CT Dose Excellence Project: A Pan European approach towards protocols unification and dose optimization

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Dose Excellence Project Leader

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affinity with doctors and patients

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trust and **fidelity** in everything we do

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constant progress through **ideas** and innovation

Leading independent provider of Advanced Diagnostic Imaging and Cancer Care services in Europe

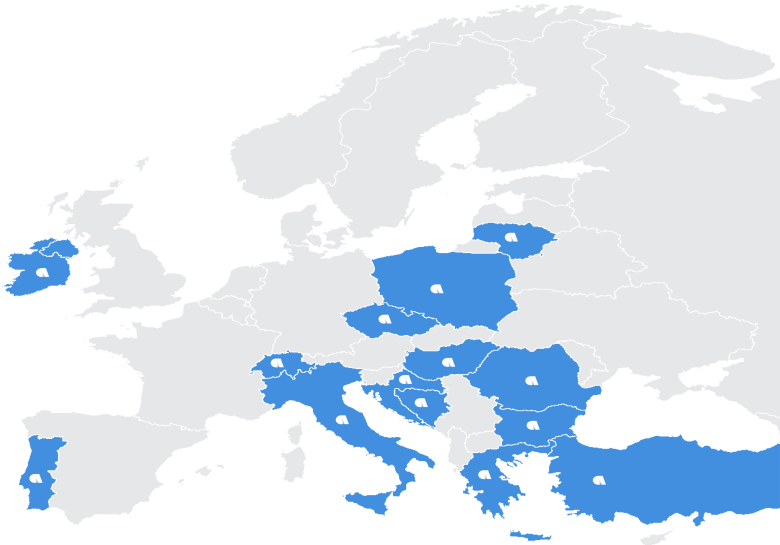
170
medical centres

4.5m
examinations

14
countries in Europe

3300
employees

680
medical doctors



Dutch holding company, owned by Waypoint Capital, the leading Swiss investor in Life Sciences

Europe's biggest investor and consolidator on the Advanced Diagnostics and Cancer Care markets

The largest, most experienced healthcare provider under the Public Private Partnership (PPP) model and an integral part of national healthcare systems

Best-in-class medical technology

Affidea's technology update investments, proprietary asset management system and large scale partnership with technology vendors result in the latest technology IB and youngest equipment fleet

145 MRI units

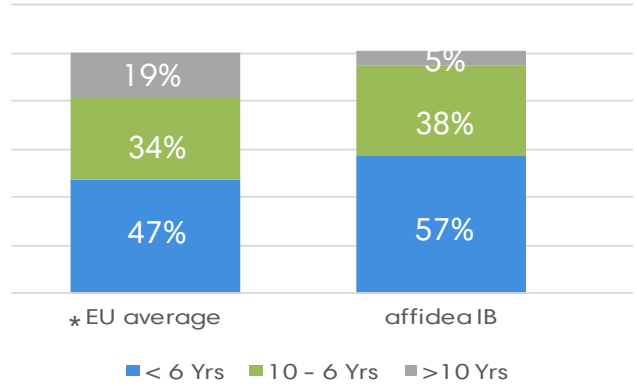
100 CT scanners

910 diagnostic and cancer care modalities

22 linear accelerators

3 gamma knives

17 PET-CT scanners



* COCIR Data

Clinical Governance Infrastructure

- Affidea Medical Council comprising Country Medical Directors in all 14 countries.
- Medical Advisory Board Seven Leading European Radiology experts (four previous Presidents of ESR) providing international leadership.
- Cancer Treatment Centre (CTC) Steering Committee in collaboration with Houston Methodists Group and independent Senior Clinician from Oxford University.
- Nuclear Medicine Working Group specifically focusing on countries that provide nuclear medicine examinations such as PET CT.

Dr. Rowland Illing, Affidea CMO

Prof. Andras Palko, University of Szeged, Affidea MAB Chairman

Prof. Filipe Caseiro Alves, University of Coimbra, Affidea Medical Council Chairman

