RADIOTHERAPY AGE PROFILE & DENSITY

December 2019 Edition

COCIR, the European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry

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1. FOREWORD

CURRENT GAPS IN ACCESS TO RADIOTHERAPY ACROSS EUROPE

COCIR is proud to highlight the increasingly important role that medical technologies play in significantly reducing morbidity and premature deaths caused by cancer, by improving prevention, screening, early diagnosis, treatment and palliation.

Our member companies develop and manufacture radiotherapy technologies and solutions that are constantly improving the cancer care pathway. They are continuously investing in research to make treatment more effective, affordable and accessible to the widest possible population.

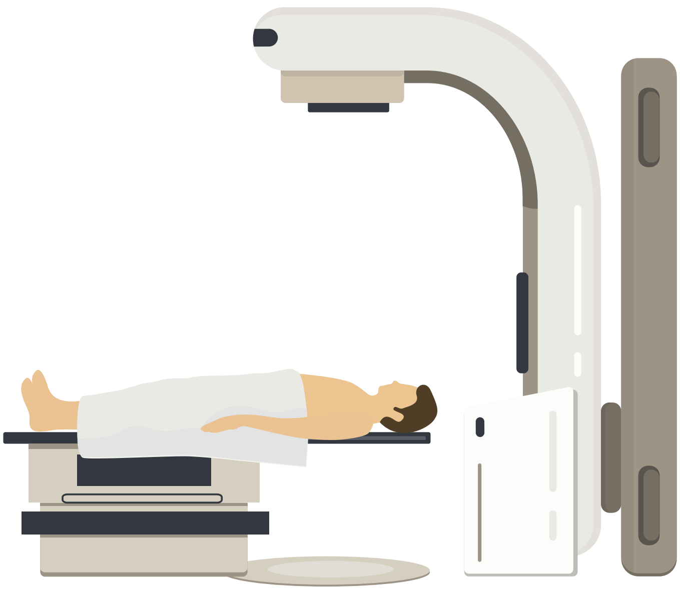
Radiotherapy has moved from palliation to curative treatment and such an impressive development of clinical outcomes has been achieved by a small industry sector with only a handful of companies.

Advances in radiotherapy enable care teams to treat and manage disease with increased accuracy while at the same time reducing radiation doses to healthy tissue. Combinations of modern imaging techniques and radiotherapy allow tumours to be targeted with previously unimagined levels of accuracy.

However, a large gap remains between actual and the most advantageous utilisation of radiotherapy, with many patients not benefiting from optimal treatment.
This gap is also due to shortages of high-quality equipment.

Furthermore, outdated equipment can undermine the effectiveness of radiotherapy and cause adverse effects for patients[1].

It is vital that policymakers and payers make full use of all available innovative technologies, and that all patients have access to modern treatments.



1 https://mariecurielegacy.org/

2. INTRODUCTION

COCIR has been collating statistics and proactively supporting European Member States in monitoring their installed base of medical imaging equipment since the 1990s. In 2003, COCIR drafted a set of pragmatic and prudent 'Golden Rules' for medical imaging equipment, on the basis that an appropriate mix in the age profile of installed equipment is essential for efficient and productive healthcare systems. COCIR uses these parameters to monitor any changes in the age profile of the installed base in European countries.

In this edition, we have widened for the first time the scope of the analysis to include radiotherapy equipment, including data from Eastern and Western Europe, Middle East, CIS, Brazil, India and China.

In 2018, COCIR, together with its radiotherapy member companies, proposed **new and specific recommendations** to support evaluation of the radiotherapy installed base and aid procurement planning. These recommendations consider the need to balance the benefits of innovation against the obligation to derive maximum value from capital investment. In this report we have compared the density and age profile in the selected countries against these Golden Rules.

THE COCIR GOLDEN RULES FOR RADIOTHERAPY

EQUIPMENT DENSITY

In 2015, 1.3 million people died from cancer in the EU-28, which equated to more than one quarter (25.4 %) of the total number of deaths[2]. By 2035, if every cancer patient who needs radiotherapy has access to it, almost one million more lives will be saved every year worldwide[3]. In 2016, there were more than 3 600 radiation therapy units in the EU Member States for which data are available[4].

COCIR adopted as target density of **7 radiation therapy systems (linacs) per million population**. This target has been based on both **GLOBOCAN**[5], the Global Cancer Observatory, and the **IAEA** published recommendation of one accelerator per 450 patients per year[6].

AGE OF EQUIPMENT

It is widely accepted to use 10 years as the economical and technical life span for radiotherapy systems. Based on this, COCIR Golden Rules have defined 12 years of age as end of life and beyond which there should ideally not exist any equipment in use. Assuming a system in full balance, there should be a linear age distribution with equal numbers of treatment delivery systems in each age group. This results in the following recommendations for age categories:

1. **At least 58% of the installed equipment base should be less than seven years old.**
Medical technology lifecycle averages suggest equipment that is up to seven years old adequately reflects the current state of technology with opportunities for economically viable upgrade measures.

2. **No more than 25% of the installed equipment base should be between seven to ten years old.**
Medical technology that is between seven to ten years old is still fit for purpose. However, systems replacement strategies should be developed to benefit from efficiency gains afforded by the latest technologies.

2 https://ec.europa.eu/eurostat/statistics-explained/index.php/Cancer_statistics
3 https://mariecurielegacy.org/
4 https://ec.europa.eu/eurostat/statistics-explained/index.php/Cancer_statistics
5 http://gco.iarc.fr/
6 IAEA Human Health Reports No. 2: Radiotherapy in Palliative Cancer Care: Development and Implementation https://www.iaea.org/publications/8128/radiotherapy-in-palliative-cancer-care-development-and-implementation

3. No more than 17% of the installed equipment base should be more than ten years old.
Medical technology more than ten years old is challenging to maintain and repair. Compared with current medical guidelines and best practices, these systems are likely configured in such a way that they cannot conduct state-of-the-art medical procedures in an optimal manner; replacement is essential.

3. BACKGROUND AND RESULTS

COCIR data monitor both the age of the equipment and the density in system units/million inhabitants.

EQUIPMENT DENSITY

The Marie Curie Legacy Campaign, pioneered by the ESTRO Cancer Foundation[7] and ESTRO[8], is a global initiative to raise awareness of the benefits of radiotherapy and optimise the provision of radiotherapy in Europe and beyond.

The White Paper "**Radiotherapy: seizing the opportunity in cancer care – November 2018**" by the **Marie Curie Legacy Campaign**[9] stated that, while

> *"Radiotherapy is recommended as part of treatment for more than 50% of cancer patients [...] at least one in four people[10] needing radiotherapy does not receive it".*

The report further indicated a large gap between actual and optimal utilisation of radiotherapy with a considerable variation between all European countries. One essential problem is, per the report, that many patients do not benefit from optimal treatment because they are not offered radiotherapy as part of their care.
This gap is exacerbated by the fact that **high-quality equipment** is partly lacking, even in high-income countries.

How we calculated COCIR's Golden Rules - Density:
The **ESTRO-QUARTS**[11] guidelines on equipment density covered the European countries as divided into three groups, based on their gross domestic product per capita (GDP/cap):

- **HIGH RESOURCE COUNTRIES** with GDP/cap ≥10,000 USD,
- **MEDIUM RESOURCE COUNTRIES** with GDP/cap between 3 and 10,000 USD and
- **LOW RESOURCE COUNTRIES** with GDP/cap ≤ 3000 USD).

ESTRO-QUARTS guidelines for the:

HIGH RESOURCE COUNTRIES with GDP/cap ≥10,000 USD, vary between 1 linear accelerator per 80,000–250,000 population (average: 1 linear accelerator per 183,000 population);

MEDIUM RESOURCE COUNTRIES with GDP/cap between 3 and 10,000 USD vary between 200,000 and 400,000 (average: 1 linear accelerator per 284,000 population);

