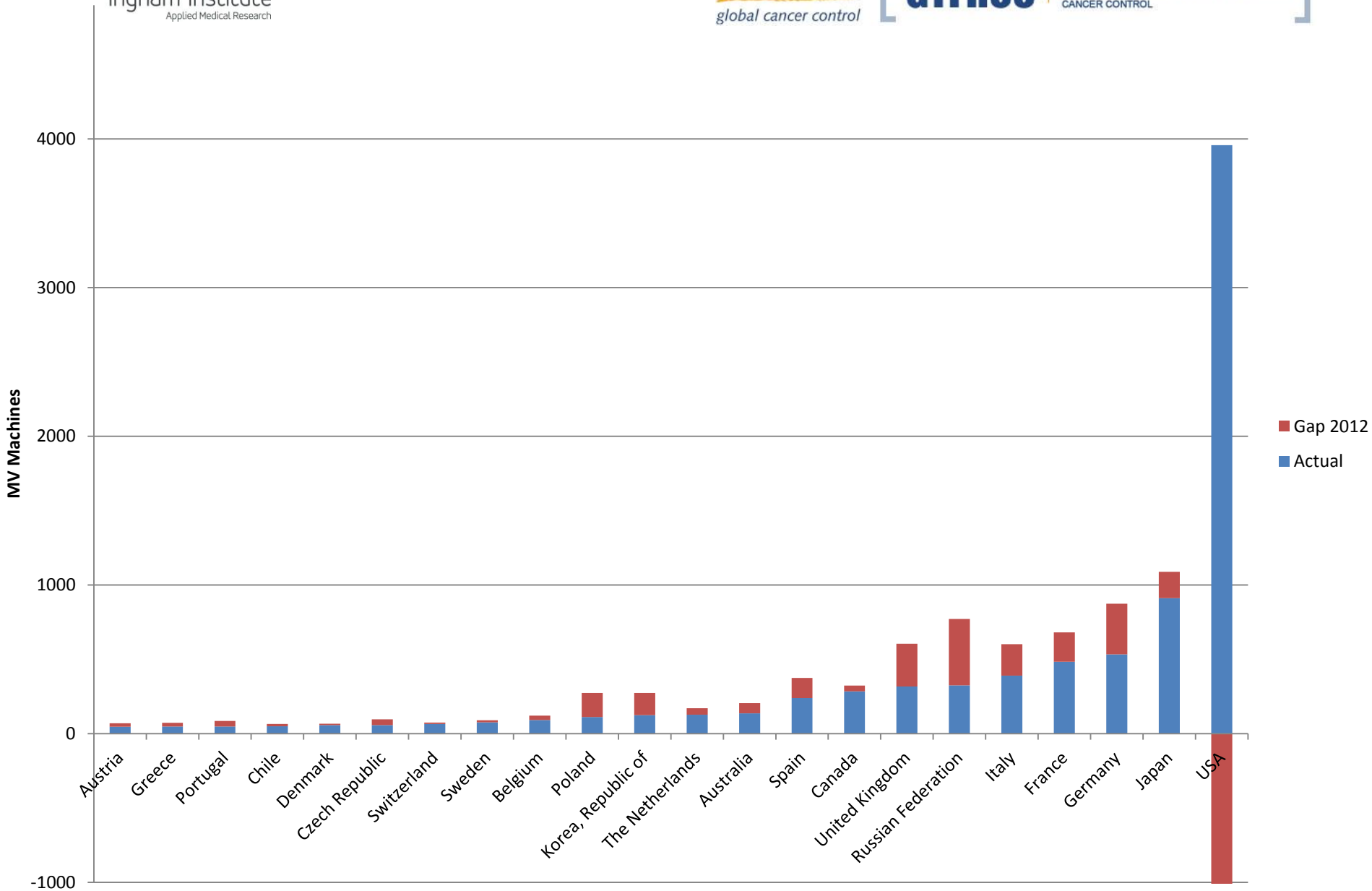

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