Prof. Ricky Sharma, Oxford University, Affidea Radiotherapy Consultant

Radiation from Medical Imaging

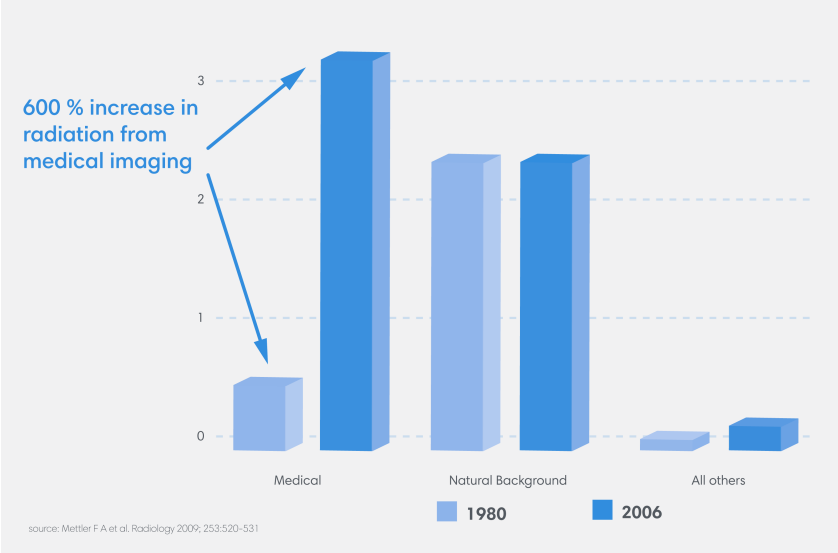
Facts for medical imaging

The per capita dose of radiation

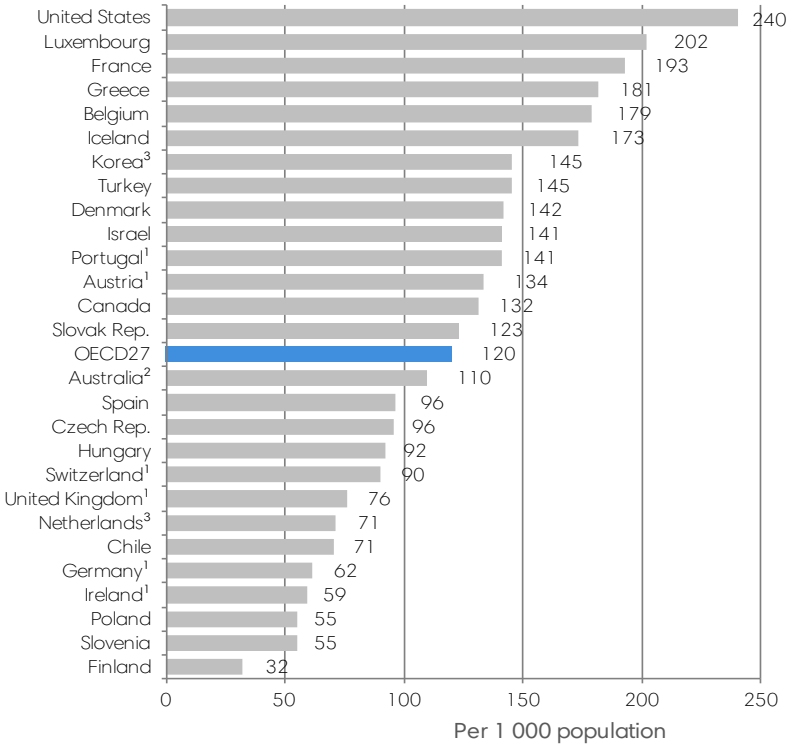
from medical imaging

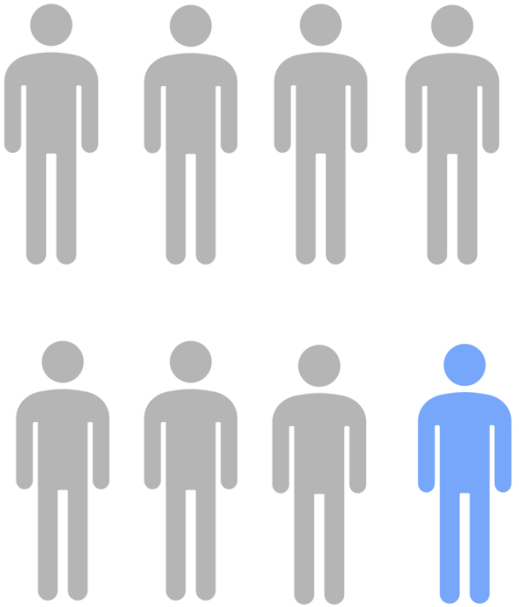
has increased by 600%

since the early 1980s



Continuing expansion of CT practice



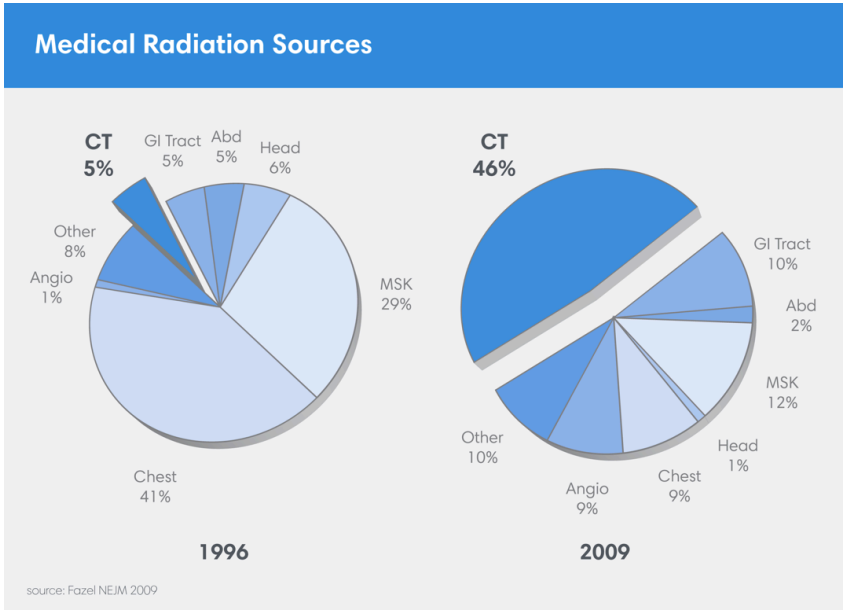


Source: OECD Health Statistics 2015: CT exams, 2013 or nearest year

Facts for CT examinations

In 1996 the contribution to the annual cumulative effective dose by CT examinations was 5%.

In 2009 the contribution to the annual cumulative effective dose by CT examinations is 46%.



Diagnostic imaging radiation incidents

- 23 January 2008

A licensed technologist, in Arcata, California performed 151 CT scan slices on a single 3 mm level on the head of a 23-month child over a 65-min period. This led to a dose of 5.4Gy to the brain and 1.5Gy to the lenses of both eyes!

- February 2008 – August 2009

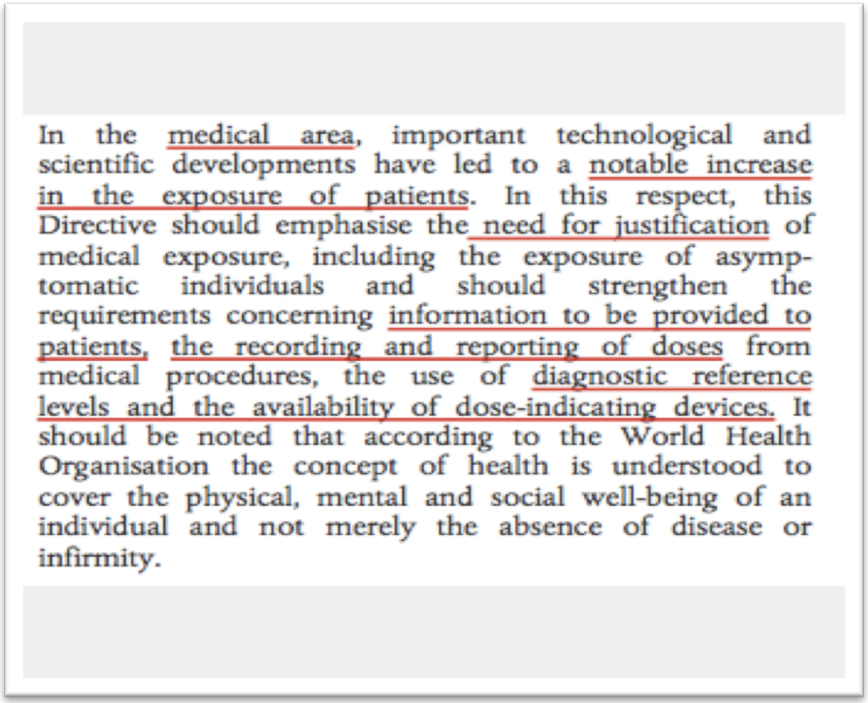
A software misconfiguration in a CT scanner used for brain perfusion scanning at Cedar Sinai Medical Center in Los Angeles, California, resulted in 206 patients receiving radiation doses approximately 8 times higher than intended.

Legislation & Exposure from Medical Ionizing Radiation

COUNCIL DIRECTIVE 2013/59/EURATOM

of 5 December 2013

Basic Safety Standards for Protection Against Dangers Arising from Exposure to Ionizing Radiation



In the medical area, important technological and scientific developments have led to a notable increase in the exposure of patients. In this respect, this Directive should emphasise the need for justification of medical exposure, including the exposure of asymptomatic individuals and should strengthen the requirements concerning information to be provided to patients, the recording and reporting of doses from medical procedures, the use of diagnostic reference levels and the availability of dose-indicating devices. It should be noted that according to the World Health Organisation the concept of health is understood to cover the physical, mental and social well-being of an individual and not merely the absence of disease or infirmity.