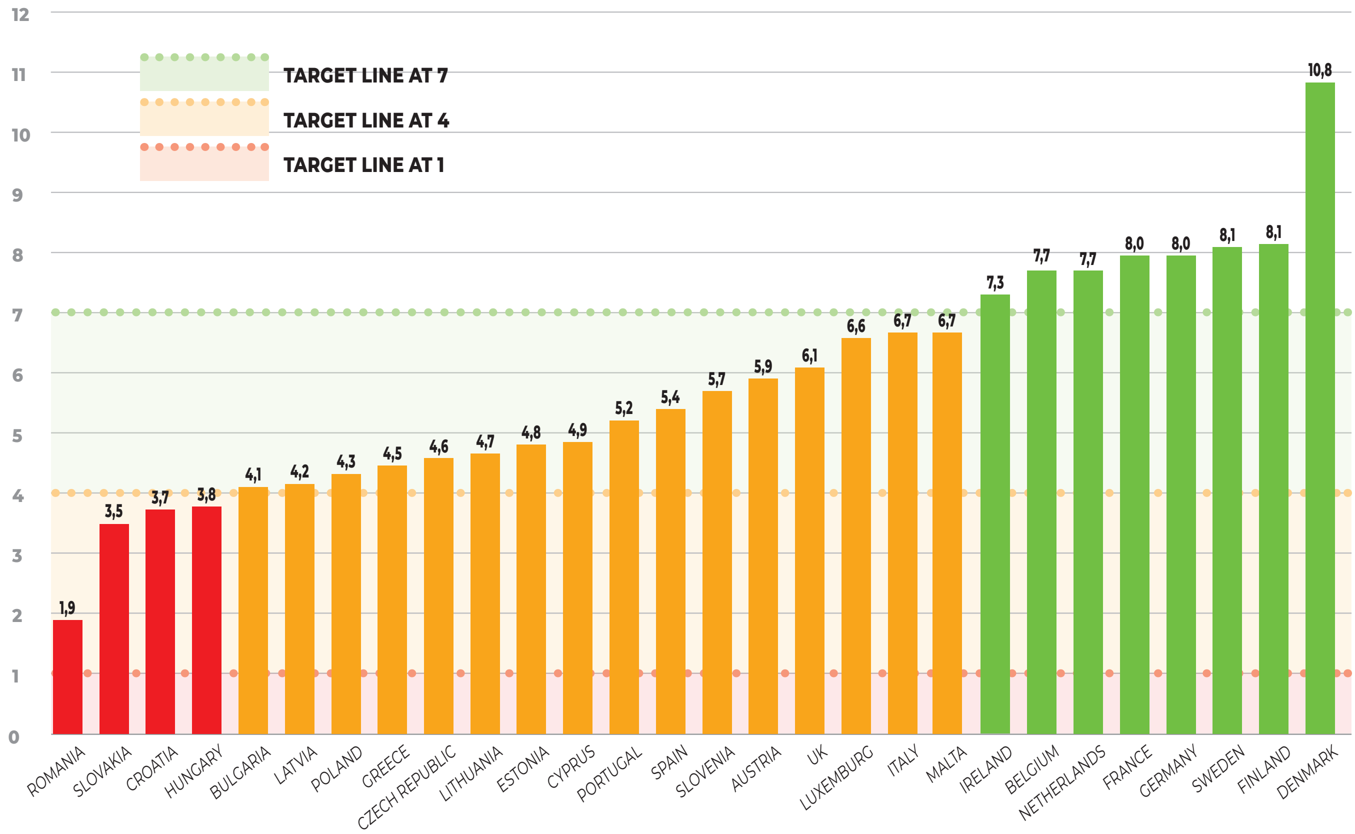
LOW RESOURCE COUNTRIES with GDP/cap ≤ 3000 USD, guidelines vary between 250,000 and 1,000,000 population (average: 1 linear accelerator per 500,000 population).

In the **ESTRO-HERO**[12] survey, a higher number of countries declared having guidelines for the total number of linacs required nationally than was the case ten years ago (25 vs. 17 countries).

7 https://www.estro.org/about/estro-foundation/index
8 https://www.estro.org/
9 https://mariecurielegacy.org/
10 Borras JM, Lievens Y, Dunscombe P, et al. 2015. The optimal utilization proportion of external beam radiotherapy in European countries: An ESTRO-HERO analysis. Radiother Oncol 116(1): 38-44 https://www.ncbi.nlm.nih.gov/pubmed/25981052
11 Overview of national guidelines for infrastructure and staffing of radiotherapy. ESTRO-QUARTS: Work package 1, June 2005. Online version: https://doi.org/10.1016/j.radonc.2004.12.005
12 Guidelines for equipment and staffing of radiotherapy facilities in the European countries: Final results of the ESTRO-HERO survey, August 2014, Online version: http://www.thegreenjournal.com/article/S0167-8140%2814%2900362-4/abstract

COCIR's target density is 7 systems (linacs)/million population. Although this is the capacity need defined by today's clinical model, COCIR recognizes that an individual country may have their target density scaled to GDP per the above ESTRO-QUARTS guidelines. Below is a chart illustrating the results from the study against the COCIR Golden Rules.

CHART 1
DENSITY UNITS / MILLION INHABITANTS
EU 28



The average density measured by COCIR in **Western Europe** slightly increased from 6.8 linacs/million inhabitants as per 1 January 2018 to **7.1** linacs/million inhabitants as per 1 March 2019, ranging from 10.8 in Denmark to 4.9 in Cyprus.

The average density measured by COCIR in **Eastern Europe** remained stable at 2.7 linacs/million inhabitants, ranging from 5.7 in Slovenia[13] to 1.9 in Romania[14].

Density in other countries outside of the European Union measured by COCIR ranges from 0.4 units/million inhabitants in India to 1.1 in Saudi Arabia, 1.3 in Russia, 1.4 in China, 1.8 in Brazil and 3.2 in Turkey.

AGE OF EQUIPMENT

The White Paper "**Radiotherapy: seizing the opportunity in cancer care – November 2018**"[15] stated that "*Even countries with apparently acceptable levels of radiotherapy facilities may have equipment that is outdated. This can undermine the effectiveness of radiotherapy and cause adverse effects for patients.*"

13 A "High income country" according to World Bank: https://data.worldbank.org/country/slovenia
14 A "Upper middle income country" according to World Bank: https://www.worldbank.org/en/country/romania/overview
15 https://mariecurielegacy.org/

How we calculated COCIR's Golden rules - Age:
The **ESTRO-QUARTS study**[16] found that guidelines for the economic lifetime of linear accelerators were available in 12 out of 41 (29.3%) countries. The mean and median were 10 years (range: 8–15 years).

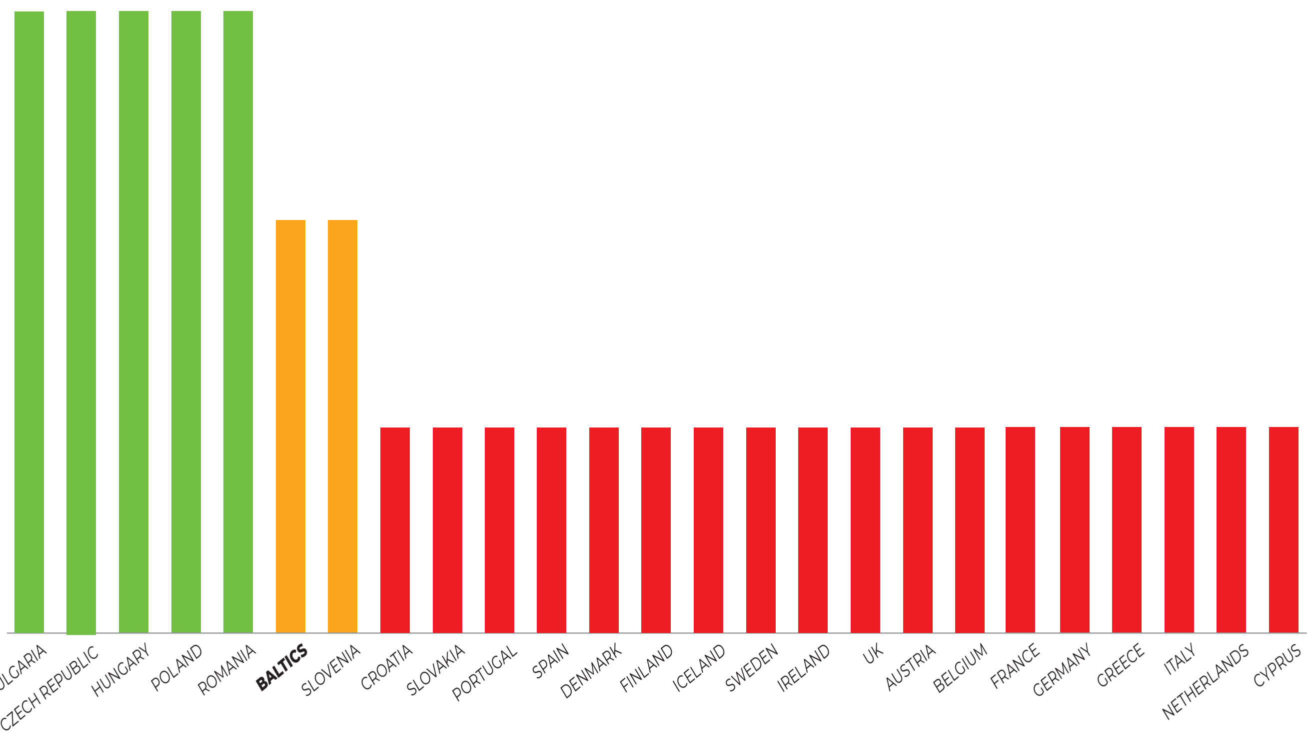
The **ESTRO-HERO survey**[17] reported that guidelines for the lifetimes of treatment machines, at 8–15 years with a most frequent value of 10 years, appear not to have changed over the last decade.

The proportion of the Age Profile aged "10 years and older" measured by COCIR as per 1 January 2018 amounted to 32% in Western Europe and 22% in Eastern Europe. In the latest COCIR measurement as per 1 March 2019, these decreased slightly to 31% in Western Europe and more markedly to 17% in Eastern Europe.