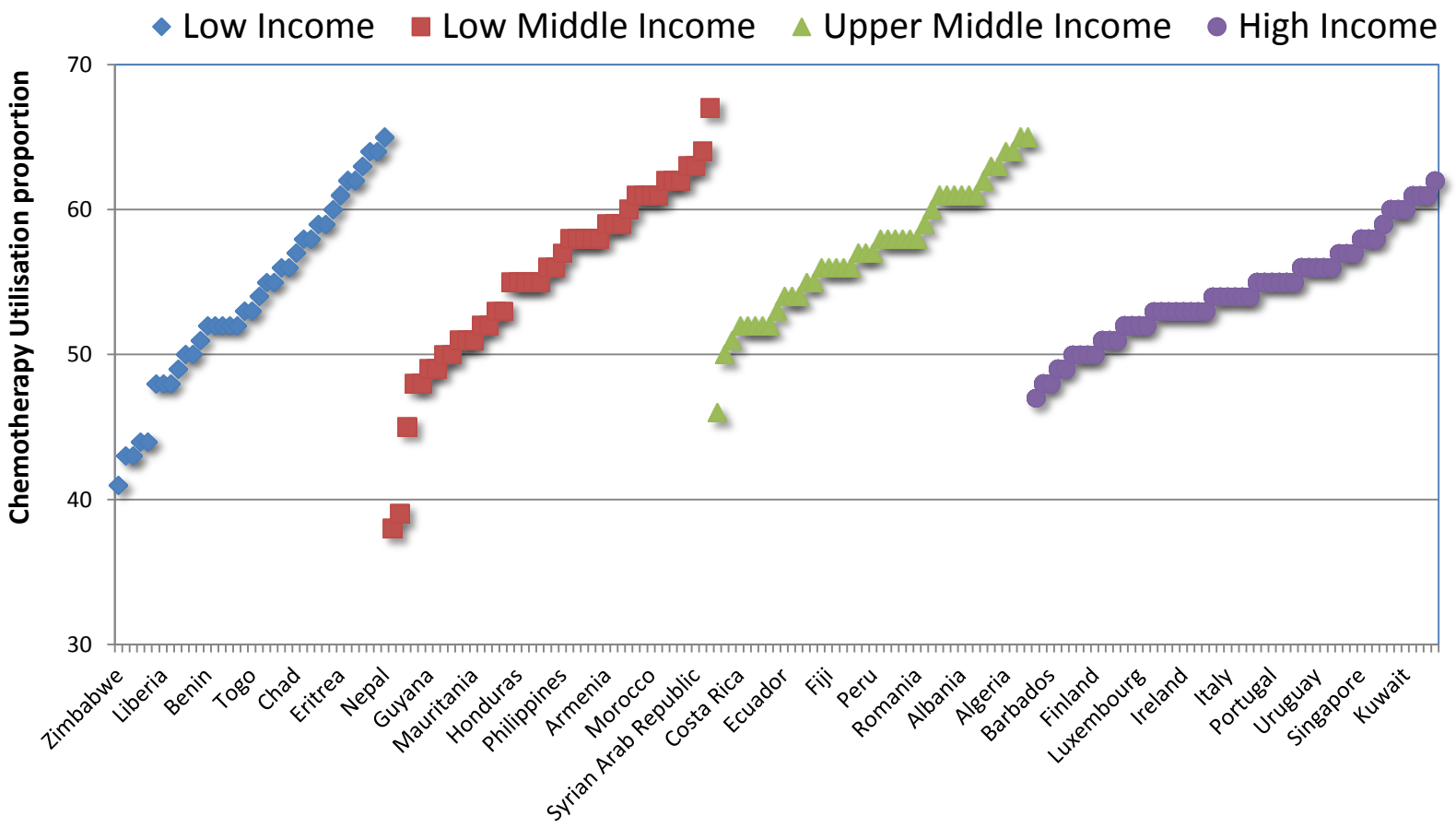
Optimal Chemotherapy Utilisation