Multi-slice CT scanners

Modern CT scanners are capable of providing precise detail of patient anatomy, but…this is not always required

appropriate image quality at optimized dose

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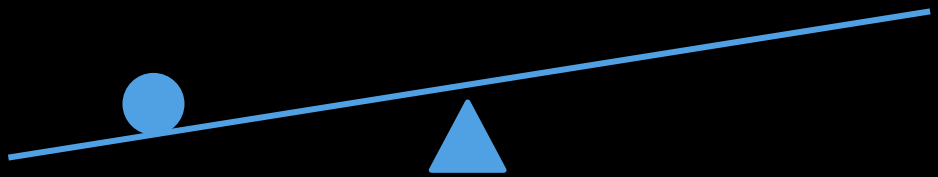
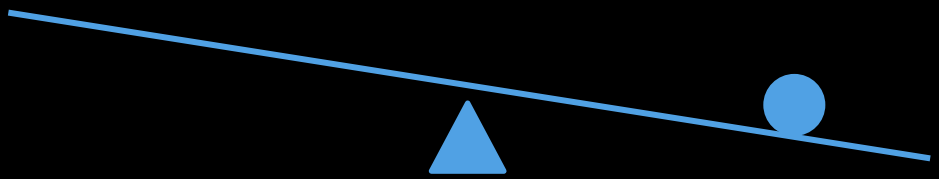
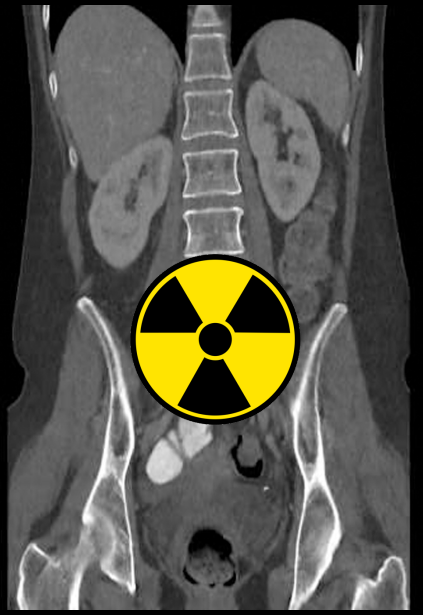
. . .not too little



Poor Image Quality

. . .not too much





Unnecessary Dose

perfect balance

Dose Excellence

BALANCED RADIOGRAPHY

The process

Vision

Leadership

Teams

Standardized & Unified Protocols with DRLs

Standard procedures

DoseWatch

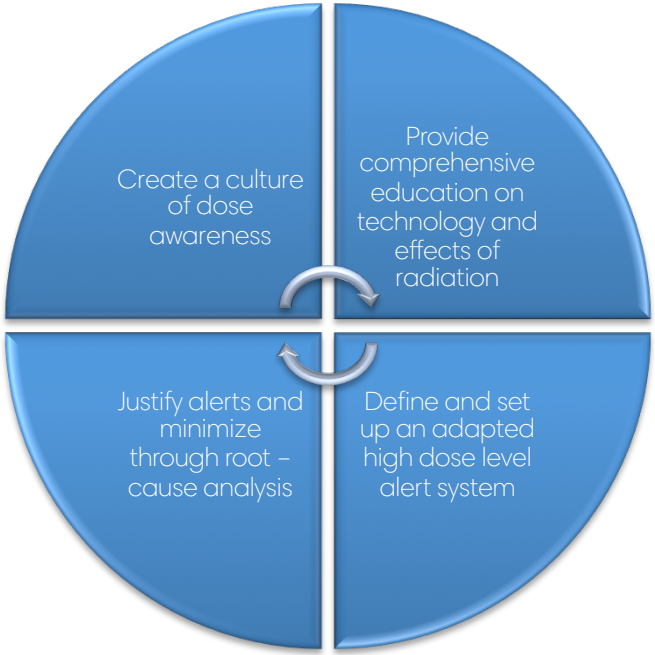
Track & Record dose data and more

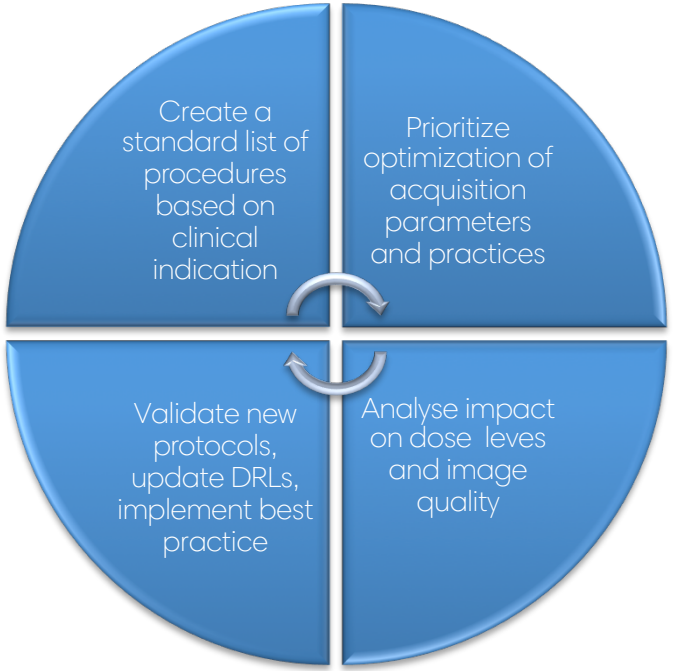
Track & Justify high dose level alerts
Analyze data
Optimize protocols & DRL