COMBINED OVERVIEW OF DENSITY AND AGE OF EQUIPMENT

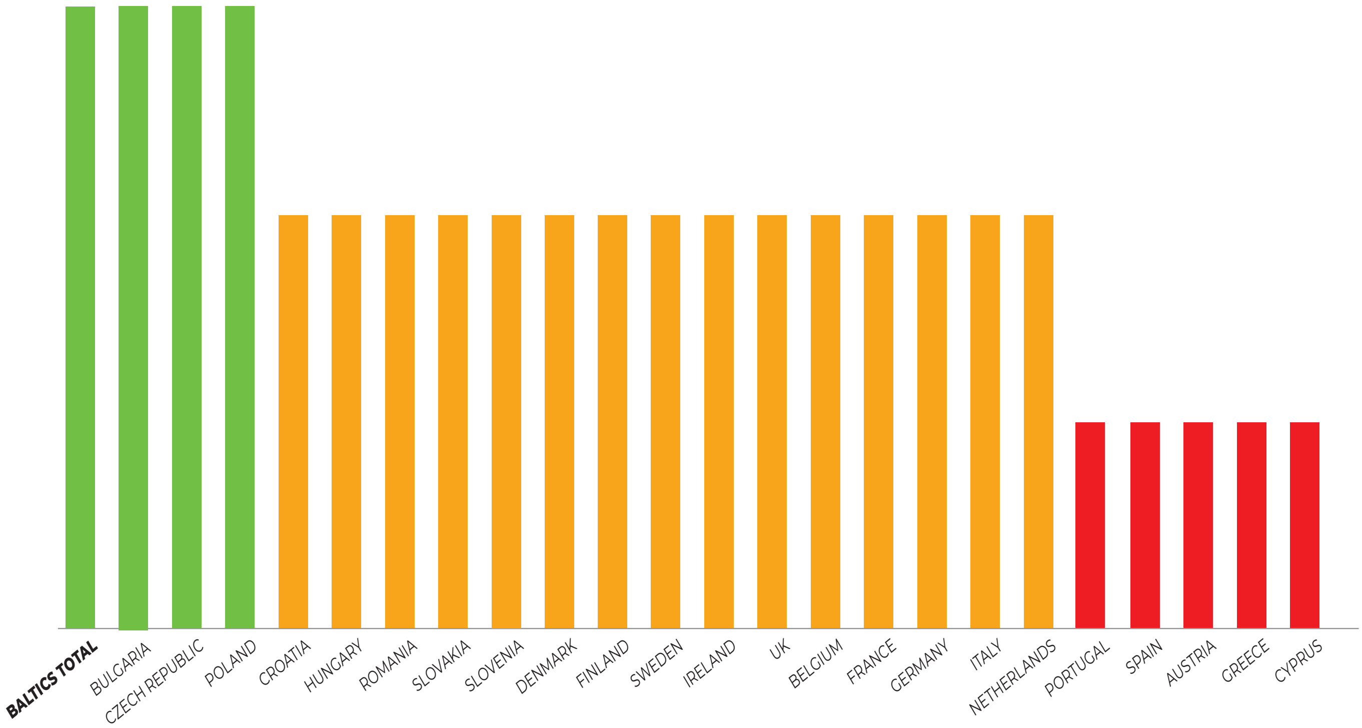
As we can see from the combined results there is a wide spread of access to radiotherapy and what quality is being provided. Countries (most of Western Europe) that were aligned with the COCIR Golden Rules for Density have many times an older machine installed base which is far away from being aligned with the COCIR Golden Rules for Age. While Central and Eastern Europe have invested later in their equipment and could pass the age-goal, they have less accessibility due to the lower density.

CHART 2
COMPLIANCE WITH GOLDEN RULES (AGE)
EU 28



16 Overview of national guidelines for infrastructure and staffing of radiotherapy. ESTRO-QUARTS: Work package 1, June 2005. Online version: https://doi.org/10.1016/j.radonc.2004.12.005
17 Guidelines for equipment and staffing of radiotherapy facilities in the European countries: Final results of the ESTRO-HERO survey, August 2014, Online version: http://www.thegreenjournal.com/article/S0167-8140%2814%2900362-4/abstract

CHART 7
COMPLIANCE WITH COCIR GOLDEN RULES (TOTAL SCORE) BY COUNTRY
EU 28



4. CONCLUSIONS

COCIR strongly supports the need for everyone to access effective, qualitative and affordable cancer care, benefiting from promising innovative technologies. COCIR is convinced that efforts to advance cancer research, diagnosis and targeted therapy should be increased, and has been striving to shape policy changes necessary to accelerate increased survival rates and improvements in cancer patient outcomes.

As we can see from the results there are a wide range of access to radiotherapy and what quality is being provided. It really matters where you live, and it shouldn't be that way. Only a few countries are providing radiotherapy access to their cancer patients according to the COCIR Golden Rules, even the Western European countries with higher density of equipment are falling behind in terms of being able to provide treatment from newer and more advanced technology.

This lack of radiotherapy technology has a clear impact on patients' outcome of treatment as well on a society health economic perspective. There is evidence that 40% of all cancers cured are eliminated by radiotherapy, either alone or acting in combination with other types of treatment[18]. Post-operative radiotherapy for breast cancer patients, for example, has been shown to halve the rate of recurrence compared with surgery alone; it is vital that as many patients as possible have timely and affordable access to appropriate diagnostic tests, screening, and treatment technologies[19].

The White Paper "**Radiotherapy: seizing the opportunity in cancer care – November 2018**"[20] recommended that Governments and policymakers make radiotherapy a central component of cancer care in policies, planning and budgets, in order to mitigate the impact of low resources on patients (e.g. long waiting times).

COCIR asks the EU and national governments to follow these recommendations and make sure to increase radiotherapy investments in their cancer planning going forward.

Procurement of radiotherapy equipment is a long-term investment and should be considered as part of an overall national cancer plan encompassing improved diagnosis, screening and other services. Furthermore, the equipment itself is only part of a holistic solution that must also encompass infrastructure and human capacity development, as well as sustainability.

18 Department of Health Cancer Policy Team. 2012 Radiotherapy Services in England 2012. London: Department of Health https://www.gov.uk/government/publications/radiotherapy-services-in-england-2012
19 Early Breast Cancer Trialists' Collaborative Group. 2011. Effect of radiotherapy after breast-conserving surgery on 10-year recurrence and 15-year breast cancer death: meta-analysis of individual patient data for 10 801 women in 17 randomised trials. Lancet 378(9804): 1707-16 https://www.ncbi.nlm.nih.gov/pubmed/22019144
20 https://mariecurielegacy.org/

2019 AGE PROFILE: DETAILED ANALYSIS OF RESULTS

This section compares the data (Reference Date: **1 March 2019**) to the COCIR Golden Rules criteria.

COCIR companies participating in Age Profile reporting for External Radiotherapy: **Accuray, Elekta, Siemens Healthineers, Varian**

WESTERN EUROPE

Western Europe is the region with the highest proportion of the Age Profile aged "7 years and older" at 60%.
None of the individual Western European countries meet the Golden Rules.
Switzerland falls just short.
UK is the country with the highest rate of new systems aged 0-7 years, 51%, followed by **Greece** at 50%.
Ireland is the country with the oldest installed base. The "7 years and older" proportion of the Age Profile amounts to 78%.

Average density in Western Europe slightly increased from 6.8 to 7.1 Systems/million inhabitants, ranging from 10.8 in **Denmark** to 4.9 in **Cyprus**.

EASTERN EUROPE

The Eastern European countries in the EU 28 that meet the COCIR Golden Rules are **Bulgaria, Czech Republic, Hungary, Poland** and **Romania**.
Slovenia just falls shorts of meeting the Golden Rules.
In Eastern Europe the country with the highest rate of new systems aged 0-7 years is **Bulgaria** with **79%.**

The Eastern European country with the highest density is **Slovenia** with **5.7** Systems/million inhabitants. **Romania** has the lowest density with **1.9**.
The average density in Eastern Europe is 2.7.

RUSSIAN FEDERATION

Russia falls just short of the Golden Rules on age, with 49% of its systems aged between 0-7 years.
Equipment density is stable at **1.3 systems/million inhabitants**, below the average density in Eastern Europe which amounts at 2.7.

TURKEY

Turkey also falls just short of the Golden Rules, with its rate of systems aged between 0-7 years at 47%.
Equipment density remains stable at **3.2 systems/million inhabitants**, therefore still way below the target, but above the average density in Eastern Europe which is 2.7.

REST OF THE WORLD

Countries that meet the COCIR Golden Rules for age are **India** and **China** where the proportion of systems aged between 0-7 years amounts to 56% and 54% respectively.
Brazil with 41% and **Saudi Arabia** with 47% do not meet the Golden Rules for age.
Equipment density ranges from 0.4 Systems/million inhabitants in India to 1.1 in Saudi Arabia, 1.4 in China and 1.8 in Brazil.
All fall short of the COCIR density target.

