Verslag van het college van geneesheren
RADIOTHERAPIE-ONCOLOGIE
contract 1 januari 2011 – 31 december 2011

Rapport du collège de médecins
RADIOTHERAPIE- ONCOLOGIE
contrat 1 janvier 2011– 31 décembre 2011

Prof. Pierre Scalliet
Voorzitter-Président

Inhoudstafel

DEEL 1

WERKING VAN HET COLLEGE VAN RADIOTHERAPIE-ONCOLOGIE

A/ Inleiding

De commissie Peer Review voor Radiotherapie-oncologie werd, op initiatief van het Ministerie van Volksgezondheid, in 1995 opgericht en bestaat uit radiotherapeuten en fysici. De doelstelling van deze commissie is de kwaliteit van de bestralingsbehandelingen trachten te verbeteren door het organiseren van peer review activiteiten.
In mei 2000 werd het college van geneesheren radiotherapie geïnaugureerd.
In september 2000 werd overgegaan tot een formele integratie van het door het ministerie benoemde college enerzijds en de reeds sinds 1995 bestaande commissie Peer Review voor Radiotherapie-oncologie anderzijds.
In juli 2003 werd een nieuw college geïnstalleerd, na verschijnen in het staatsblad (KB 30-7-2003).
In 2006 werd opnieuw een nieuw college samengesteld (KB 15-12-2006), de samenstelling vindt u onder B/.

In **2011** verschillende projecten gewerkt:

1. **ALANINE DOSIMETRIE**
2. **Procare**
3. **Incident Report Systems**
4. **IMRT**
5. **Audits**

De stand van zaken van deze verschillende projecten vindt U in deel 2 van dit verslag.

In maart 2011 ging de jaarlijkse vergadering van het college en de diensthoofden van alle Belgische radiotherapie centra door. Op deze vergadering zijn ook de fysici aanwezig. Feedback werd gegeven over de uitgevoerde projecten, en de planning voor 2011-2012 werd voorgesteld en besproken.

B/ Samenstelling van het college van radiotherapeuten-oncologen

Leden van het college in de periode 2000-2003 (KB 10/6/1999):

Prof. P. Vanhoutte (voorzitter)
Dr. P. Huget (ondervoorzitter)
Prof. C. Weltens (contactpersoon en secretaris)
Dr. G. Demeestere
Dr. W. Deneve
Dr. D. Marchal
Prof. P. Scalliet
Dr. K. Vandeputte

Leden van het college in de periode 2003-2006 (KB 30/7/2003)

Dr. P. Huget (voorzitter)
Prof. P. Scalliet (ondervoorzitter)
Prof. C. Weltens (contactpersoon en secretaris)
Prof. J.M. Deneufbourg
Dr. D. Marchal
Dr. P. Spaas
Dr. K. Vandeputte
Dr. L. Vanuytsel

Huidige samenstelling van het college (KB 15/12/2006)

Prof. P. Scalliet (voorzitter)
Dr. P. Spaas (ondervoorzitter)
Prof. C. Weltens (contactpersoon en secretaris)
Dr. C. Mitine
Dr. K. Vandeputte
Dr. D. Van den Weyngaert
Dr. L. Vanuytsel († 30-8-2008)

Naast de door het ministerie aangestelde leden, wordt het college sinds zijn installatie vervoegd door experten (fysici, verpleegkundigen en radiotherapeuten).

In 2011 was de samenstelling van de commissie van experten is als volgt:

radiotherapeuten
Prof. P. Vanhoutte
Dr. J. Vanderick
Dr. P. Huget
Prof. Y. Lievens (voorzitter VBS)
Dr. P. Bulens (voorzitter BVRO)

physici
A. Rijnders
F. Vanneste
M. Van Dycke
Prof. D. Verellen
K. Feyen (voorzitter BVZF/BSPH)

verpleegkundigen
G. Vandevelde
P. Bijdekerke
S. D'Haese (voorzitter VVRO)

C/ Plenaire vergaderingen

Volgende plenaire vergaderingen werden gehouden in 2011:

DATUM
01-03-2011
31-05-2011
11-10-2011

De verslagen van bovenstaande vergaderingen zijn in dit jaarverslag geïncludeerd, u vindt ze op de volgende pagina's.

Minutes of the meeting of 01-03-2011

provisional report

Present:
College: P. Scalliet, C. Weltens, D. Van den Weyngaert, K. Vandeputte,
Experts radiation oncologists: J. Vanderick, P. Van Houtte, P. Huget
Experts phycisists: F. Vanneste, A. Rijnders, M. Van Dycke, D. Verellen
Invited:

1. K. Feyen for the BVZF
2. Guy Vandevelde, P. Bijdekerke for the VVRO

Apologized: Y. Lievens, P. Coucke, S. D'Haese, C. Mitine, P. Spaas

Approval of the minutes of the previous meeting
The minutes are approved.

Briefing BVRO and VBS
A possible fusion of BVRO/ABRO and VBS/GBS is for the moment under discussion. The financial and legal consequences are being studied.

Beldart
Measurement are on schedule. "Classical" RT treatments are measured, however IMRT and Tomotherapy treatments are not for currently not measured, but measurement techniques are under evaluation (for V-Mat, Rapid Arc, ...). Funding is a problem.

QMS

1. Incident Reporting System

1. This is not ACCIDENT reporting. ACCIDENT reporting has to be done (FANC), however the legal framework is not clear. P. Scalliet is investigating the European situation.
2. The PRISMA RT system is proposed for incident reporting. Funding for implementation in all radiotherapy departments is provided by the Cancer Plan.
3. The aim is to provide a tool for incident analysis within each department, however anonymised benchmarking on a national level is also possible (though not mandatory).

2. On Site Visits and Audits

4. Training of the auditors on 11-12 March
5. 5 teams will be trained
6. Each year 5 hospitals (5 radiotherapy departments) will be audited
7. 2011: Namur, Turnhout, Liege, Hasselt and Verviers
8. Departments will receive a report, no certification!
9. The individual reports belong to the college (auditors) and the department itself, they will not be made public, nor communicated to official bodies. It are confidential data, they are not dissiminated. A general report with (anonymised) general remarks will be made for the college.

Quality Indicator project
On hold for practical reasons: website failure

QA IMRT physics project
A new questionnaire is under development

Acquilab
successful project, more than 400 cases have been reviewed.

Brachytherapy Prostate Cancer
1.400.000 Euro has to be saved on the cost for prostate brachytherapy. This will be discussed with the VBS. This will also be discussed on the meeting of the heads of department. Marc Brosens and Yolande Lievens are involved in the discussions.

"Diensthoofdenvergadering"
The meeting of the college with the heads of departments is planned on March 18th.

Next Meeting:

31-5-2011, Arenberg, 19.00

C. Weltens 28-5-2011

Minutes of the meeting of 31-05-2011

provisional report

Present:
College: P. Scalliet, C. Weltens , K. Vandeputte, C. Mitine, P. Spaas
Experts radiation oncologists: J. Vanderick
Experts phycisists: F. Vanneste, A. Rijnders, M. Van Dycke, D. Verellen
Invited:

4. K. Feyen for the BVZF
5. Guy Vandevelde, P. Bijdekerke for the VVRO
6. Renaat Van den Broeck for the HUB

Apologized: P. Van Houtte, Y. Lievens, P. Coucke, S. D'Haese, D. Van den Weyngaert, P. Huget

Approval of the minutes of the previous meeting
Addition to point 2. The fusion of BVRO and VBS will not take place. The legal structure of the 2 organisations is not compatible.
Addition to point 4. Incident reporting: P. Scalliet has investigated the situation in European countries with respect to the declaration of accidents. Only in France this is mandatory. From other countries he did not receive an answer. In Belgium the situation remains unclear: on one hand you are never obliged to incriminate yourself, on the other hand if you do not declare this can be used against you.