Dose Excellence

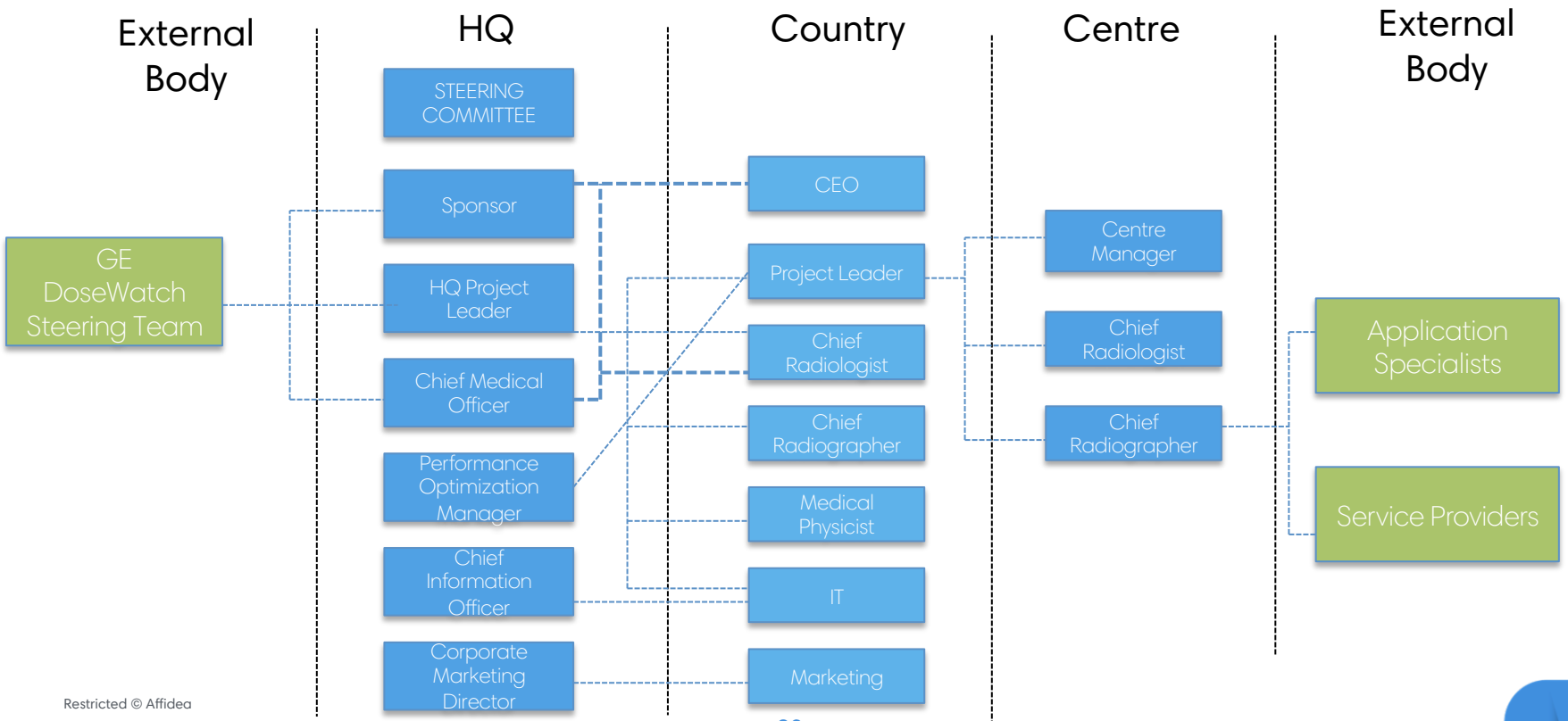
BALANCED RADIOGRAPHY

Set clear goals





DEP Teams and Communication channels



CT protocols and DRLs

Adult CT protocols categories

Routine	• By anatomic region and clinical indication. To further categorize by standard and big patients.
CTA	• By anatomic region
Oncology follow up	• By primary tumor type: lung, breast, upper abdomen, lower abdomen, lymphoma, sarcoma, melanoma, head & neck
Screening	• Chest
Cardiac	• By prospective, retrospective and BPM
Interventional	• Biopsy (liver, lung etc.), joint injection, drainage/therapy (abdominal cavity, liver, spine etc.)

Pediatric CT protocols categories

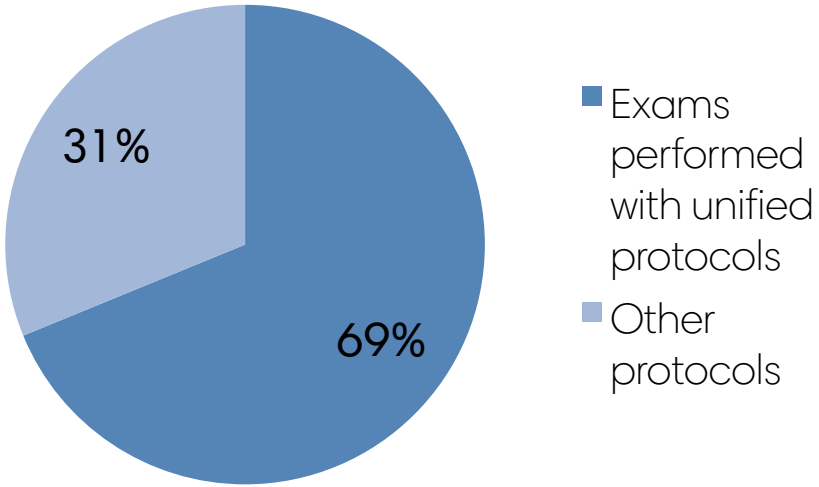
Routine	• By anatomic region, clinical indication, weight or age
Oncology follow up	• By primary tumor type: leukemia, brain/CNS, neuroblastoma, nephroblastoma, lymphoma, osteosarcoma

Example of adult unified protocols setup

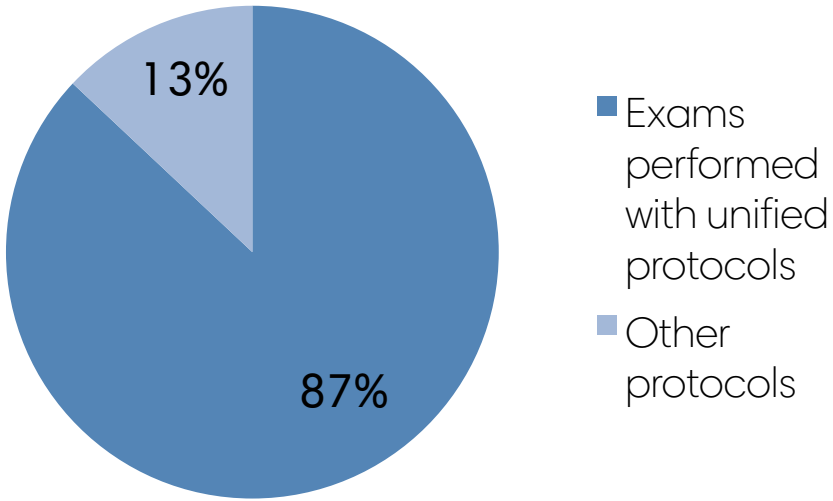
Anatomic Area	Protocole Name= clinical indication	Main Clinical Indication	Main Diagnostic Task	Scanning Mode	Exam Description	NS	RPID	DRL P75 CTDivol (mGy)
CHEST	General Chest max 2 series	Metastasis detection, Staging, Tumor evaluation, Dyspnea, Unclear chest symptoms, First examination	Parenchyma, mediastinum, airways, mediastina vessels	helical	with and/or without contrast	<= 2	RPID17	10.0
CHEST	Pulmonary Embolism	Thrombus detection	Vessels, parenchyma	helical, recommended 1.5 mm thickness	with contrast	1	RPID336	10.0
CHEST	Chest follow-up	Follow-up for infection or nodules, tumor staging	Parenchyma, mediastinum	helical	1 phase without contrast for parenchyma evaluation OR 1 phase with contrast for mediastinum evaluation	1	RPID16	7.5

The number of unified protocols is important

29 Unified CT protocols



75 Unified CT protocols



Dose Monitoring software

GEHC DoseWatch

A multimodality, vendor independent tracking, recording and analyzing software of dosimetric data and much more…

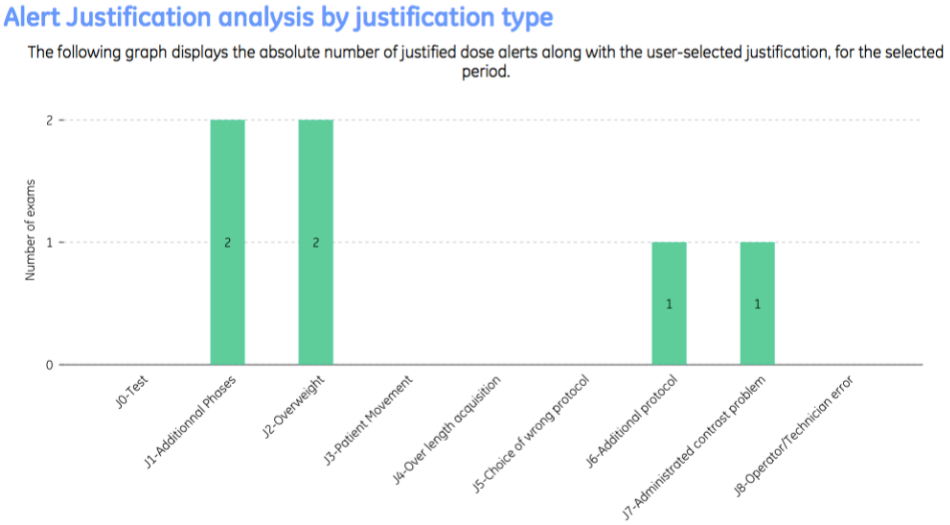
Tools to facilitate Dose Excellence:

- RadLex playbook to map site CT protocols to Affidea's Standardized CT protocols in order to track compliance
- Data to assess correct patient positioning in FOV, mA modulation function, CTDIvol, DLP, SSDE, patient cumulative dose, BMI and more
- Definition, monitoring and justification of high-level dose alerts
- Custom made report for analysis of data, sent automatically via email to all relevant recipients