Outcome benefit

- Population 5 year incremental benefit
- Local control and overall survival
- Radical indications assumed 0% benefit without XRT
- Systematic reviews of benefits of indications
- 27 cancers listed in GLOBOCAN

T Hanna, J Shafiq

RT survival and local control benefit

WORLD	RTU	Local Control (5 Year Benefit)	Overall Survival (5 Year Benefit)
Lip, oral cavity	55%	16%	6%
Nasopharynx	100%	77%	61%
Other pharynx	83%	34%	16%
Oesophagus	71%	5%	2%
Stomach	27%	2%	1%
Colorectal	22%	5%	2%
Liver	0%	0%	0%
Gallbladder	17%	0%	0%
Pancreas	49%	0%	3%
Larynx	93%	59%	39%
Lung	77%	9%	6%
Melanoma	21%	3%	0%
Breast	87%	15%	2%
Cervix	71%	35%	20%
Uterine Corpus	38%	5%	4%
Ovary	4%	0%	0%
Prostate	58%	25%	1%
Testis	7%	9%	9%
Kidney	15%	0%	0%
Bladder	47%	6%	4%
Brain	80%	10%	7%
Thyroid	4%	1%	1%
Hodgkin	85%	9%	4%
NHL	71%	13%	7%
Multiple myeloma	45%	2%	1%
Leukaemia	4%	1%	1%
ALL CANCERS	50.3%	10.4%	4.1%

Shafiq J, Hanna TP, Vinod SK, Delaney GP, Barton MB. *A Population-based Model of Local Control and Survival Benefit of Radiotherapy for Lung Cancer.* Clin Oncol (R Coll Radiol). 2016 Oct;28(10):627-38

Benefit by Income Range

	Local control	Survival
HIC	10.10%	3.20%
UMIC	8.60%	3.90%
LMIC	13.40%	6.20%
LIC	13.60%	6.30%
ALL	10.40%	4.10%