Briefing BVRO and VBS
"staten general" : all machine suppliers were present

Beldart
Bob Schaeken will defend his thesis on June 28th, in the "promotiezaal of the VUB" in Etterbeek.
Future project: alanine dosimetry for tomotherapy treatments

QMS

1. Incident reporting system
   Since the funding for this system is directly given to the hospitals (not to the college), the radiotherapy departments have to decide how to proceed:
   1. The hospital has his own incident reporting system and the radiotherapy department uses this system
   2. The hospital has his own incident reporting system but the radiotherapy department prefers to use PRISMA
   3. The hospital has no incident reporting system and the radiotherapy department uses PRISMA
      PS will communicate this to the different radiotherapy departments.
2. On Site Visits: AUDITS
   The training of the auditors was successful completed in March 2011. Karen Feyen is the coordinator of the audits, and she will send the different presentations to the auditors.

Luxembourg also wants to be audited: will be planned (PS, GVDV, KV, KF, PB).
The audits will start in September 2011. The auditors will be divided into 5 groups of 3 auditors, each group will audit 1 hospital. In each group 1 experienced auditor will be responsible (PS, YL, SV, GVDV, MVD).
Luxembourg also wants to be audited: will be planned as first audit (PS, GVDV, KV, KF, PB).

IMRT questionnaire
A new questionnaire (MVD) is planned on the methodology and tolerances of IMRT.
The alanine phantom will be used to check IMRT treatments.

Prostate brachy
This project still exists, but only small numbers of patients are registered

Procare
This project runs well, 500 cases have been reviewed. An abstract was proposed on ESTRO

Formation of nurses and technologists:
Renaat Van den Broeck informes us on the actual situation of the formation of nurses (postgraduaat radiotherapie) and technologists in the HUB (Hogeschool Universiteit Brussel)

1. Postgraduaat radotherapie
   Each year about 12 students follow this postgraduate course in radiotherapy. 20 studypoints.
2. TMB = Technoloog Medische Beeldvorming
   In this training, students can choose for a specialization in radiotherapy (choose among nuclear medicine, CT, NMR, cardio and radiotherapy). This specialization takes 13 weeks.
3. BANABA oncological nurse
   Possibility is offered to include this 13 weeks of specialization in radiotherapy.

The attention is drawn to the fact that although TMBs are formed, they cannot officially operate in a radiotherapy department. The college fully understands the problem and agrees to support the the necessary changes in the law. The college suggests that the VVRO takes action which is then supported by the college/bvro/bvzf.

Joined meeting between VVRO-BVRO-BVZF should be planned in the spring of 2013, the annual meetings of the different societies should take place as usual not to interfere with the sponsoring of the different societies!

Weltens Caroline
02-06-2011

NEXT MEETING: 20 September 2011

Minutes of the meeting of 11-10-2011

provisional report

Present:
College: P. Scalliet, C. Weltens , K. Vandeputte, P. Spaas, D. Van den Weyngaert
Experts radiation oncologists: J. Vanderick, P. Van Houtte, P. Huget
Experts phycisists: F. Vanneste, A. Rijnders, M. Van Dycke, D. Verellen,
Invited:

7. K. Feyen for the BVZF
8. Guy Vandevelde for the VVRO
9. Renaat Van den Broeck for the HUB
10. Y. Lievens for the VBS
11. B. Schaeken for Beldart

Apologized: S. D'Haese, C. Mitine, P. Bijdekerke

Approval of the minutes of the previous meeting

Briefing BVRO and VBS

Beldart
Dosimetry in Belgian radiotherapy depts. And alanine dosimetry for tomotherapy treatments

QMS

- Incident reporting system
- On Site Visits: AUDITS

IMRT questionnaire
A new questionnaire (MVD) is planned on the methodology and tolerances of IMRT.
The alanine phantom will be used to check IMRT treatments.

Procare
This project runs well, 500 cases have been reviewed. An abstract was proposed on ESTRO

Weltens Caroline
23-1-2012

NEXT MEETING: January 2012

DEEL 2:

RESULTATEN

1. Alanine dosimetry of the radiotherapy machines in Belgium

Belgian Dosimetry Audits in Radiotherapy (BEL*d*ART): 2009-2011

Final Report of an external audit of basic dosimetry of radiation devices for external radiotherapy in Belgium

Members of the steering committee:
Alex Rijnders (College van Geneesheren), Francois Sergent (BVZF), Dirk Verellen (College van Geneesheren), Stefaan Vynckier (BVZF); NuTeC: Bob Schaeken ,Wouter Schroeyers,Sonja Schreurs, Robin Cuypers .

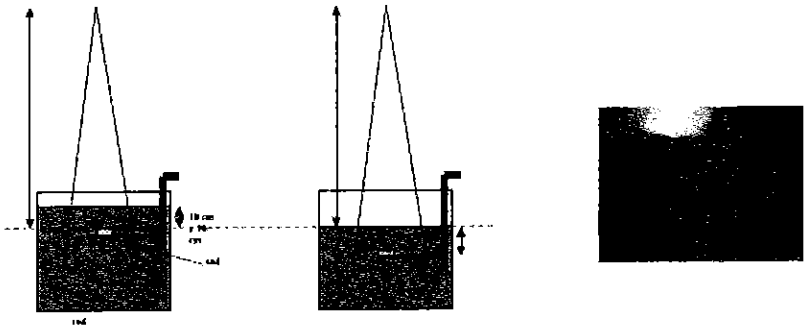
1. M & M's: measurement set up

"BELdART 2009-2011 : monitors beam dosimetry quality (basic parameters)

"Basic" mechanical check: isocentrum; lasers; telemeter; light field correspondence

"Basic" dosimetry check: dose measurements in water on beam axis at pre-defined depths

- photon beams: 11 dose measurements all types
- electron beams: 2 dose measurements in reference conditions



1. M & M's: Uncertainty budget (4 Harwell detectors; 5 rotations)

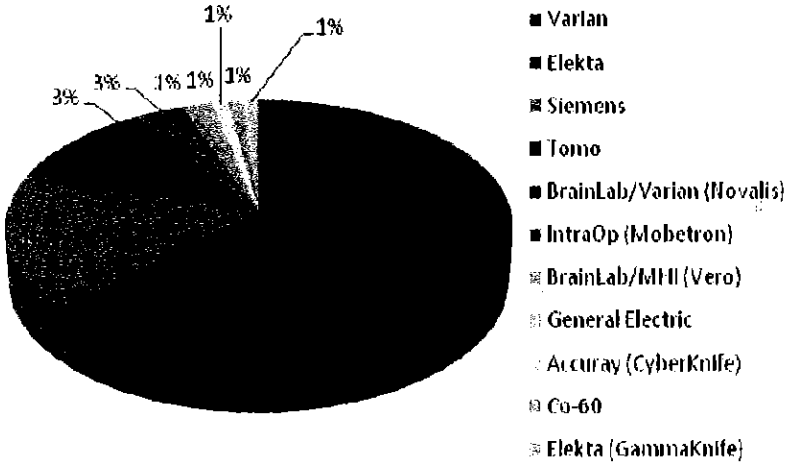
Base function detectors (25 Gy):	
Dose (primary standard)	*0.30%*
Amplitude: (A_D)	*0.12%*
Mass: (≈50µg)	*0.04%*
Field detector (4 Gy):	
Amplitude: (A_D; 30 mGy = worst case)	*0.75%*
Mass:(≈50µg)	*0.04%*
Experimental conditions:	
Fading:	*0.02%*
Irr. temp:	*0.03%*
Beam quality:	*0.27%*
Positioning	*0.04%*
Encapsulation	*0.50%*
Combined standard uncertainty	*1.00% : 4 Gy, 4 pellets in γ*
	2.04% : 4 Gy, 4 pellets in β