High dose level alerts

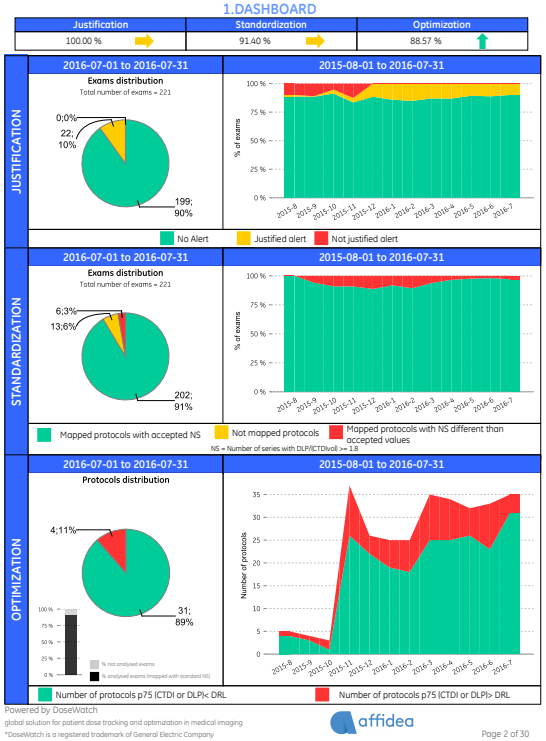
Alert system definition

Alerts defined by protocol. An alert is triggered when DLP recorded for the specific patient examination is 2 x median DLP from the collected data on the specific CT scanner and practice.



DEP outcomes

Justification, Standardization, Optimization - dashboard



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Dose levels analysis

General protocols: Dose Reference Level (DRL) analysis - 2015-12-01 to 2015-12-31

Device	RPID	Max accepted NS	Protocol name	# Exams	P25 of Max series CTDIvol (mGy)	P75 of Max series CTDIvol (mGy)	Max CTDI DRL (mGy)	CTDI diff	P75 of Total DLP (mGy. cm)	P25 of Total DLP (mGy. cm)
VCT 64	RPID195	3	6.4 General abdomen/pelvis max 3 phases	46	5.56	9.35	17.00	-45.00 %	775.36	411.10
VCT 64	RPID248	4	5.8 TAP max 4 phases	34	7.04	13.69	15.00	-8.73 %	1066.92	603.93
VCT 64	RPID372	4	1.1 General Head incremental	20	50.79	51.83	55.00	-5.76 %	1566.40	782.86
VCT 64	RPID17	2	5.1 General Chest max 2 series	19	4.37	7.99	10.00	-20.05 %	441.12	157.53
VCT 64	RPID280	2	5.4 Lung parenchyma	11	3.85	6.19	7.50	-17.47 %	224.55	144.78
VCT 64	[illegible]	3	6.1 General abdomen max 3 phases	8	6.19	11.57	14.00	-17.39 %	1086.68	417.23
VCT 64	RPID54	[illegible]	6.7 Urography - Kidneys	7	3.75	8.89	14.00	-36.50 %	841.02	294.48
VCT 64	RPID324	1	2.1 Sinus [illegible] trauma	5	5.13	5.15	10.00	-48.55 %	69.00	62.83
VCT 64	RPID38	2	3.1 Neck Space occupy lesion	5	11.58	15.21	30.00	-49.30 %	846.84	607.49
VCT 64	RPID232	2	6.10 Pelvis max 2 phases	4	[illegible]	12.52	17.00	-26.38 %	743.80	349.99
VCT 64	RPID25	1	9.2 Lower extremities trauma	4	6.40	[illegible]	20.00	-67.68 %	146.66	105.08
VCT 64	RPID155	2	2.4 Inner ear	3	94.16	94.44	30.00	214.80 %	1240.61	831.12
VCT 64	RPID344	1	6.8 Renal stone	3	4.86	4.87	5.00	-2.60 %	220.49	207.71
VCT 64	RPID23	4	1.2 Head space occupying lesion - inflammation incremental	2	50.56	51.83	55.00	-5.76 %	1604.00	1442.[illegible]
VCT 64	RPID98	2	2.2 Sinus space occupying lesion	2	23.66	23.70	30.00	-21.00 %	663.43	554.34
VCT 64	RPID860	1	6.3 Abdomen/pelvis follow up max 1 phase	2	3.64	4.12	17.00	-75.76 %	199.57	168.78
VCT 64	RPID87	3	6.9 Virtual colonography	2	3.85	3.86	11.00	-64.91 %	400.11	325.66
VCT 64	RPID1527	1	7.2 Lumbar Spine Herniation helical	2	20.43	22.96	50.00	-54.08 %	622.52	522.41
VCT 64	RPID21	1	3.5 Cervical Spine Trauma Herniation	1	21.17	21.17	18.00	17.61 %	474.82	474.82
VCT 64	RPID16	1	5.3 Chest follow-up	1	3.81	3.81	7.50	-49.20 %	118.46	118.46
VCT 64	RPID1057	1	5.31 SnapShot Segment 0.625 mm 66-75 BPM (LP)	1	15.27	15.27	55.00	-72.24 %	505.47	505.47
VCT 64	RPID960	1	5.5 Chest screening 1 phase without contrast	1	3.82	3.82	3.00	27.33 %	130.14	130.14
VCT 64	RPID360	2	5.6 CTA Chest Aorta	1	28.17	28.17	15.00	87.80 %	728.27	728.27
VCT 64	RPID953	4	6.2 Abdomen focal liver lesion/kidney max 4 phases	1	9.82	9.82	14.00	-29.86 %	789.20	789.20
VCT 64	RPID956	4	6.5 Abdomen/pelvis with delayed parenchymal phase, max 4 phases	1	10.57	10.57	17.00	-37.82 %	1144.16	1144.16
VCT 64	RPID242	4	7.1 Lumbar Spine Herniation incremental	1	26.65	26.65	40.00	-33.38 %	234.86	234.86
VCT 64	RPID27	2	9.1 Lower extremities soft tissue	1	6.51	6.51	25.00	-73.96 %	364.35	364.35

This table shows a DRL analysis for all mapped protocols with accepted NS. The P75 values (Max series CTDIvol) that are above the DRL threshold are displayed in red writing.

Powered by DoseWatch
global solution for patient dose tracking and optimization in medical imaging
*DoseWatch is a registered trademark of General Electric Company

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VCT 64	RPID17	2	5.1 General Chest max 2 series	19	4.37	7.99	10.00	-20.05 %	441.12	157.53