ANNEX 1: **TABLES & CHARTS**

CHART 1
DENSITY UNITS / MILLION INHABITANTS
EU 28

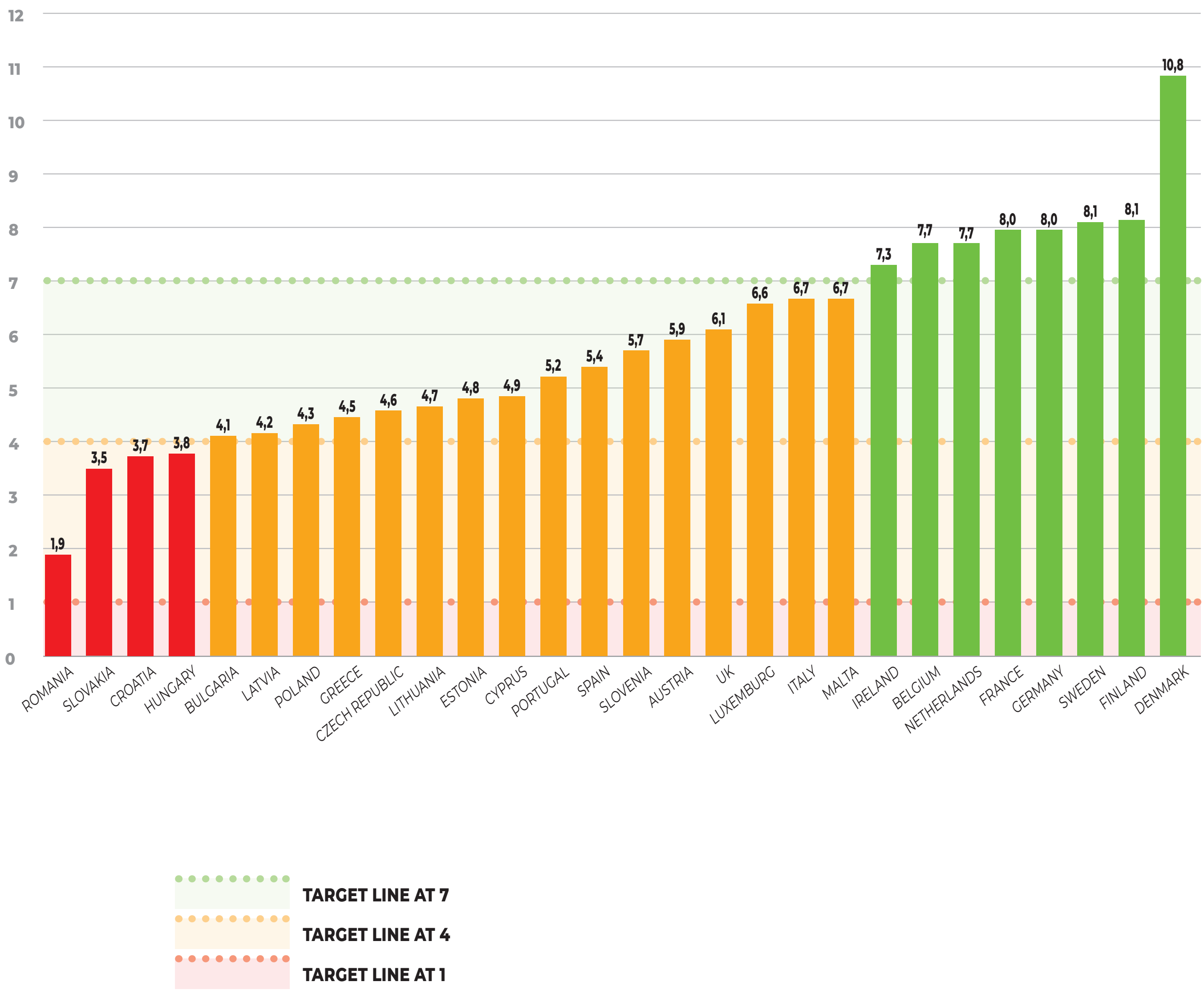


CHART 2
COMPLIANCE WITH GOLDEN RULES (AGE)
EU 28 - FULL DATASET

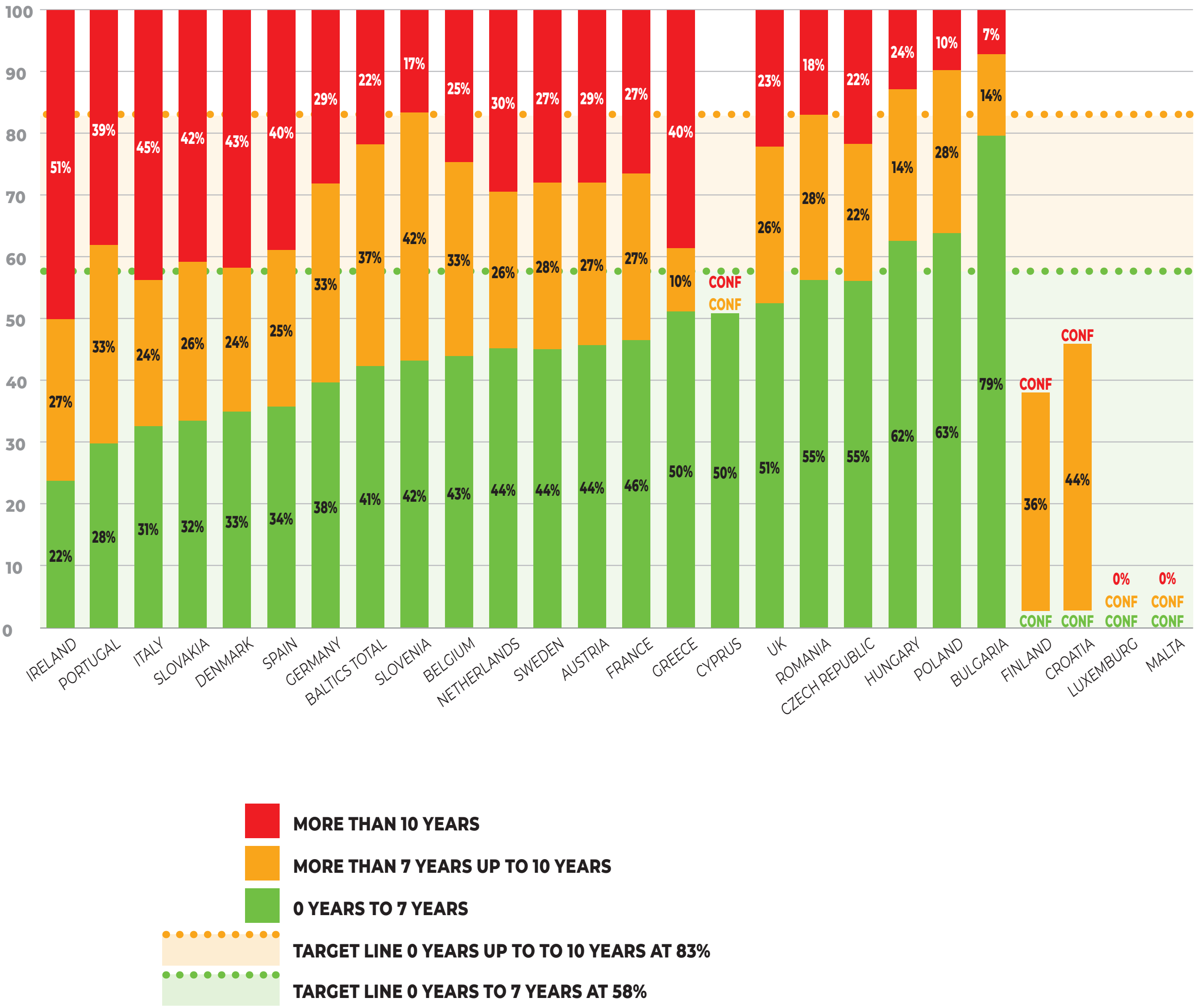


CHART 3
COMPLIANCE WITH GOLDEN RULES (AGE)
EUROPE VS. **BRIC, ME-CIS**

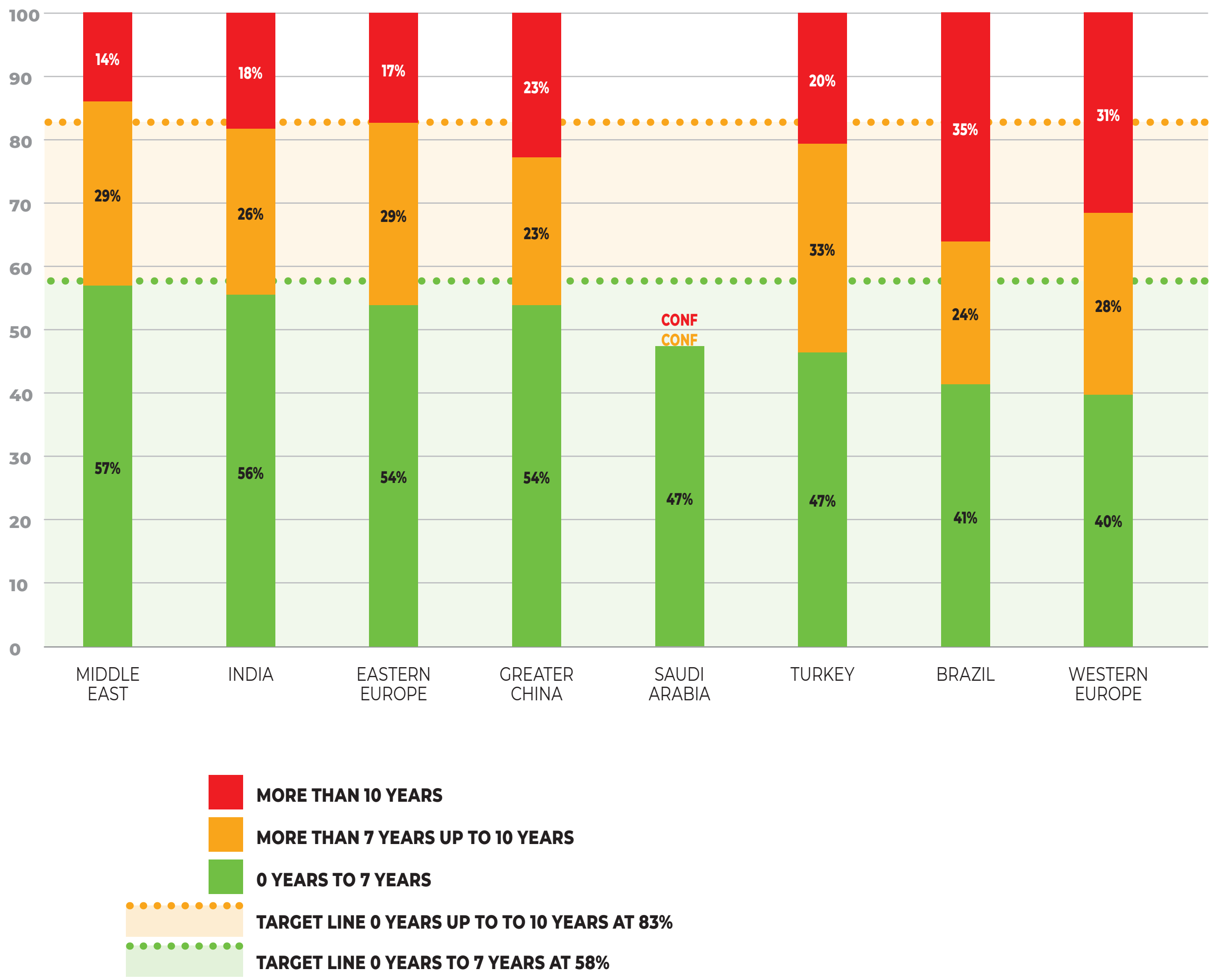