1. M & M's: Dosimetry audits: action levels

The relative deviation $|\delta| \equiv |(D_{measured} - D_{center}) \times 100 / D_{center}|$ is classified into four levels with respect to actions to be taken:

- **"within optimal level": $|\delta| \leq 3\%$ ➔ 3 σ !!**
- **Out of optimal level but "within tolerance level": $3\% < |\delta| \leq 5\%$**
- **"out of tolerance level": $5\% < |\delta| \leq 10\%$**
- **"alarm level": $|\delta| > 10\%$.**

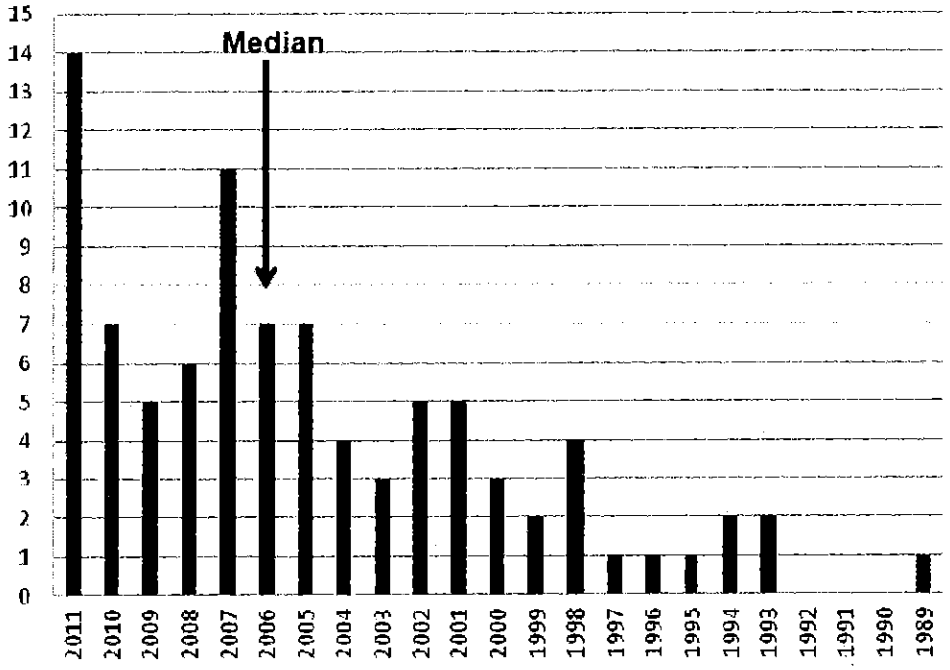
Status per Jan. 2012: number of clinical linacs in operation in Belgium



91 linacs, installed at 26 radiotherapy centres over 35 sites

74 "standard" linacs + 17 "dedicated"

Status per Jan. 2012: year of installation



Varian	23
Elekta	21
Siemens	14
BrainLab/MHI	1
General Electric	1
BrainLab/Varian	1
Total =	61

excl. 7 TomoTherapy,, 3 Mobetrons, 1 GammaKnife, 1 CyberKnife

3. Status of BELdART I (feb. 2009- sept. 2011) :

61 linacs: Varian: 22;
Siemens: 14;
Elekta: 22;
Novalis: 1;
BrainLabAB/MHI "Vero": 1;
General Electric: 1

Dosimetry was checked in

112 photon beams: 6x 4MV; 1x 5MV; 49x 6MV; 4x 10MV; 21x 15MV; 18x 18MV; 3x 23MV

110 electron beams: 3x 4MeV; 1x 5MeV; 25x 6MeV; 1x 7MeV; 7x 8MeV; 8x 9MeV; 10x 12MeV; 2x 14MeV; 11x 15MeV; 2x 16MeV; 14x 18MeV; 5x 20MeV; 1x 25MeV

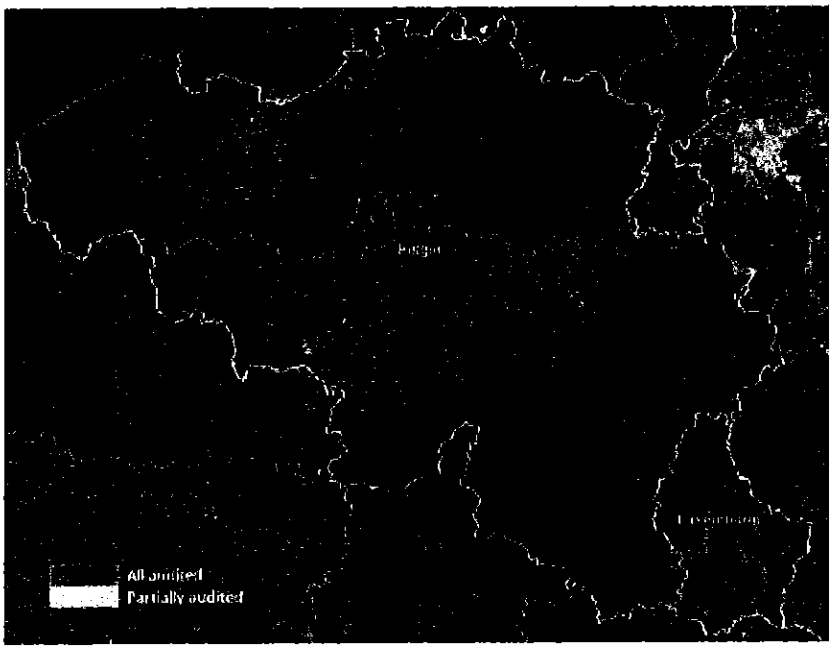
For 2nd run measurements in photon beams:

$D_{meas} / D_{stated} = 1.001 , \sigma = 0.014$ (#1342)
$D_{alanine} / D_{ionometry} = 1.003 , \sigma = 0.009$ (#192)

2. Results: survey on dose protocols and ionisation chambers

used protocols			ionisation chambers			periodicity chamber calibration		
photon beams			**photon beams**					
	#	%		#	%		#	%
NCS18(2008)	23	42	Nuclear Enterprise	18	33	within 2 y	10	33
NCS2(1986)	21	38	PTW	21	38	within 3 y	5	17
HPA(1985)	2	4	IBA	16	29	within 4 y	5	17
IAEA TRS 398(2000)	9	16				5 y	2	7
electron beams			**electron beams**			6 y	5	17
	#	%		#	%	7 y	3	10
NCS18(2008)	16	36	Nuclear Instruments	2	5			
NCS5(1989)	14	31	PTW	36	84			
IAEA TRS 398 (2000)	13	29	IBA	5	11			
IAEA TRS 381 (1987)	1	2						
TG-51	1	2						