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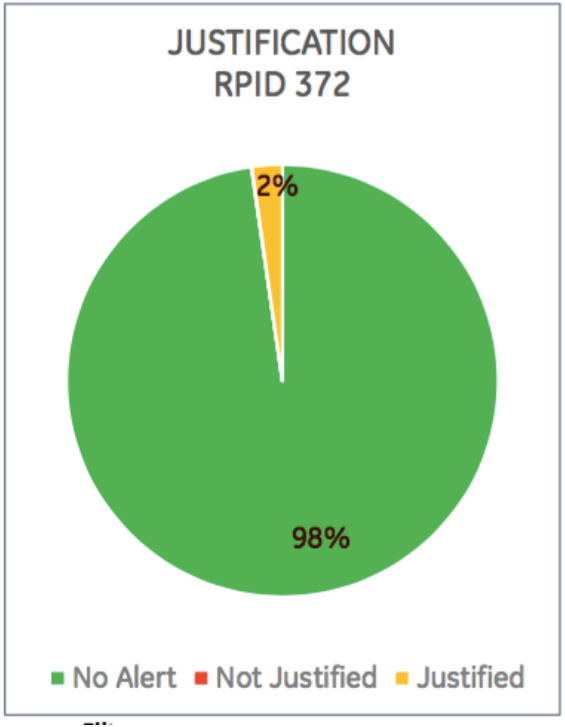
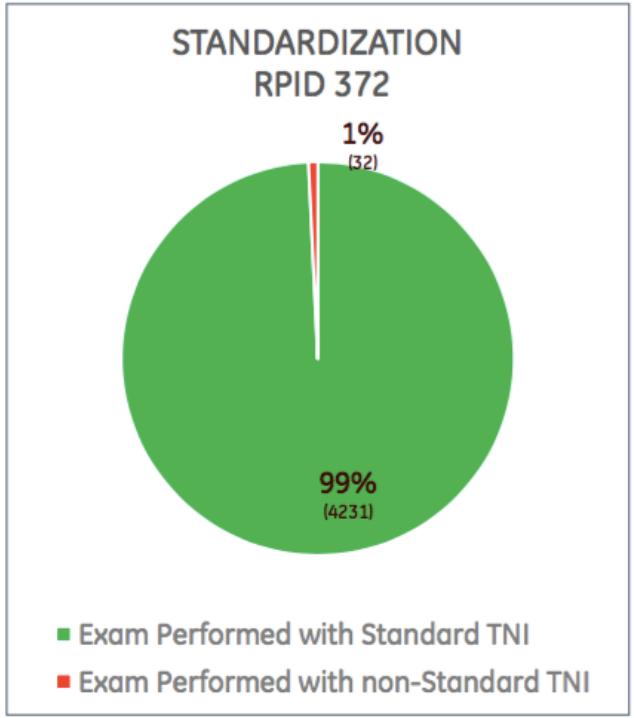
Consolidated data analysis example

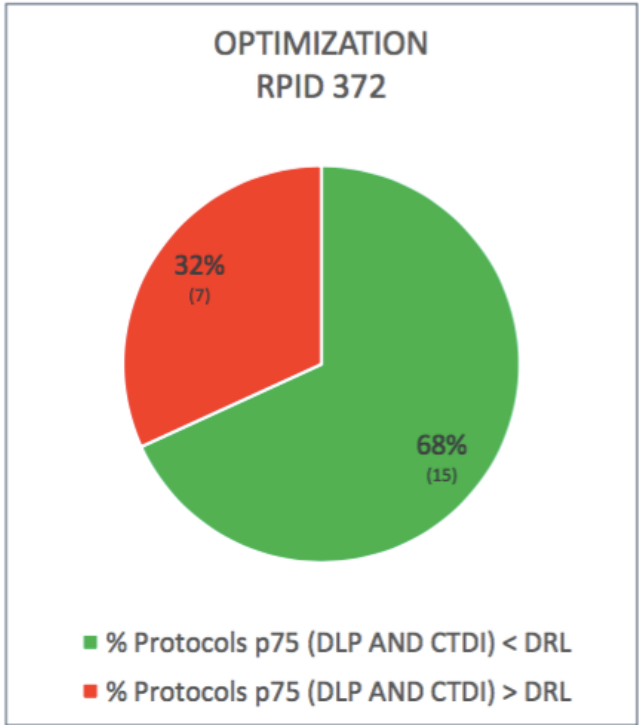
General Head incremental protocol – RPID 372

Data period	01/02/16 – 31/03/16
Number of countries	7
Number of CT departments	21
Number of CT models	13
Total number of examinations	4,275
Max accepted number of series	4
Median of most used number of series	1
Excluded protocols	< 20 examinations
Excluded series/examinations	Non diagnostic and tests