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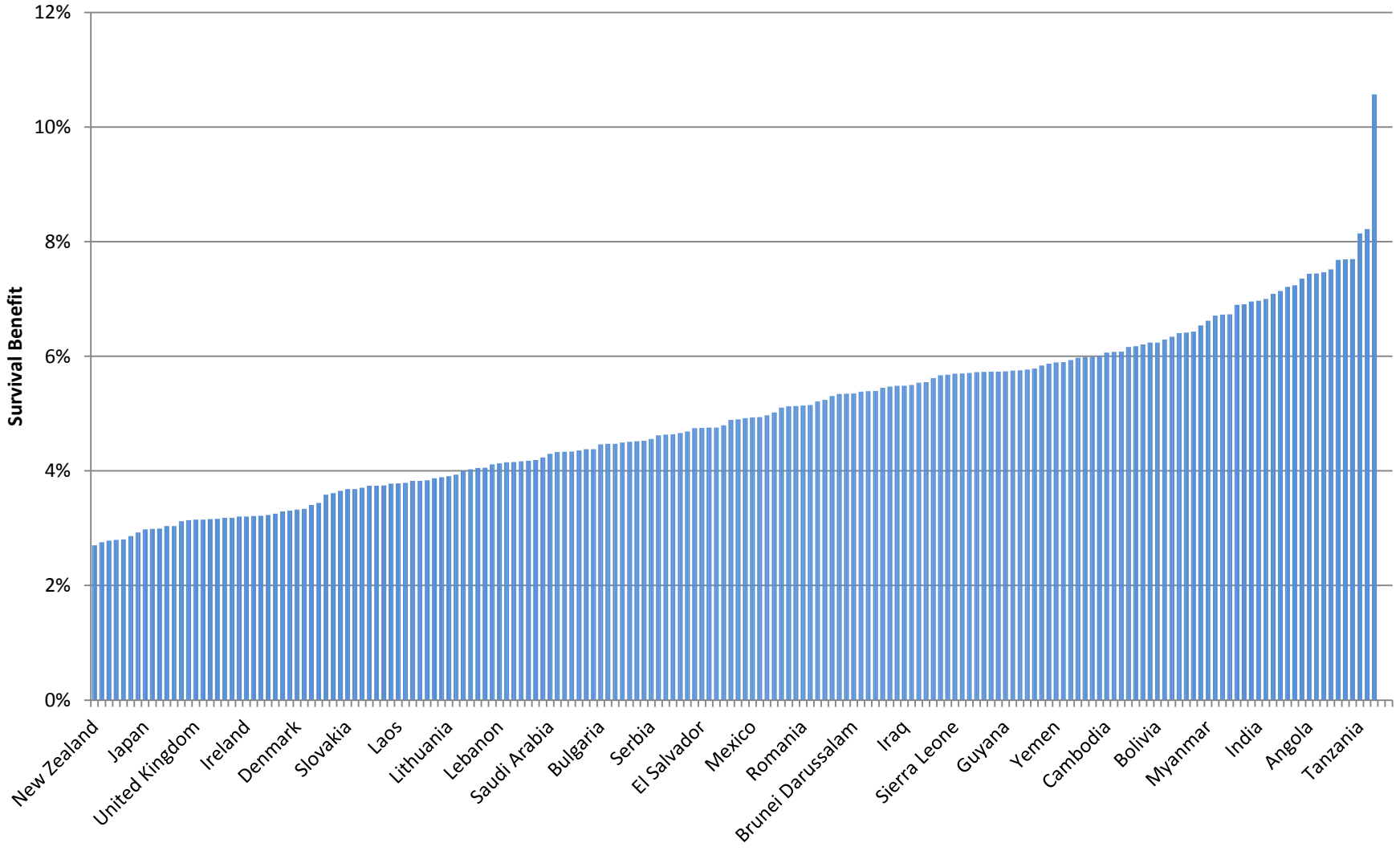
Survival benefit by country