2. Results: geographical dispersal



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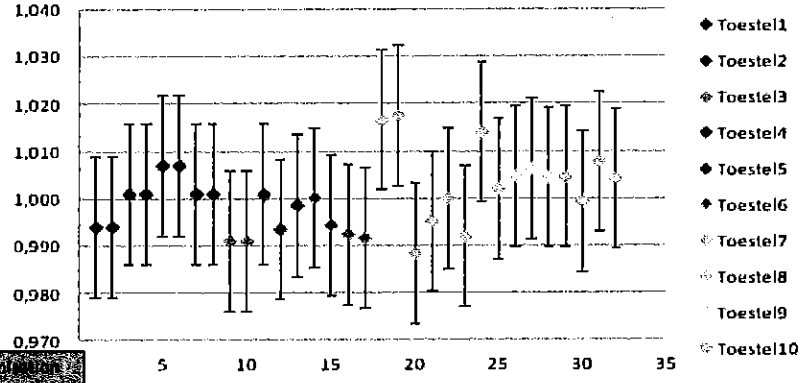
2. Results: Traceability in photon beams (BHP4): reference beams

$D_{w,\,alanine}/D_{w,\,ionisation\ chamber}$: ref beams



N =	28
mean =	1,000
σ =	0,008
range =	0,029

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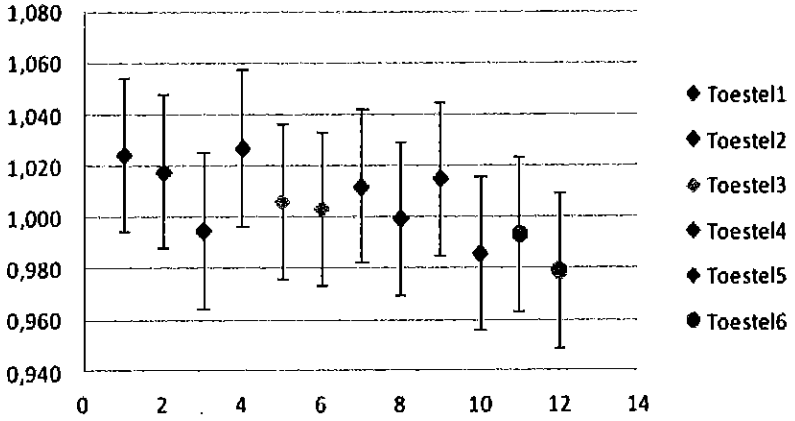
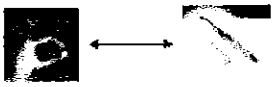
2. Results: Traceability in electron beams (BHPA): reference beams

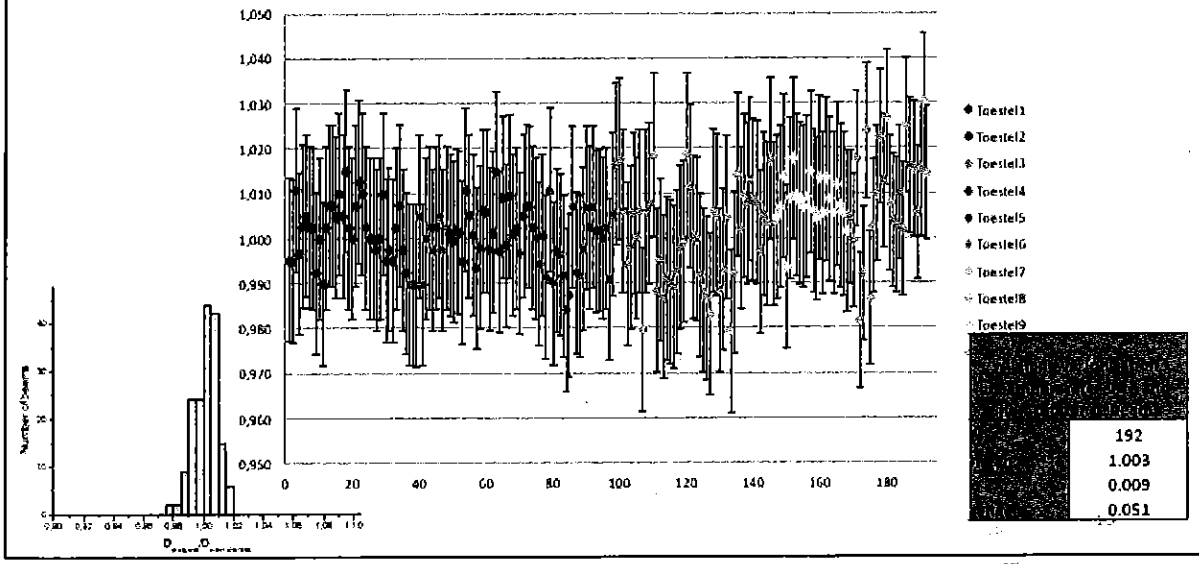
$D_{w,\,alanine}/D_{w,\,ionisation\ chamber}$



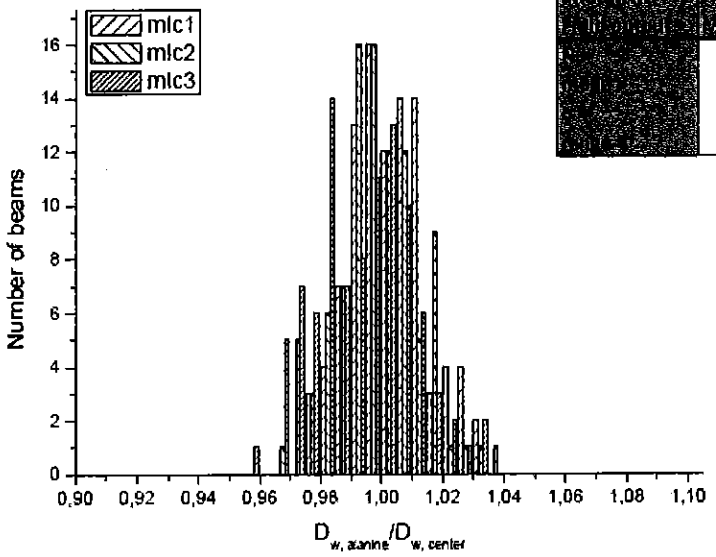
2. Results: Traceability in photon beams (BHPA): ref and non reference