CHART 4
UNITS / MILLION INHABITANTS
EASTERN EUROPE

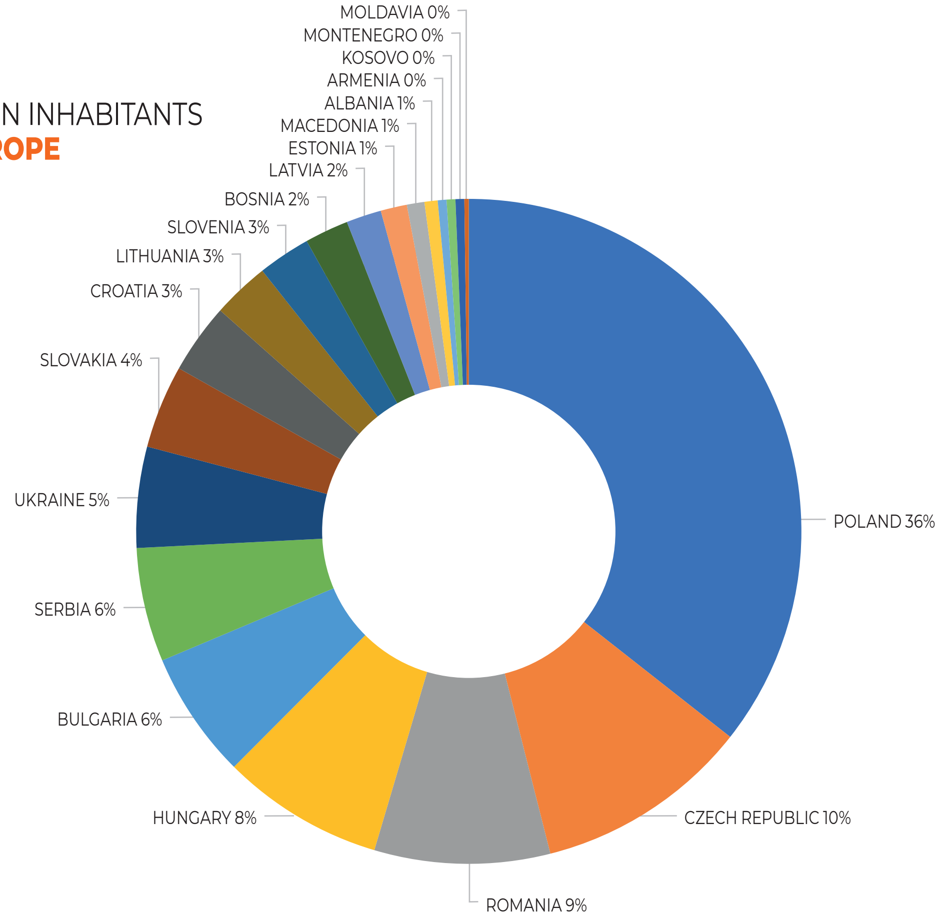


CHART 5
UNITS / MILLION INHABITANTS
WESTERN EUROPE

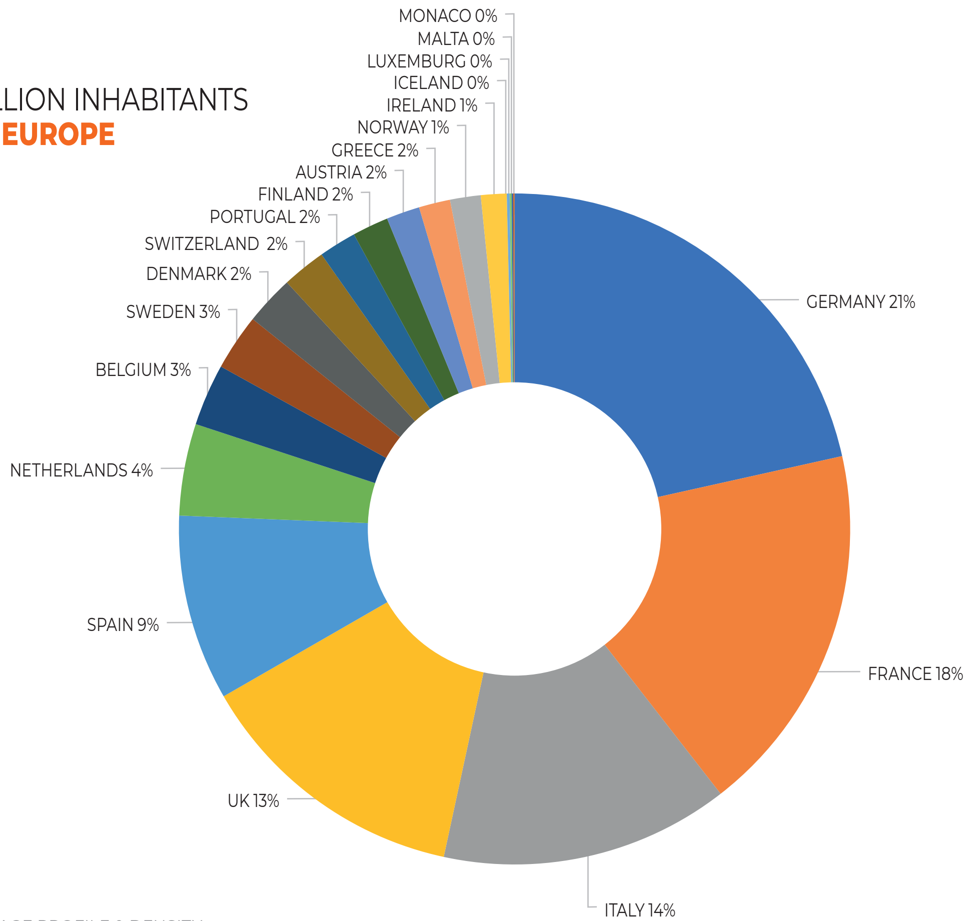


CHART 6
DENSITY UNITS / MILLION INHABITANTS
EUROPE VS. **BRIC, ME-CIS**

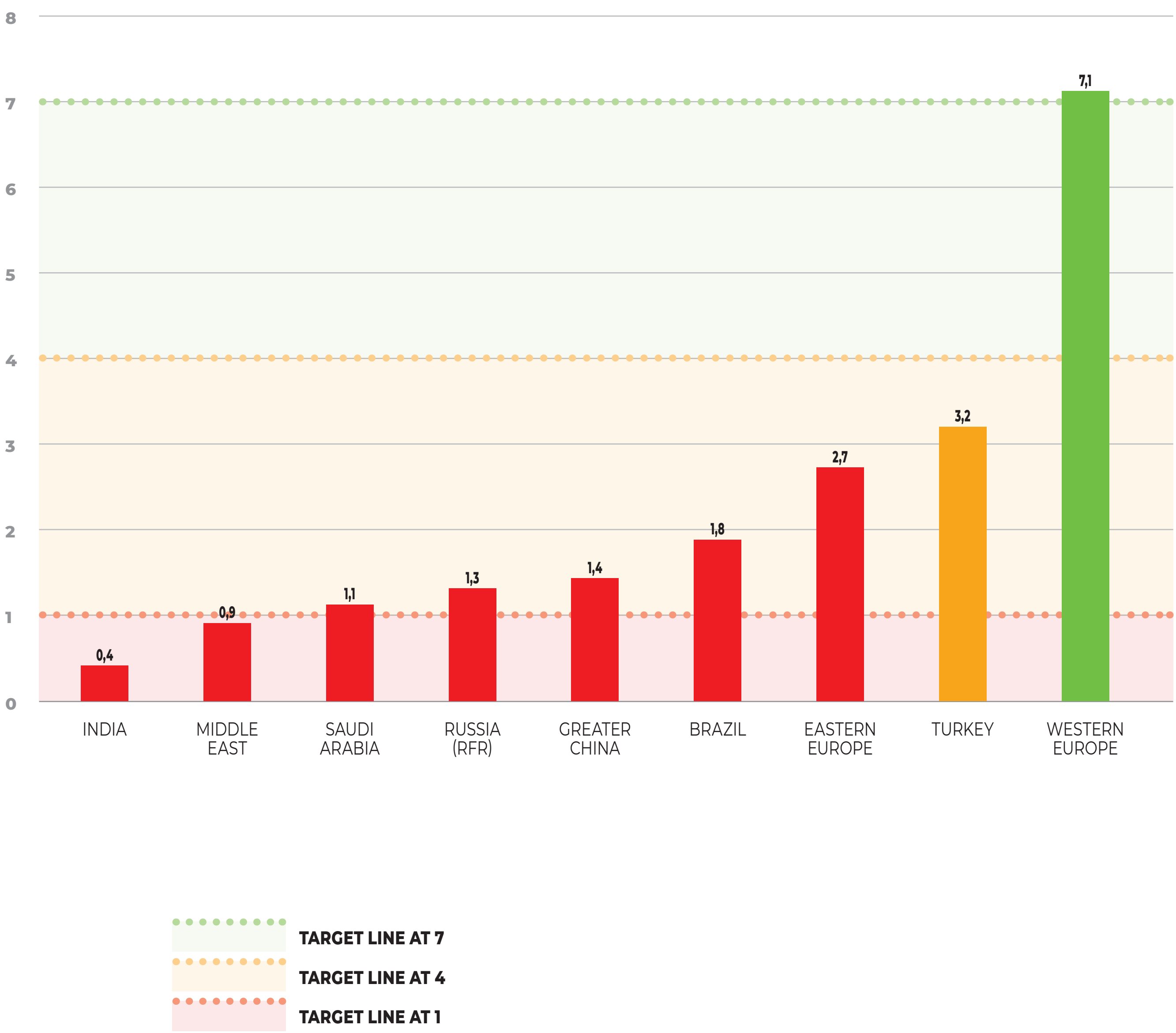