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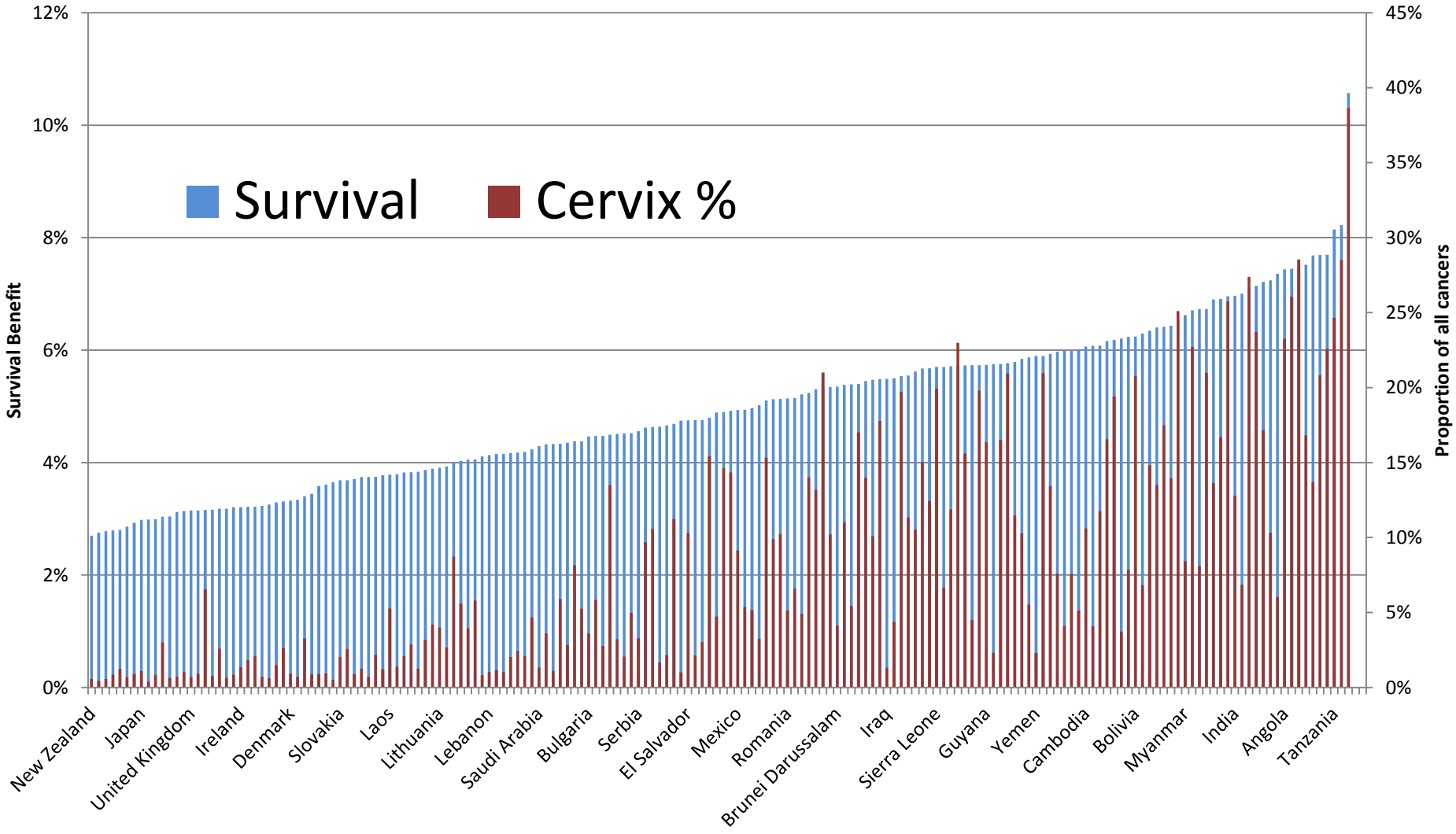
Survival benefit by country



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By 2035 there will be

- 24 million new cancer cases
- 12 million cancer cases needing XRT
  - 220 million fractions of RT
  - 1 million lives saved
  - 2.5 million with local control

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What will we need in 20 years?

2035	High-income countries	Upper-middle-income countries	Lower-middle-income countries	Low-income counties
Fractions	76 424 000	77 014 000	40 974 000	13 268 000
Radiotherapy departments	4600	3700	2000	600
Megavoltage machines	9200	7400	3900	1300
CT scanners	4600	3700	2000	600
Radiation oncologists to be trained	15 500	16 800	9900	3300
Medical physicists to be trained	17 200	12 500	7200	2400
Radiation technologists to be trained	51 900	45 300	24 900	8100

Atun et al., Lancet Oncology 2015
Slide courtesy of Y Lievens

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GTFRCC Lancet commission paper

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Health

Call to improve radiotherapy access around world

26 September 2015 | Health

Millions of people globally have died unnecessarily from cancers that could have been treated by radiotherapy, according to doctors.

New figures suggest as many as nine out of 10 people in low-income countries cannot access radiotherapy treatment.