$D_{w,\,alanine}/D_{w,\,ionisation\ chamber}$

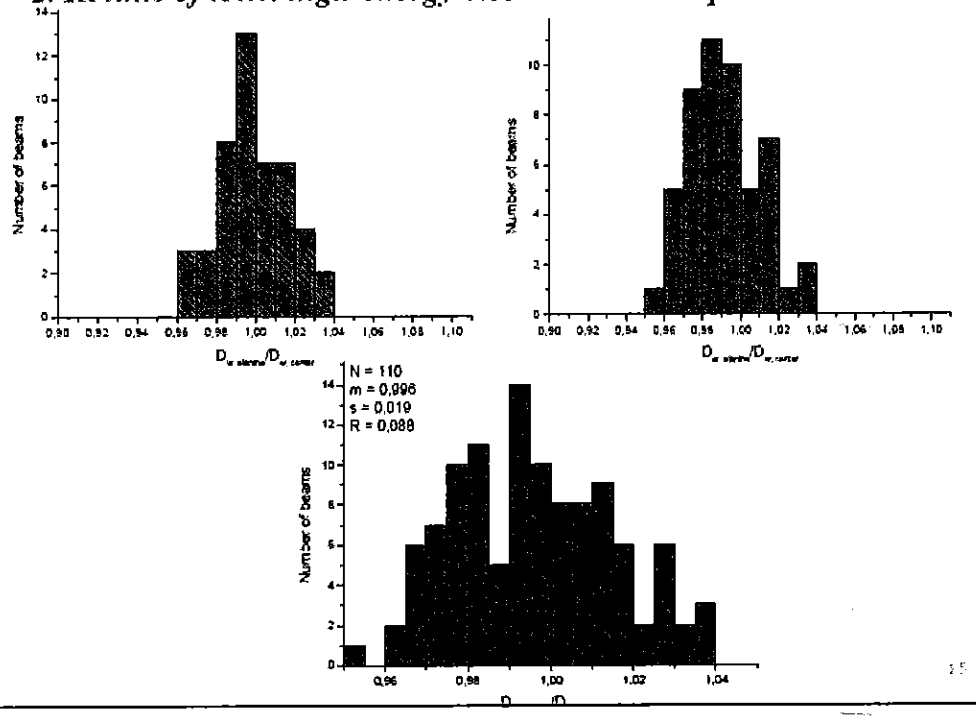


2. Results of tests: irregular field openings



	96	96	96
	1,003	0,999	0,994
	0,013	0,014	0,016
	0,058	0,070	0,075

2. Results of tests: high-energy electron beam output



2. Results of tests: summary (< Feb. 2012)

Tests & class of tests	# meas	mean $D_{measured}/D_{planned}$	1 s	Range	max	min	confidence limit Δ
All photon beams	1342	1.001	0.014	0.390	1.045	0.655	2.17
All low energy photon beams	728	1.000	0.014	0.090	1.045	0.955	2.10
All high energy photon beams	613	1.002	0.014	0.073	1.038	0.965	2.25
10x10@dref	112	1.001	0.012	0.056	1.030	0.974	1.81
10x10@dref Tray	53	1.000	0.012	0.059	1.032	0.973	1.76
10x10@10	102	1.002	0.012	0.056	1.030	0.974	1.90
10x10@20	108	1.002	0.014	0.074	1.036	0.962	2.37
10x10@10 Wedge	106	0.999	0.012	0.073	1.035	0.961	1.90
10x10@20 Wedge	106	1.002	0.018	0.090	1.045	0.955	2.85
6x6@8	112	1.005	0.012	0.051	1.028	0.977	2.27
8x20@8	106	1.002	0.012	0.074	1.040	0.966	2.04
20x8@8	106	1.003	0.013	0.063	1.037	0.974	2.19
20x20@8	110	1.001	0.014	0.076	1.035	0.959	2.13
mlc1@8	106	1.004	0.013	0.058	1.034	0.977	2.29
mlc2@8	106	1.000	0.014	0.070	1.037	0.967	2.12
mlc3@8	106	0.995	0.016	0.075	1.033	0.957	2.89
All mlc measurements	318	1.000	0.015	0.080	1.037	0.957	2.24
All open field measurements	757	1.002	0.013	0.084	1.040	0.956	2.12
All wedged measurements	212	1.001	0.015	0.090	1.045	0.955	2.36
QI	115	0.999	0.010	0.054	1.021	0.967	
All electron beams	110	0.996	0.019	0.088	1.038	0.950	3.27
All low energy electron beams	52	1.000	0.018	0.074	1.037	0.963	2.75
All high energy electron beams	58	0.993	0.020	0.088	1.038	0.950	3.69

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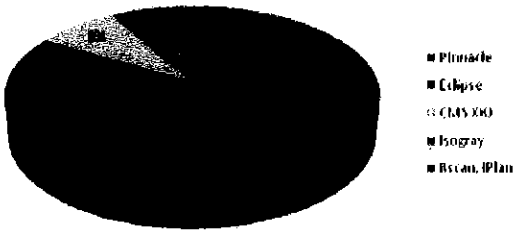
2. Results: summary (< Feb. 2012)

Ref.	period	system	beam energy	D_{meas}/D_{reqire}	1s	# meas	remarks
Joh86	< 1985	Farmer/ NACP	^{60}Co	1.001	0.019	59	ref cond
			^{60}Co	0.999	0.021	51	non ref cond
			MV	1.025	0.029	62	sealed IC
			MeV	0.995	0.017	59	scatter filter
Ize00	1969-1998	TLD	all photon beams	1.013	0.088	3307	
Fer00	1998	TLD	all photon beams	0.994	0.021	235	ref cond
				1.001	*0.014*	*1342*	
			QI	0.996	0.015	217	
				0.999	*0.010*	*115*	
			coll opening	1.003	0.018	642	regular field size
				1.002	*0.013*	*757*	
			wedged beams	1.006	0.130	208	regular field size
				1.001	*0.015*	*212*	
			wedge transmission	1.007	0.100	405	
Bla02	1993	Farmer/pp	all photon beams	1.001	0.007	10	In phantom/ regional
			all electron beams	1.004	0.014	34	in phantom/ regional
Kro03	1997-2001	TLD	all photon beams	0.996	0.028	362	incl off axis/ national
			wedged beams	1.000	0.027	122	incl off axis/ national

2. Results: treatment planning systems used

deviations ≈ ? TPS used ... (RPC -2010)



TPS	Number
Pinnacle	27
Eclipse	24
CMS XiO	5
Isogray	3
Bscan, iPlan	2

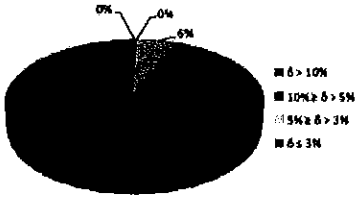
not in our case... (BELdART)

2. Results: of mechanical tests

Test	Number Checked	Acceptable	Small Deviation	Large Deviation
Validation of the isocentre	61	60	1	0
Validation of the optical distance indicator	59*	59	0	0
Validation of the position of the laser lines	60**	60	0	0
Correspondence of light and irradiation field	61	60	0	1