CHART 7
COMPLIANCE WITH COCIR GOLDEN RULES (TOTAL SCORE) BY COUNTRY
EU 28

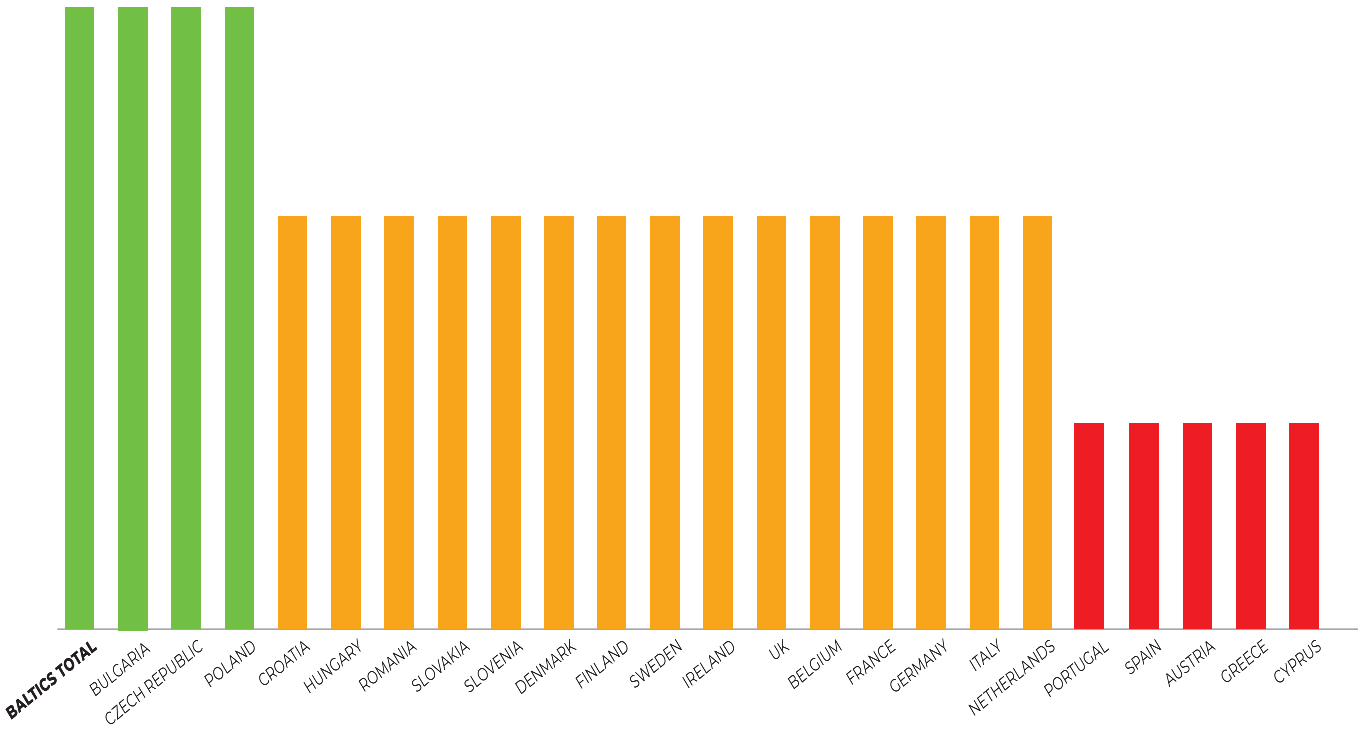


CHART 8
COMPLIANCE WITH COCIR GOLDEN RULES (TOTAL SCORE) BY COUNTRY
EUROPE VS. **BRIC, ME-CIS**

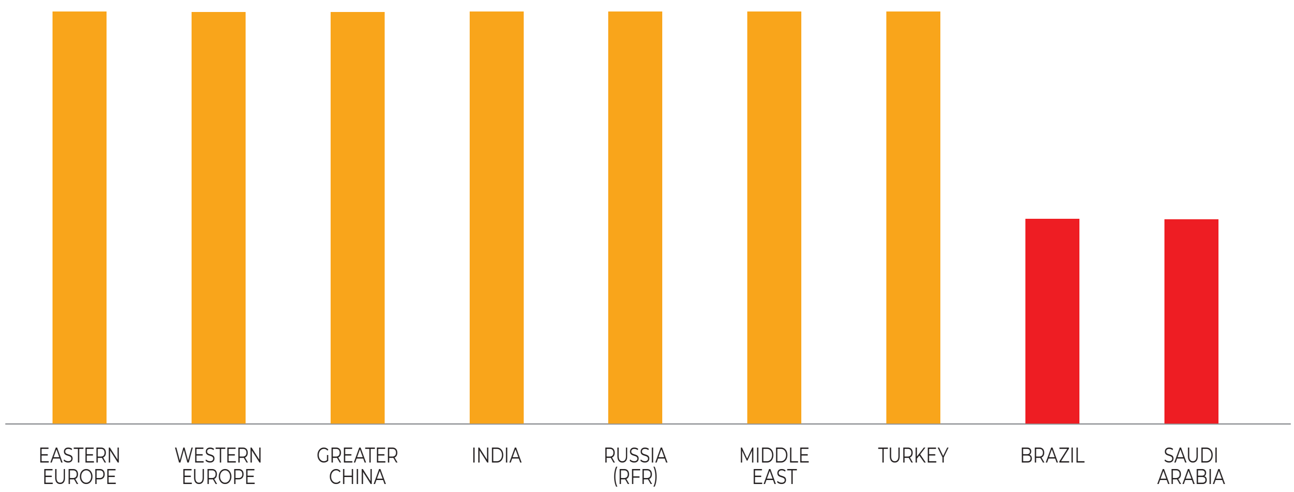


TABLE 1
COMPLIANCE WITH GOLDEN RULES (AGE)
EUROPE (EU AND NON-EU)