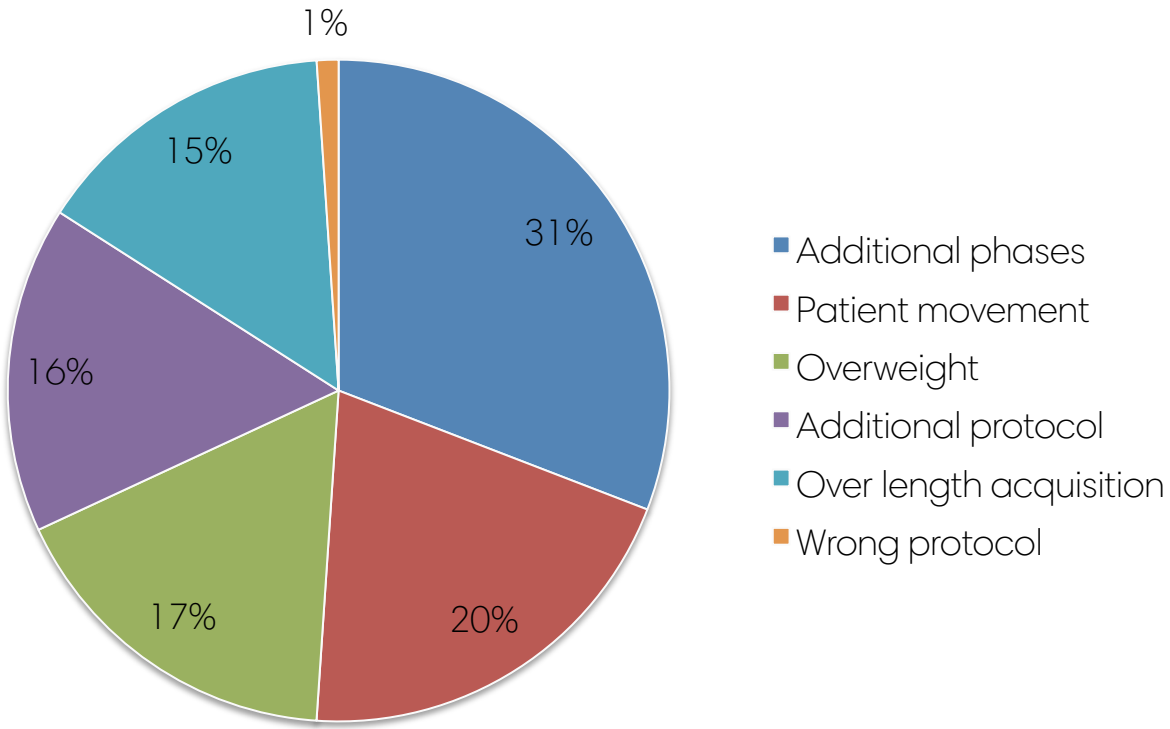
Dashboard



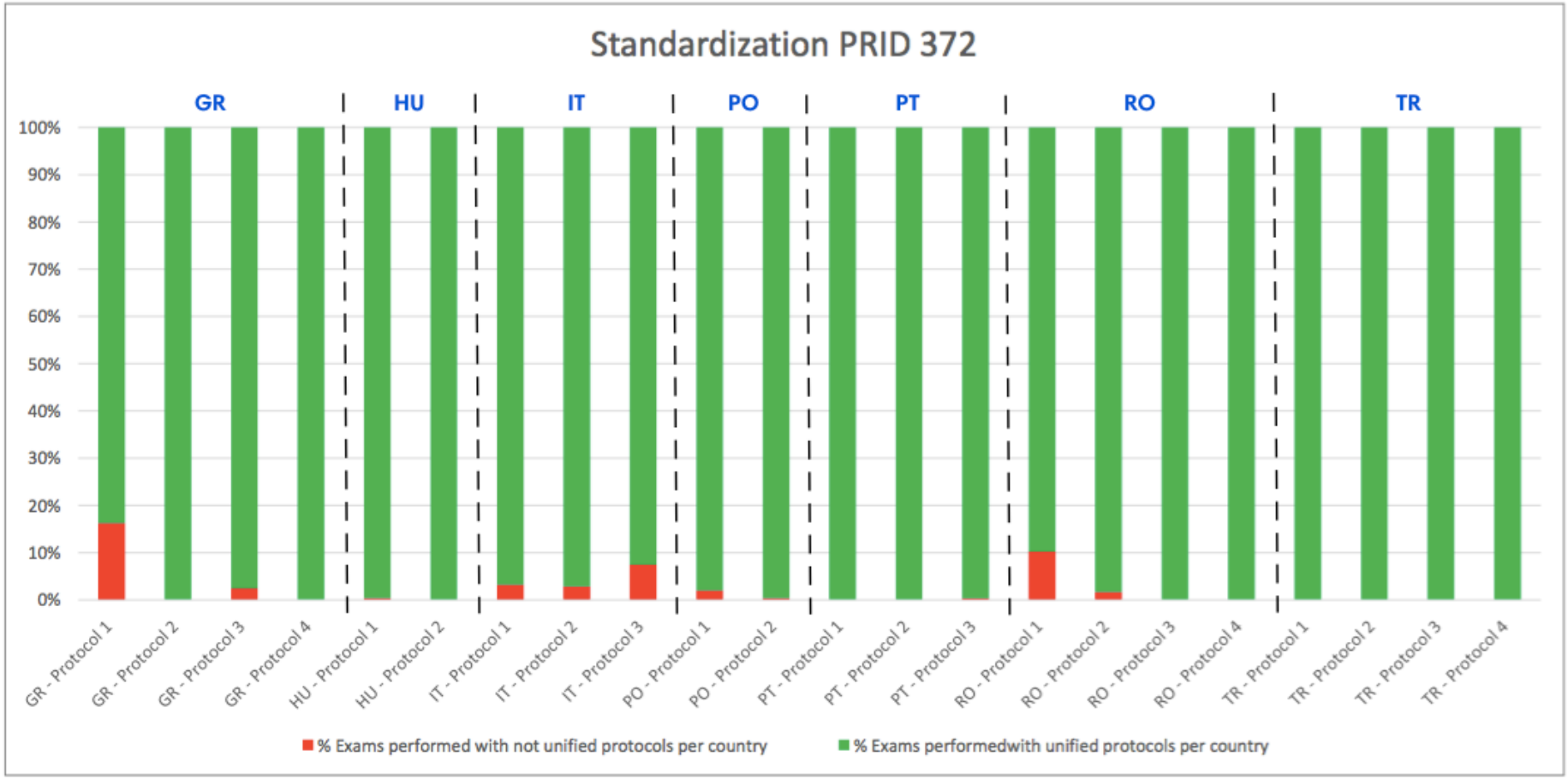




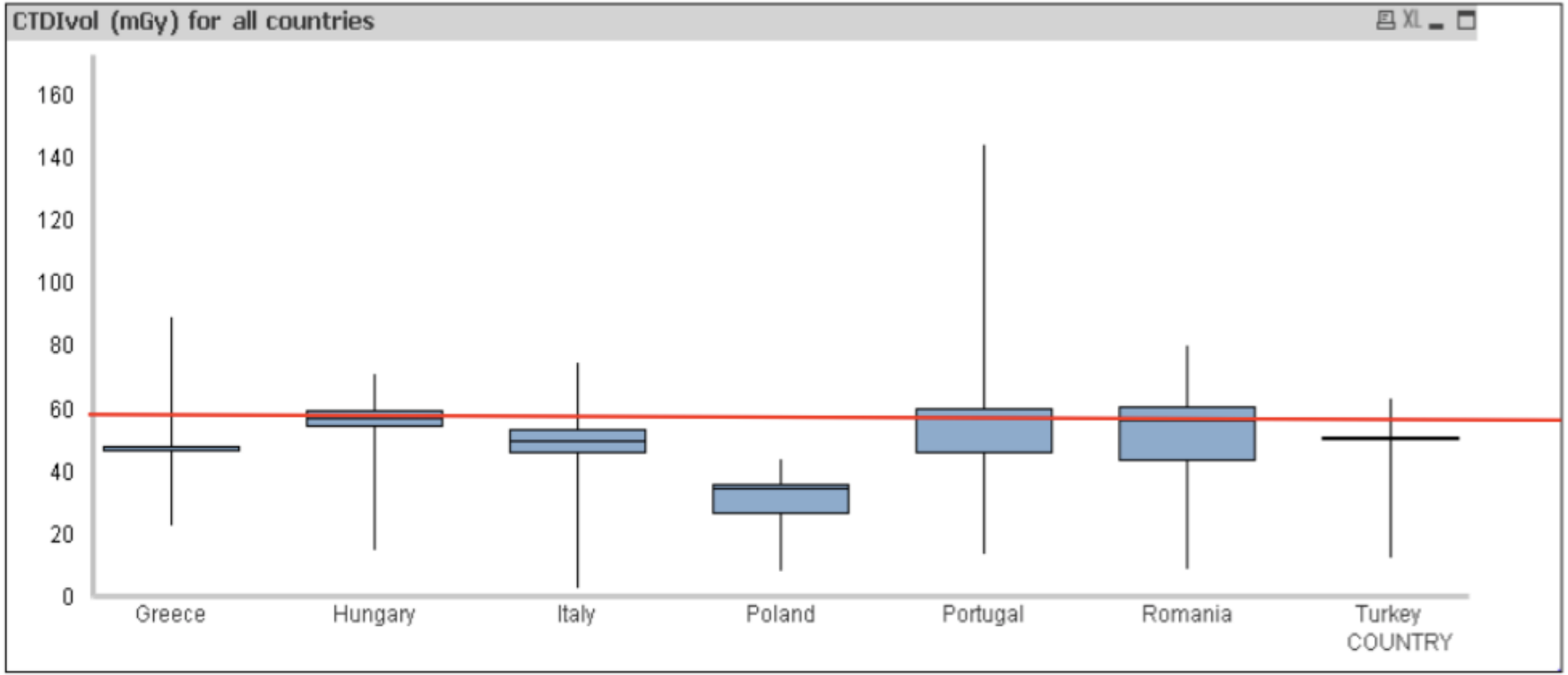
Alerts root – cause analysis



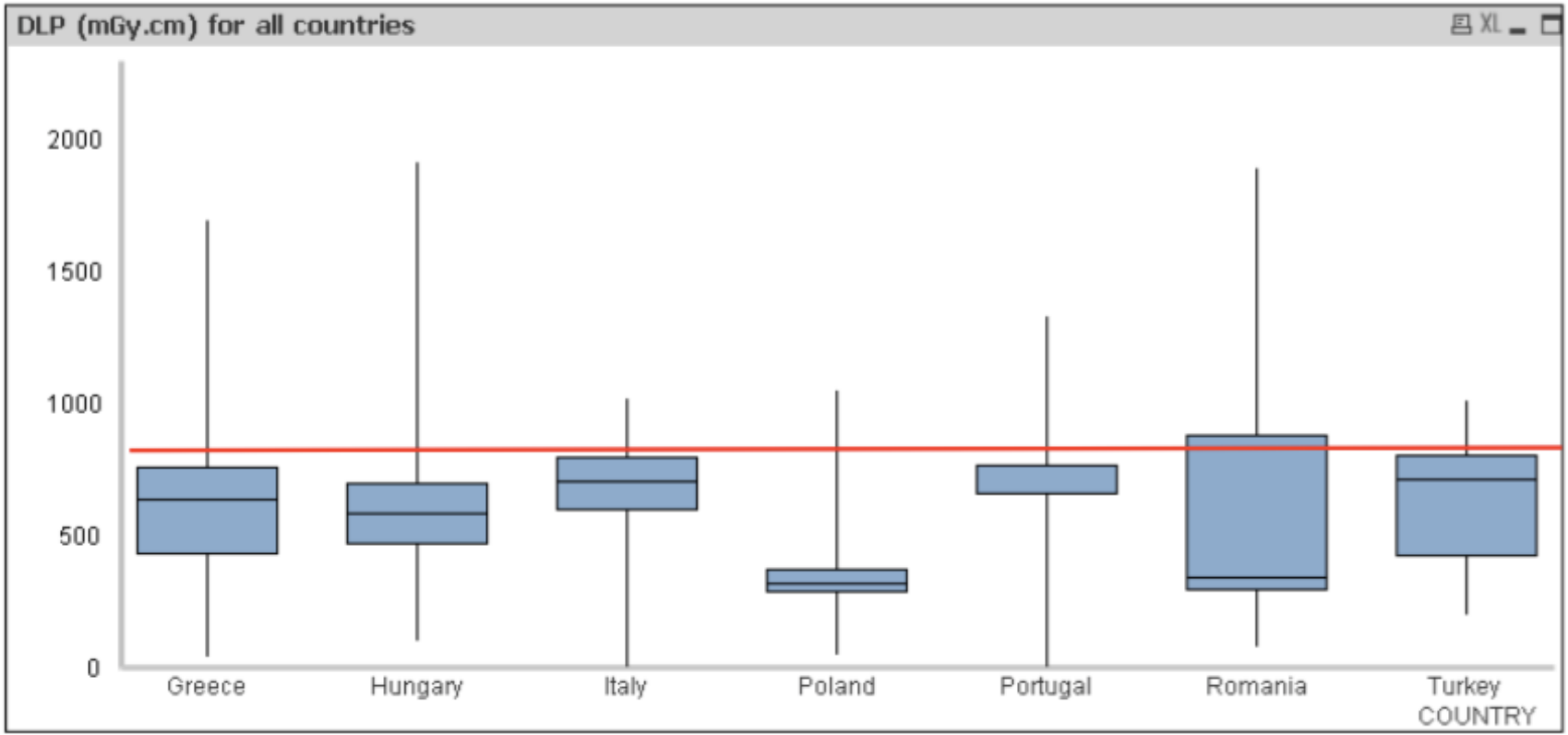
Standardization



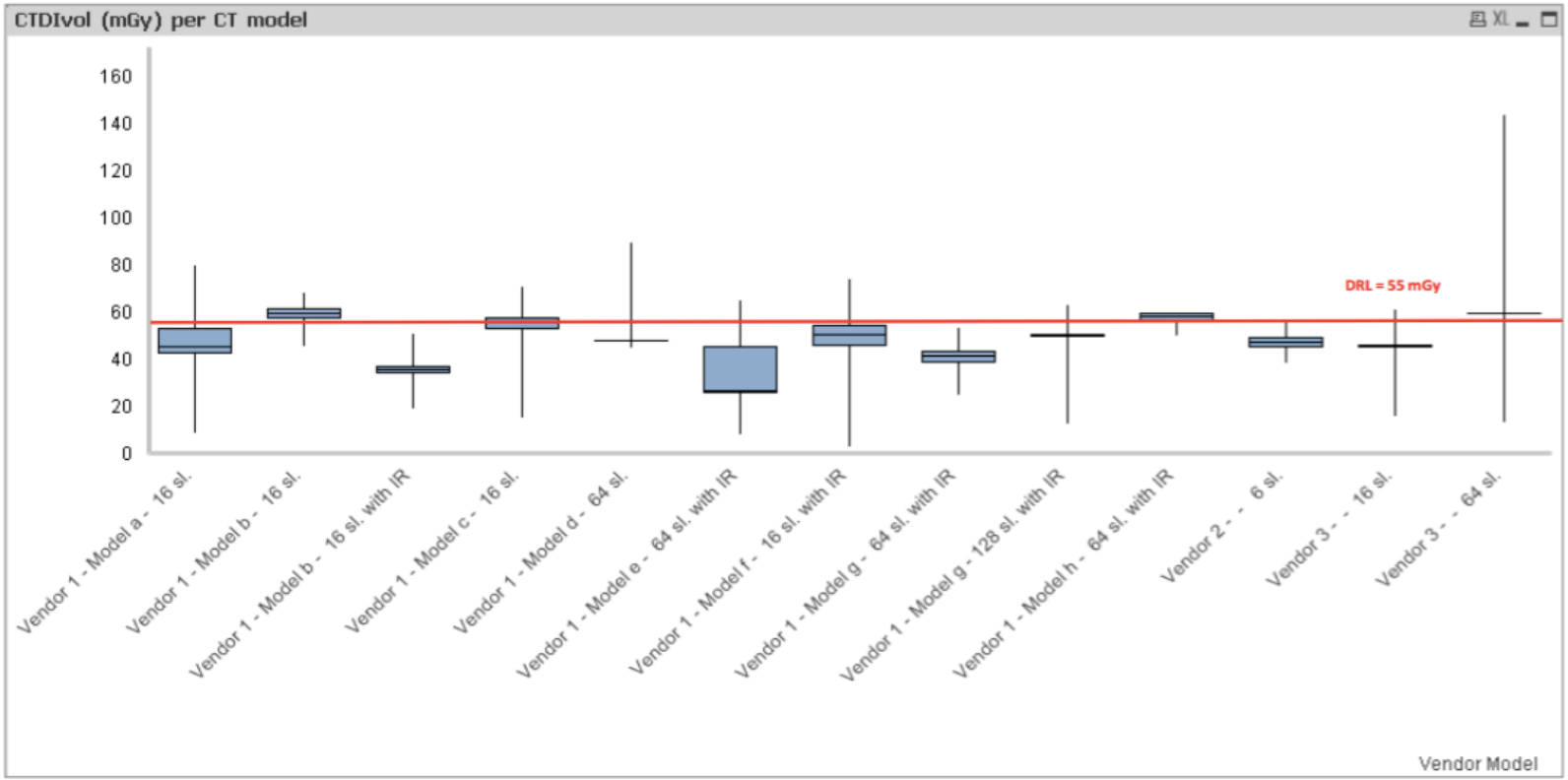
CTDIvol per county



DLP per country



CTDIvol per CT model



Challenges and tips

Challenges

- Resistance to change
- Fear of misdiagnosis
- Assessing image quality
- National Health System rules
- Unclear referral notes

Tips

- Choose your teams wisely and encourage collaboration
- Review your goals and reassess when required
- Do not make big changes, people need time to adjust
- Make sure your results are accurate before you implement changes
- Meet and communicate frequently
- Inspire, be enthusiastic and reward your teams for their work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