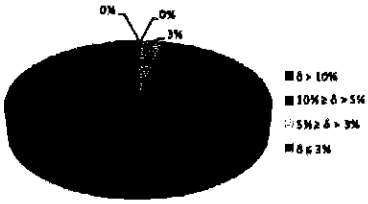
2. Results: all photon beams

1st run measurements



	1	0,1
	4	0,3
	80	5,9
	1270	93,7

2nd run measurements

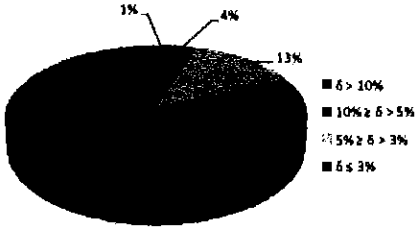


	0	0,0
	0	0,0
	44	3,3
	1296	96,7

20

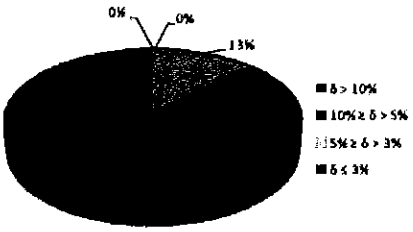
2. Results: all electron beams

1st run measurements



	1	1,0
	4	4,1
	13	13,3
	80	81,6

2nd run measurements



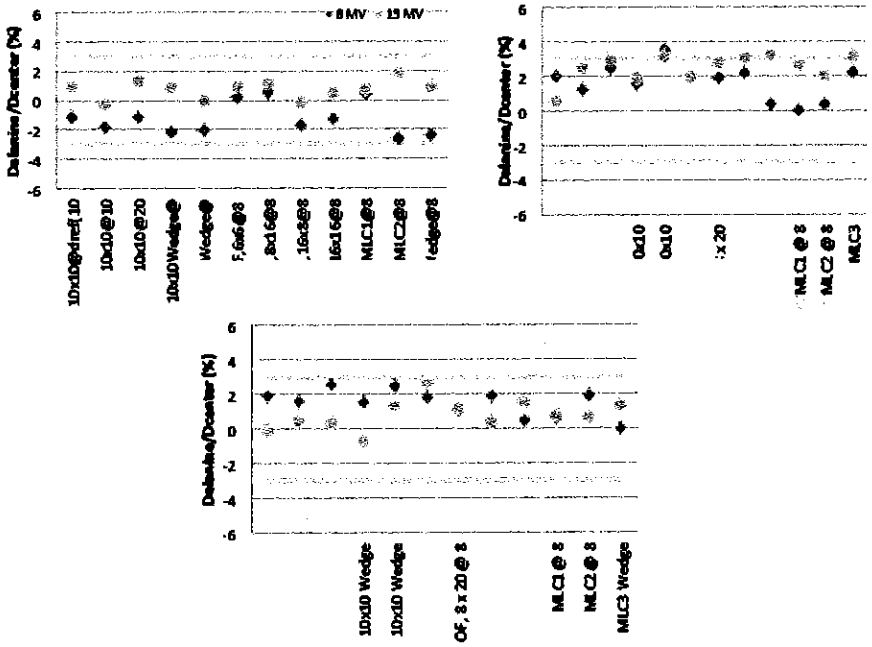
	0	0,0
	0	0,0
	14	12,7
	96	87,3

21

6. casus: auditing all clinical beams

0.78	0.81	-0.11	0.37	-1.26	-0.13	0.44	1.73	0.28	0.11	1.86	1.34	0.20	Toestel 1 (4MV)
-0.04	-0.04	-0.11	-0.07	-0.65	0.94	1.55	-0.81	-0.16	0.34	0.84	-0.15	-0.45	Toestel 2 (6MV)
-1.39	-1.07	-2.29	-0.82	-1.03	-0.07	-1.62	-0.97	-0.97	-1.93	-0.46	-1.21	-0.45	Toestel 2 (15MV)
-1.64	-1.01	-1.27	-0.21	-2.40	0.00	-0.42	-1.41	-0.86	-3.18	1.10	-3.25	-1.73	Toestel 3 (6MV)
-0.36	-0.95	-0.36	-0.34	-1.08	-1.40	-0.72	0.05	-0.03	-0.21	0.93	-0.47	-2.03	Toestel 3 (18MV)
-1.71		-2.86	-2.87	-2.22	-2.52	-2.71	-3.31	-2.84	-2.67	-1.24	-2.69	-3.48	Toestel 4 (6MV)
-3.08		-2.92	-2.76	-2.94	-2.01	-3.07	-3.68	-3.10	-3.83	-3.39	-4.12	-3.38	Toestel 5 (15MV)
-0.79		-0.16	0.79	0.19	0.55	-2.38	0.62	0.10	-0.44	0.65	-0.95	-1.78	Toestel 6 (6MV)
-1.87		-2.33	-2.17	-1.99	-1.02	-2.10	-1.21	-0.76	-1.58	-1.62	-2.87	-1.80	Toestel 7 (15MV)
0.52		0.50	1.60	-0.58	-0.48	2.15	0.20	0.30	1.57	-0.72	-0.01	-3.25	Toestel 8 (6MV)
-2.60		-2.60	-3.80	-1.10	-3.60	-0.50	-1.10	-0.60	-0.40	0.50	-0.80	-0.50	Toestel 13 (6MV)
						0.49							(6MV)
2.96	2.77	2.52	2.41	-1.08	-4.23	2.03	4.02	3.31	1.64	3.44	1.61	-2.62	(6MV)
1.62	1.96	1.48	0.93	-1.19	-3.18	2.81	3.80	3.66	3.49	2.31	0.47	-0.90	(15MV)
1.47	1.40	0.37	0.39	-3.87	-1.46	2.76	1.93	2.26	2.18	3.13	0.73	-2.96	(6MV)
2.02	3.17	2.95	3.52	-1.21	-2.46	2.74	1.56	2.47	2.80	2.76	1.89	-3.15	(15MV)

6. casus: one centre, 4 locations:



3. ***Discussion:*** **what is the *confidence* we may have in standard dose deliveries ?**

… to judge specific performance with only *ONE* parameter (Venselaar R&O, 2002):

confidence limit Δ = (|% devl + 1.5 sd)

Δ= 3%: if gaussian, ≈94% of all measurements are within ± 3%; ≈ 6% of all individual measurements fall outside this bandwidth (one-sided confidence probability p= 0.065)

→ **BEL*d*ART offers an estimation of the underlimit of Δ**

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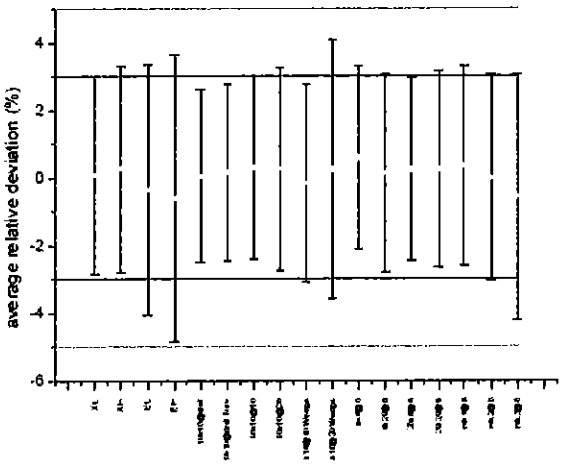
3. Discussion: confidence limit for standard beam axis dose calc. (BELdART)



	Δ (%)
X Low	2.3
X High	2.6
E Low	3.1
E High	3.8
10x10@dref	2.0
10x10@dref Tray	2.1
10x10@10	2.3
10x10@20	2.5
10x10@10 Wedge	2.4
10x10@20 Wedge	3.1
6x6@8	2.6
8x20@8	2.3
20x8@8	2.3
20x20@8	2.4
MLC1@8	2.6
MLC2@8	2.3
MLC3@8	3.3
	2.5

BELdART : Δ = 2.5%

for a single dept.: … TPS "standard" beams : 2.4% (large asymm) < Δ < 4.0% (asymmetric, missing tissue, inhomogeneity, oblique)

4. conclusions for BELdART-1:

- *alanine/EPR was successfully used as transfer dosimetry system in auditing*
  proven methodology
  the "PTB system" is robust, transferrable and stable in the long run

  > 15.000 alanine pellets ware read out !
  13.000 km travelled between 34 locations

- *allows sufficient accurate dose measurements*

- *results into accordance with independent (reference) ionometry*

- *beam (axis) data are well modeled in TPS for the visited centers*

But...

Out of tolerance situations disappear in a 2nd run, a clear explanation is difficult to find...

Aim of BEL*d*ART-2:

-offering proven technology/ methodology ...
-highly accurate dose measurements in RT
-maintaining expertise and "drive" in the present auditing-work

What BEL*d*ART-2 will do:

- BEL*d*ART^{Basic}: continuation of beam dosimetry auditing

-BEL*d*ART^{Treatment} : end-to-end testing of class specific treatments

"what you see is what you get" ?

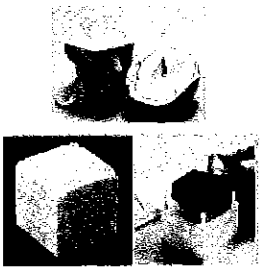
the BEL*d*ART-2 project remains supervised by effective members of the BHPA on behalf of BHPA and CvGR-CdMR!