	AGE DISTRIBUTION RATING	0 YEARS TO 7 YEARS	MORE THAN 7 YEARS UP TO 10 YEARS	MORE THAN 10 YEARS
ESTONIA	CONF*	CONF	CONF	CONF
LATVIA	CONF	CONF	CONF	CONF
LITHUANIA		31%	46%	23%
BALTICS		41%	37%	**22%**
ALBANIA		**67%**	CONF	CONF
ARMENIA		**100%**	0%	0%
BOSNIA		CONF	**90%**	CONF
BULGARIA		79%	14%	7%
CROATIA		CONF	44%	CONF
CZECH REPUBLIC		**55%**	22%	**22%**
HUNGARY		**62%**	14%	24%
KOSOVO	CONF	0%	CONF	CONF
MACEDONIA	CONF	0%	CONF	CONF
MOLDAVIA	CONF	0%	CONF	CONF
MONTENEGRO	CONF	CONF	CONF	0%
POLAND		**63%**	28%	**10%**
ROMANIA		**55%**	28%	**18%**
SERBIA		**54%**	19%	27%
SLOVAKIA		32%	26%	42%
SLOVENIA		42%	42%	**17%**
UKRAINE		35%	52%	**13%**
EASTERN EUROPE		**54%**	29%	17%
PORTUGAL		28%	33%	39%
SPAIN		34%	25%	40%
IBERIA		33%	27%	40%
DENMARK		33%	24%	43%
FINLAND		CONF	36%	CONF
ICELAND		CONF	91%	CONF
NORWAY		45%	18%	36%
SWEDEN		44%	28%	27%
NORDIC		37%	34%	29%
IRELAND		22%	27%	51%
UK		51%	26%	23%
UK & IRELAND		49%	26%	25%
AUSTRIA		44%	27%	29%
BELGIUM		43%	33%	25%
FRANCE		46%	27%	27%
GERMANY		38%	33%	29%
GREECE		50%	10%	40%
ITALY		31%	24%	45%
LUXEMBURG	CONF	CONF	CONF	0%
MALTA	CONF	CONF	CONF	0%
MONACO	CONF	CONF	0%	CONF
NETHERLANDS		44%	26%	30%
SWITZERLAND		48%	31%	**21%**
WESTERN EUROPE		40%	28%	31%
EUROPE		42%	28%	29%
CYPRUS		50%	CONF	CONF

* There is not enough information to provide data without breaching COCIR confidentiality rules.

TABLE 2

COMPLIANCE WITH GOLDEN RULES (AGE)

REST OF THE WORLD

	AGE DISTRIBUTION RATING	0 YEARS TO 7 YEARS	MORE THAN 7 YEARS UP TO 10 YEARS	MORE THAN 10 YEARS
BRAZIL		41%	24%	35%
GREATER CHINA		**54%**	23%	23%
INDIA		**56%**	26%	**18%**
BRICS		53%	24%	**24%**
AZERBAIJAN	CONF	CONF	CONF	CONF
BELARUS	CONF	CONF	47%	CONF
KAZAKHSTAN		53%	CONF	CONF
RUSSIA (RFR)		49%	36%	15%
TURKMENISTAN	CONF	CONF	CONF	0%
UZBEKISTAN	CONF	CONF	0%	CONF
CIS		48%	38%	15%
BAHRAIN	CONF	CONF	0%	CONF
EMIRATES (UAE)		40%	CONF	CONF
KUWAIT		CONF	CONF	50%
OMAN	CONF	CONF	0%	CONF
QATAR	CONF	CONF	CONF	0%
YEMEN	CONF	CONF	0%	CONF
GULF		54%	CONF	CONF
IRAQ		89%	CONF	CONF
JORDAN		CONF	CONF	44%
LEBANON		56%	22%	22%
SYRIA	CONF	CONF	0%	CONF
LEVANT		63%	17%	20%
IRAN		59%	32%	10%
SAUDI ARABIA		47%	CONF	CONF
MIDDLE EAST		57%	29%	14%
CYPRUS		50%	CONF	CONF
GEORGIA		92%	CONF	CONF
ISRAEL		52%	CONF	CONF
PAKISTAN		39%	15%	45%
TURKEY		47%	33%	20%
OTHERS		48%	30%	22%
ME-CIS		50%	32%	18%

COCIR PARAMETERS FOR TABLES 1&2	AGE DISTRIBUTION RATING	0 YEARS TO 7 YEARS	MORE THAN 7 YEARS UP TO 10 YEARS	MORE THAN 10 YEARS		
IDEAL VALUE		**58%**	**25%**	**17%**		
GREEN		58%-53%		17%-22%	**BOTH**	new and old are within 5 points to the ideal value
YELLOW		53%		22%	**EITHER**	new and old are within 5 points to the ideal value
RED		<53%		>22%	**NEITHER**	new nor old are within 5 points to the ideal value

TABLE 3
COMPLIANCE WITH COCIR GOLDEN RULES (TOTAL SCORE) BY COUNTRY
EUROPE

	AGE DISTRIBUTION RATING	DENSITY RATING	TOTAL SCORE
ESTONIA	CONF		
LATVIA	CONF		
LITHUANIA			
BALTICS TOTAL			
ALBANIA			
ARMENIA			
BOSNIA			
BULGARIA			
CROATIA			
CZECH REPUBLIC			
HUNGARY			
KOSOVO	CONF		
MACEDONIA	CONF		
MOLDAVIA	CONF		
MONTENEGRO	CONF		
POLAND			
ROMANIA			
SERBIA			
SLOVAKIA			
SLOVENIA			
UKRAINE			
EASTERN EUROPE			
PORTUGAL			
SPAIN			
IBERIA			
DENMARK			
FINLAND			
ICELAND			
NORWAY			
SWEDEN			
NORDIC			
IRELAND			
UK			
UK & IRELAND			
AUSTRIA			
BELGIUM			
FRANCE			
GERMANY			
GREECE			
ITALY			
LUXEMBURG	CONF		
MALTA	CONF		
MONACO	CONF		
NETHERLANDS			
SWITZERLAND			
WESTERN EUROPE			
EUROPE			
CYPRUS			

TABLE 4

COMPLIANCE WITH COCIR GOLDEN RULES (TOTAL SCORE) BY COUNTRY

REST OF THE WORLD

	AGE DISTRIBUTION RATING	DENSITY RATING	TOTAL SCORE
BRAZIL	[Red]	[Red]	[Red]
GREATER CHINA	[Yellow]	[Red]	[Yellow]
INDIA	[Green]	[Red]	[Yellow]
BRICS	[Grey]	[Grey]	[Grey]
AZERBAIJAN	CONF	[Red]	[Grey]
BELARUS	CONF	[Red]	[Grey]
KAZAKHSTAN	[Yellow]	[Red]	[Yellow]
RUSSIA (RFR)	[Yellow]	[Red]	[Yellow]
TURKMENISTAN	CONF	[Red]	[Grey]
UZBEKISTAN	CONF	[Red]	[Grey]
CIS	[Yellow]	[Red]	[Yellow]
BAHRAIN	CONF	[Red]	[Grey]
EMIRATES (UAE)	[Red]	[Red]	[Red]
KUWAIT	[Red]	[Red]	[Red]
OMAN	CONF	[Red]	[Grey]
QATAR	CONF	[Red]	[Grey]
YEMEN	CONF	[Red]	[Grey]
GULF	[Grey]	[Grey]	[Grey]
IRAQ	[Green]	[Red]	[Yellow]
JORDAN	[Red]	[Red]	[Red]
LEBANON	[Green]	[Yellow]	[Yellow]
SYRIA	CONF	[Red]	[Grey]
LEVANT	[Grey]	[Grey]	[Grey]
IRAN	[Green]	[Red]	[Yellow]
SAUDI ARABIA	[Red]	[Red]	[Red]
MIDDLE EAST	[Green]	[Red]	[Yellow]
CYPRUS	[Red]	[Red]	[Red]
GEORGIA	[Green]	[Red]	[Yellow]
ISRAEL	[Red]	[Yellow]	[Yellow]
PAKISTAN	[Red]	[Red]	[Red]
TURKEY	[Yellow]	[Yellow]	[Yellow]
OTHERS	[Grey]	[Grey]	[Grey]
ME-CIS	[Grey]	[Grey]	[Grey]
GRAND TOTAL	[Grey]	[Grey]	[Grey]

COCIR PARAMETERS FOR TABLE 3 & TABLE 4	TOTAL SCORE	AGE DISTRIBUTION RATING		DENSITY RATING	
Green + Green = **GREEN**	[Green]	[Green]	[Green]	[Green]	[Green]
Green + Yellow or Yellow + green = **GREEN**	[Green]	[Green]	[Yellow]	[Green]	[Yellow]
Green + Red or Red + Green = **YELLOW**	[Yellow]	[Green]	[Red]	[Green]	[Red]
Yellow + Yellow = **YELLOW**	[Yellow]	[Yellow]	[Yellow]	[Yellow]	[Yellow]
Yellow + Red or Red + yellow = **YELLOW**	[Yellow]	[Yellow]	[Red]	[Yellow]	[Red]
Red + Red = **RED**	[Red]	[Red]	[Red]	[Red]	[Red]

ANNEX 2: **THE IMPORTANCE OF RADIOTHERAPY**

A combination of four major treatment modalities – surgery, radiotherapy, immunotherapy and chemotherapy – may be used to create a comprehensive, customised treatment plan for a cancer patient, of which radiotherapy is an integral component. The International Atomic Energy Agency (IAEA) estimates that radiotherapy should be used to treat more than 55% of all patients diagnosed with cancer. This percentage may in fact be much higher in low-income countries – as many as 70-80% of all cancer patients in LMICs may require radiotherapy as part of their treatment.[21]