The Lancet Oncology Commission

Expanding global access to radiotherapy

Rifat Atun, David A Jaffray, Michael B Barton, Freddie Bray, Michael Baumann, Bhadrasain Vikram, Timothy P Hanna, Felicia M Knaul, Yolande Lievens, Tracey Y M Lui, Michael Milosevic, Brian O'Sullivan, Danielle L Rodin, Eduardo Rosenblatt, Jacob Van Dyk, Mei Ling Yap, Eduardo Zubizarreta, Mary Gospodarowicz

Radiotherapy is a critical and inseparable component of comprehensive cancer treatment and care. For many of the most common cancers in low-income and middle-income countries, radiotherapy is essential for effective treatment. In high-income countries, radiotherapy is used in more than half of all cases of cancer to cure localised disease, palliate symptoms, and control disease in incurable cancers. Yet, in planning and building treatment capacity for cancer, radiotherapy is frequently the last resource to be considered. Consequently, worldwide access to radiotherapy is unacceptably low. We present a new body of evidence that quantifies the worldwide coverage of radiotherapy services by country. We show the shortfall in access to radiotherapy by country and globally for 2015–35 based on current and projected need, and show substantial health and economic benefits to investing in radiotherapy. The cost of scaling up radiotherapy in the nominal model in 2015–35 is US$26·6 billion in low-income countries, $62·6 billion in lower-middle-income countries, and $94·8 billion in upper-middle-income countries, which amounts to $184·0 billion across all low-income and middle-income countries. In the efficiency model the costs were low: $14·1 billion in low-income, $33·3 billion in lower-middle-income, and $49·4 billion in upper-middle-income countries—a total of $96·8 billion. Scale-up of radiotherapy capacity in 2015–35 from current levels could lead to saving of 26·9 million life-years in low-income and middle-income countries over the lifetime of the patients who received treatment. The economic benefits of investment in radiotherapy are very substantial. Using the nominal cost model could produce a net benefit of $278·1 billion in 2015–35 ($265·2 million in low-income countries, $38·5 billion in lower-middle-income countries, and $239·3 billion in upper-middle-income countries). Investment in the efficiency model would produce in the same period an even greater total benefit of $365·4 billion ($12·8 billion in low-income countries, $67·7 billion in lower-middle-income countries, and $284·7 billion in upper-middle-income countries). The returns, by the human-capital approach, are projected to be less with the nominal cost model, amounting to $16·9 billion in 2015–35 (–$14·9 billion in low-income

Lancet Oncol 2015; 16: 1153–86

See Comment pages 1143–52

Harvard TH Chan School of Public Health (Prof R Atun MD), Harvard Global Equity Initiative (F M Knaul PhD), and Harvard Medical School (F M Knaul), Harvard University, Cambridge, MA, USA; Princess Margaret Cancer Centre, Toronto, ON, Canada (Prof D A Jaffray PhD, Prof M Milosevic MD, Prof B O'Sullivan MD, Prof M Gospodarowicz MD); TECHNA Institute, University Health Network, Toronto, ON, Canada (Prof D A Jaffray, T Y M Lui MSc); Department of Radiation Oncology, University of Toronto, Toronto, ON, Canada (Prof D A Jaffray, Prof B O'Sullivan, D L Rodin MD, Prof M Gospodarowicz); Ingham Institute for Applied Medical Research, University of New South Wales, Liverpool

Atun R, Jaffray DA, Barton MB, Bray F, Baumann M, Vikram B, Hanna TP, Knaul FM, Lievens Y, Lui TY, Milosevic M, O'Sullivan B, Rodin DL, Rosenblatt E, Van Dyk J, Yap ML, Zubizarreta E, Gospodarowicz M. Expanding global access to radiotherapy. Lancet Oncol. 2015 Sep;16(10):1153-86.

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Thinking differently about solutions

- Traditional stand-alone department not always viable
- Novel financing
- South-South collaborations
- Remote monitoring and QA
- Innovative accelerators
- Global coordination of volunteers

Acknowledgements

CCORE, Ingham Institute

- Geoffrey Delaney
- Susannah Jacob
- Tim Hanna
- Jesmin Shafiq
- Mei Ling Yap
- Stephen Thompson

IARC, Lyon

- Freddie Bray
- Jacques Ferlay

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- Mary Gospordarowicz
- Rifat Atun
- Eduardo Zubizarreta
- David Jaffray
- Yolande Lievens
- Danielle Rodin