How will BEL*d*ART-2 proceed:

BEL*d*ART^{Basic} :

- as BELdART-1 with reduced # tests
- mailed audit, no visitation

BEL*d*ART^{Treatment} : IMRT verifications



- alanine/EMR + EBT2/3 film dosimetry
- we start with intra cranial IMRT treatment
- mailed audit, no visitation

creation/ elaboration of a Belgian Film Dosimetry WG with BHPA

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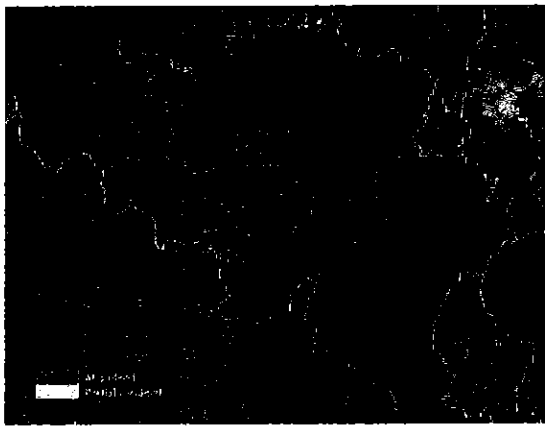
Status per Jan. 2012: 91linacs in operation in Belgium



within BEL*d*ART-1: *208 beams audited ≈ 61 linacs*

still 30 linacs need an audit

incl. 7 TomoTherapy,, 3 Mobetrons, 1 GammaKnife, 1 CyberKnife

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Output of BEL*d*ART-2:

-further auditing as usual of "new" linacs (mailed; BEL*d*ART^{Basic})

-auditing for Tomo, Mobetron, GammaKnife (and CyberKnife)

-evidence based determination on a national scale of tolerance levels for BEL*d*ART^{Treatment}

-IMRT auditing by end-to-end testing (mailed; BEL*d*ART^{Treatment})

(irradiate phantom as patient)

-auditing Ir-HDR treatments

-offering a platform of expertise for dosimetry to BHPA members and encouraging discussion in therapy-dosimetry

2. Procare

Prof. Dr. K. Haustermans

Improving rectal cancer care in Belgium by standardizing CTV delineation

The PROCARE RT project

Introduction

- Current status
- Review procedure
- Analysis of results
- Conclusion

- Current status
- Review procedure
- Analysis of results
- Conclusion

Brief history

- 2009 Nov – first Aquilab installation
- 2010 March – start of the review with 3 centers
- 2010 April – launch of the official test
- 2010 May – full operation between 10 centers
- 2011 March – 18 centers participating
- 2011 July – 20 centers participating

Clinical guidance

- 2010 March – a CD distributed
  - Procare guidelines
  - A CTV delineation atlas
  - The ESTRO teaching course presentation
  - An OAR delineation atlas
  - The manuscript on CTV delineation

Clinical guidance

- Guidelines for CTV delineation peer reviewed and published
  - A common solution to all
- Guidelines for OAR reviewed by abdominal radiologist (F. Claus)
- Eszter Hortobagyi trained by UZL and half time appointed to Procare project

Delineation guidelines

doi:10.1016/j.ijrobp.2009.02.090

CLINICAL INVESTIGATION Rectum

DEFINITION AND DELINEATION OF THE CLINICAL TARGET VOLUME FOR RECTAL CANCER

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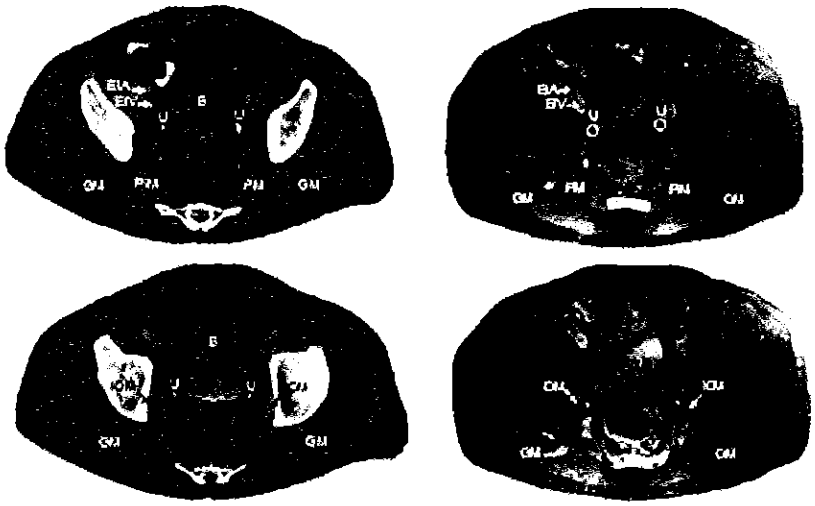
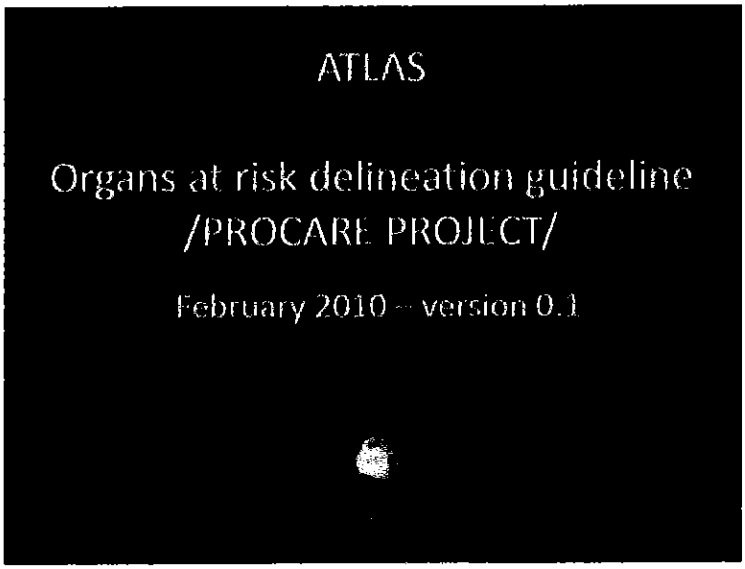
*Department of Radiotherapy, †Surgery, and ‡Radiology, University Hospital Gasthuisberg, Leuven, Belgium; and §Department of Radiotherapy, Ghent University Hospital, Ghent, Belgium