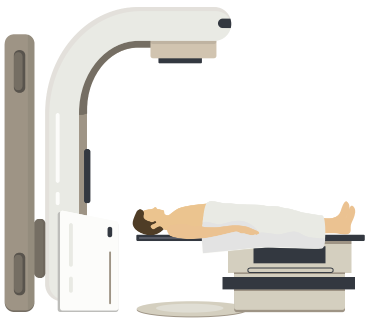
From a clinical perspective, advances in radiotherapy have dramatically changed the delivery of cancer care. In an era of personalised medicine, radiotherapy beams may be shaped and modulated to conform to the shape of tumors. Radiotherapy thereby offers the means to optimise the delivery of a prescribed dose to the tumor, potentially sparing more normal tissues. This advanced treatment tool may thus enable clinicians to treat in a curative manner when treating early stage primary tumors, cure localised disease and to palliate and minimise symptoms of incurable cancers.[22]

From an economic perspective, radiotherapy can be highly cost-effective. One radiotherapy machine can treat tens of thousands of patients over an average ten-year life span.[23] This may result in better cost-effectiveness compared to alternative treatment methods. Different studies have demonstrated that radiotherapy is cost-effective for both curative and palliative cancer therapy.[24] Finally, a recent Lancet Oncology Commission study demonstrates that building radiotherapy capacity in low- and middle-income countries could lead to the saving of 26.9 million life years and produce the benefit of US$278.1 billion over the next 20 years.[25]

RECOMMENDED TYPE AND CONFIGURATION OF RADIOTHERAPY EQUIPMENT

Conventional External-Beam Radiotherapy (EBRT) can be delivered on a Cobalt teletherapy system or on a linear accelerator. Cobalt teletherapy systems are earlier-generation radiotherapy machines typically capable of delivering only the basic radiotherapy treatments. For example, 2D external beam radiotherapy consists of static radiation beams delivered from one to four directions. This dramatically minimises the conformality of the radiation treatment dose; consequently, only a roughly shaped "box" of radiation can be delivered to the approximate location of the tumor, with little or no consideration given to surrounding sensitive structures.

In contrast to Cobalt teletherapy systems, linear accelerators can be used to deliver more advanced types of treatment. These techniques seek to improve the potential of radiotherapy to achieve its essential goal: to remove or destroy all cancer cells.[26]



21 Rosenblatt, et al., "Radiotherapy in Cancer Care: Facing the Global Challenge," *International Atomic Energy Agency*, 2017, 6.
22 This paragraph and the following are excerpted from the COCIR Strategic Research Agenda, *COCIR*, https://www.cocir.org/media-centre/publications/article/cocir-strategic-research-agenda.html - COCIR is a member of DITTA.
23 The life span of a radiotherapy machine may extend longer than ten-years in certain environments. Dr. Gilberto Lopes, " Investing in Cancer Prevention and Control to Reduce Global Economic Burden," *American Society of Clinical Oncology Daily News*, 30 May 2015, https://am.asco.org/investing-cancer-prevention-and-control-reduce-global-economic-burden.
24 Michael B. Barton, et al., "Estimating the demand for radiotherapy
25 Rifat Atun, et al., "Expanding global access to radiotherapy," *The Lancet*, no. 16 (2015).
26 Michael Baumann, Tobias Hölscher & Daniel Zips (2008) The future of IGRT – Cost Benefit Analysis, Acta Oncologica, 47:7, 1188-1192, DOI: 10.1080/02841860802304556

NECESSARY ACCESSORIES

The WHO List of Priority Medical Devices for Cancer Management furthermore captures an extensive list of accessories and supporting devices required for the successful and effective operation of a linear accelerator. Of particular importance, the publication states[27]:

> *"Radiotherapy cannot be delivered without a treatment planning system, which is used to determine target volumes and other critical structures, and, subsequently, to determine how the radiotherapy system will deliver the treatment as required. Additionally, oncology information systems combine all oncology data pertaining to a patient for easy access and reference. This enables clinicians to perform essential quality assurance measures in order to facilitate best outcomes for patient data."*

Furthermore:

> *"The role of imaging in radiation therapy is a determinant of the success of the therapy, ..."*

As a consequence (Computed Tomography-) Simulators including virtual simulation software are essential parts of the process, whereby the patient anatomy is captured and modelled as input for subsequent treatment planning. Fixation and simulation accessories are similarly vital to the delivery of radiotherapy, as they are used to ensure that the patient position is accurate and consistent across multiple treatment sessions/days – if the patient is not accurately positioned, the treatment beam may not be delivered accurately to the tumor but may rather hit surrounding healthy tissues and/or vital organs.

SUPPORTING ENVIRONMENT: INFRASTRUCTURE AND HUMAN RESOURCES

When considering initiatives to implement new radiotherapy equipment, particularly in emerging countries, it is critical to ensure that there is an appropriate, enabling environment. Physical infrastructure and human resources are the most importance components of this environment.

Construction of physical infrastructure has consistently been a source of delays in radiotherapy project completion. Public procurement initiatives often tender for and award construction contracts separately from equipment supply contracts. This may result in scenarios in which the contractor does not have the requisite expertise in radiotherapy infrastructure, causing significant delays or mistakes that ultimately require extensive and costly refurbishment. Allowing input from the radiotherapy manufacturer(s) regarding the design of the center prior to construction, especially regarding requirements for the shielded rooms (bunkers) used to house the equipment, would likely serve to reduce some of the issues surrounding construction.

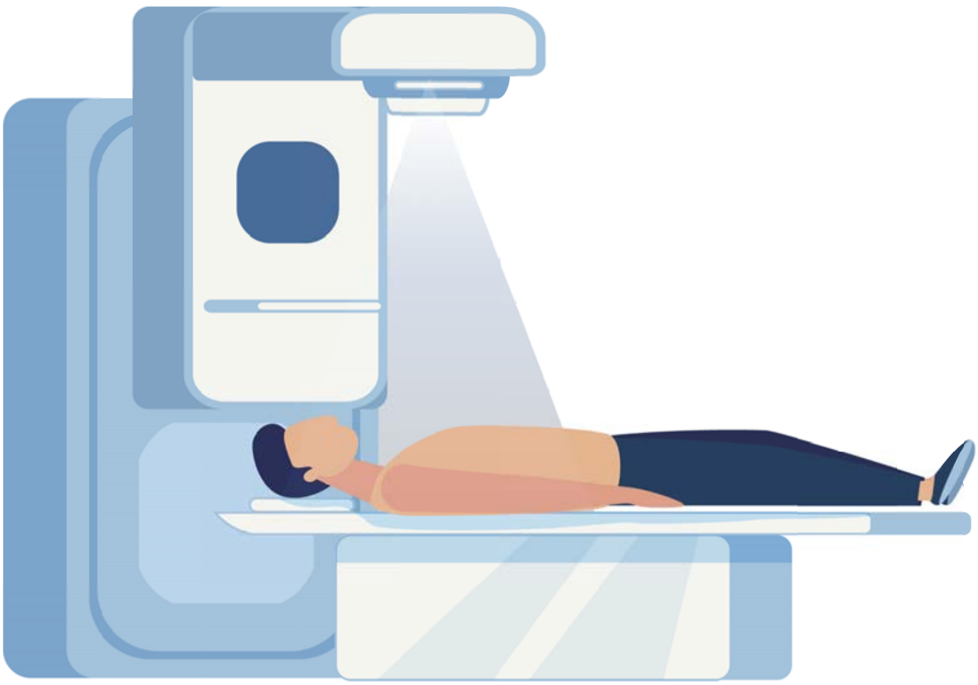
A key difference between the diagnostic and radiotherapy industries is the level of academic and clinical education required for personnel delivering a safe and effective service. Three main categories of personnel deliver radiotherapy services: radiation oncologists (or clinical oncologists), medical physicists and radiotherapy technicians. International benchmarks suggest that each radiotherapy department should have 1 radiation oncologist for every 200 to 250 patients treated per year and 1 physicist for every 400 patients.[28]

Rigorous academic backgrounds are required for radiotherapy personnel: the minimum clinical training period in radiation oncology is three years following medical school (the international standard is four years). Medical physicists should have a post-graduate degree (1-3 years) and clinical training (2 or more years) after a university degree (3-4 years).[29] Radiotherapy technician training varies significantly from country to country, as do roles and responsibilities, but often consists of a 2-3-year specialisation after general radiography certification. Without a robust academic foundation, training in equipment operation or clinical protocols cannot take place.

27 WHO list of priority medical devices for cancer management, ISBN: 978-92-4-156546-2
28 Atun, "Expanding global access to radiotherapy," 20.
29 Rosenblatt, "Radiotherapy in Cancer Care: Facing the Global Challenge," 244 and 252.

CONCLUSION

Procurement of radiotherapy equipment is a long-term investment and should be considered as part of an overall national cancer plan encompassing improved diagnosis, screening and other services. Furthermore, the equipment itself is only part of a holistic solution that must also encompass infrastructure and human capacity development, as well as sustainability.



GENERAL INFORMATION ABOUT COCIR

COCIR is the European Trade Association representing the medical imaging, radiotherapy, health ICT and electromedical industries.

Founded in 1959, COCIR is a non-profit association headquartered in Brussels (Belgium) with a China Desk based in Beijing since 2007. COCIR is unique as it brings together the healthcare, IT and telecommunications industries.

Our focus is to open markets for COCIR members in Europe and beyond. We provide a range of services in the areas of regulatory, technical, market intelligence, environmental, standardisation, international and legal affairs.

COCIR is also a founding member of DITTA, the Global Diagnostic Imaging, Healthcare IT and Radiation Therapy Trade Association (www.globalditta.org).

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