Delineation guidelines



Delineation guidelines for OAR

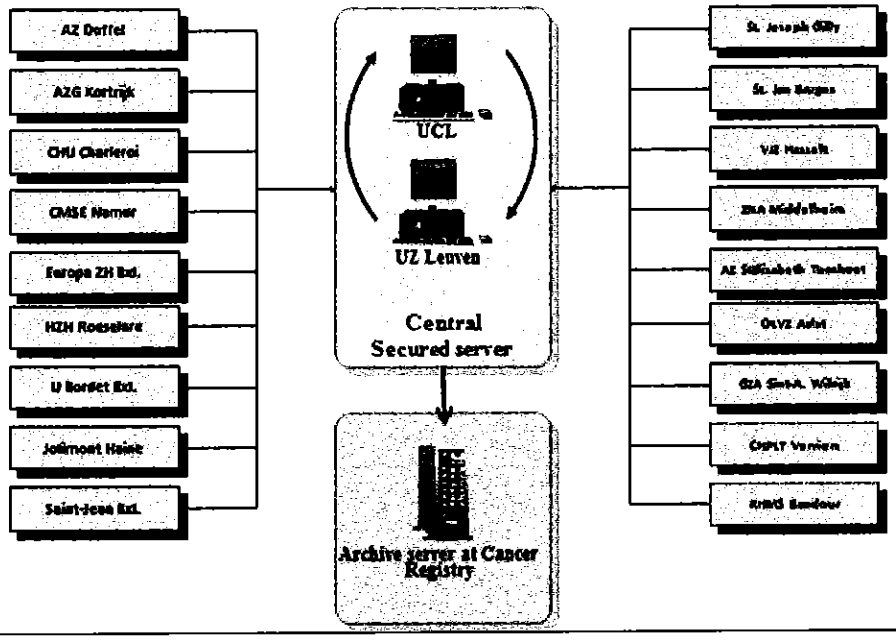


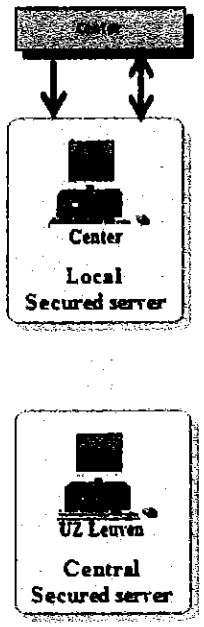
Current situation

- 21 centers agreed to participate in the QA Procare network with Aquilab as platform
- 20 centers have their license installed
- 20 centers have been connected to the network /submitted at least one case/

- Current status
- **Review procedure**
- Analysis of results
- Conclusion

Structure of the system





Review procedure

I.	**Submission**
1.	Uploading the CT, RT Structure to local Secured Server
2.	Email to procare@uzleuven.be - Notification - Providing clinical information
II.	**Review**
1.	Transferring data from local to central Secured Server
2.	Reviewing the Case in Aquilab
3.	Modified RT Structure uploaded to Centre's local Secured Server
4.	Email to centre - Explanation of modifications
III.	**Feedback on used CTV**
1.	Downloading the modified CTV
2.	Email to procare@uzleuven.be - About used CTV
3.	Uploading used RTStructure

Required information

- Name of the sender hospital
- Identification of the patient
- National registration number -/INSZ-NISS/
- TNM Staging
- Localization of the tumor
- Name of the hospital where the surgery or chemotherapy is planned
- Any further comment

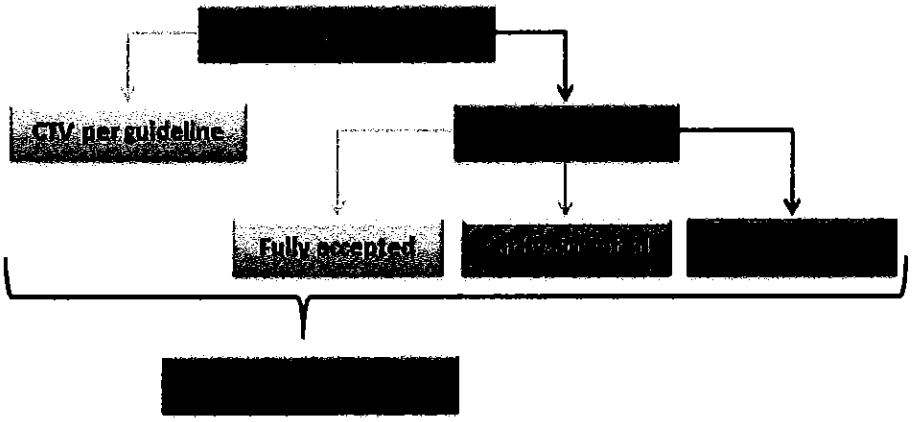
Agreement

- Contours are reviewed within 24 hours
- Modified CTV structures are sent back as "CTV-mod"
- It is not mandatory to implement the modifications!
- Please send back "CTV-used"

Agreement

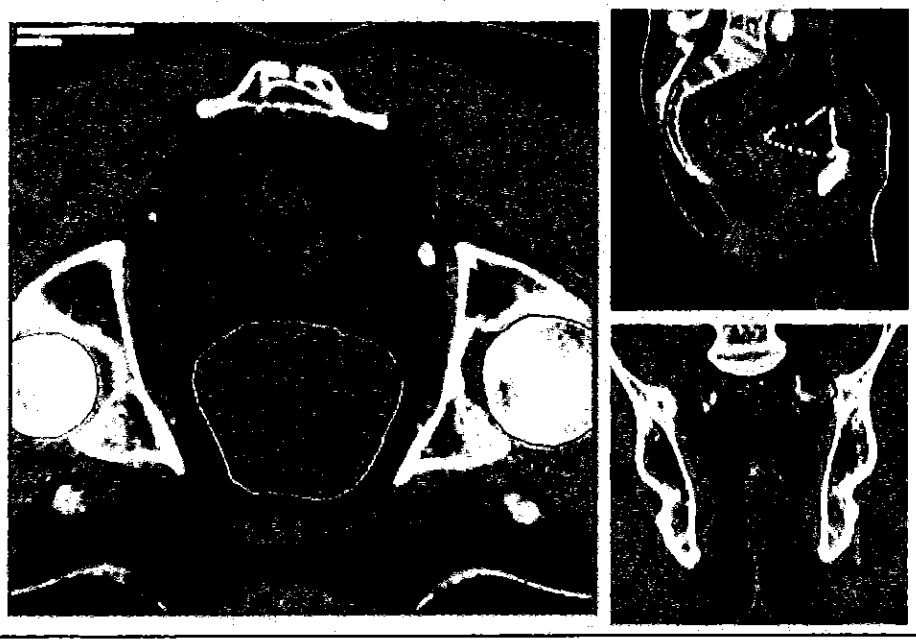
- Delineation of OAR is not required but highly recommended
- UZ Leuven is checked by UCL and vice versa
- The final database will be archived at the Cancer Registry using national registration number-NISZ/INSS

Review outcome

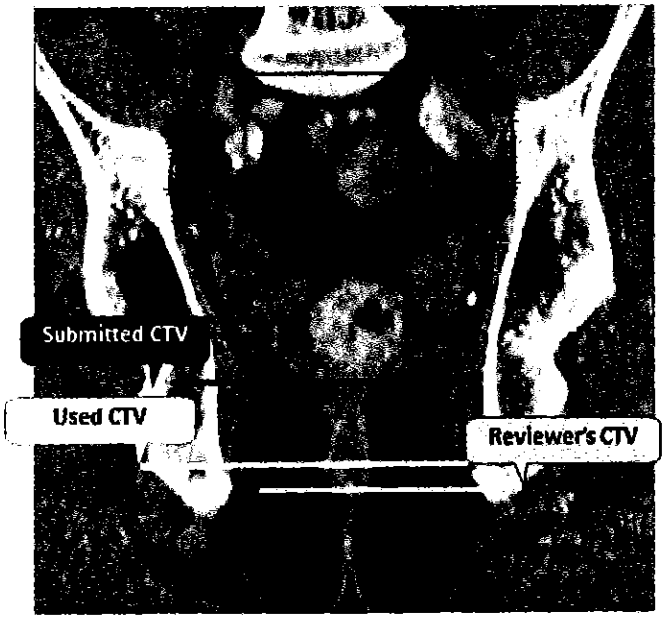


Storing the Used CTV is important to properly assess treatment outcome

CTV 'Mod'



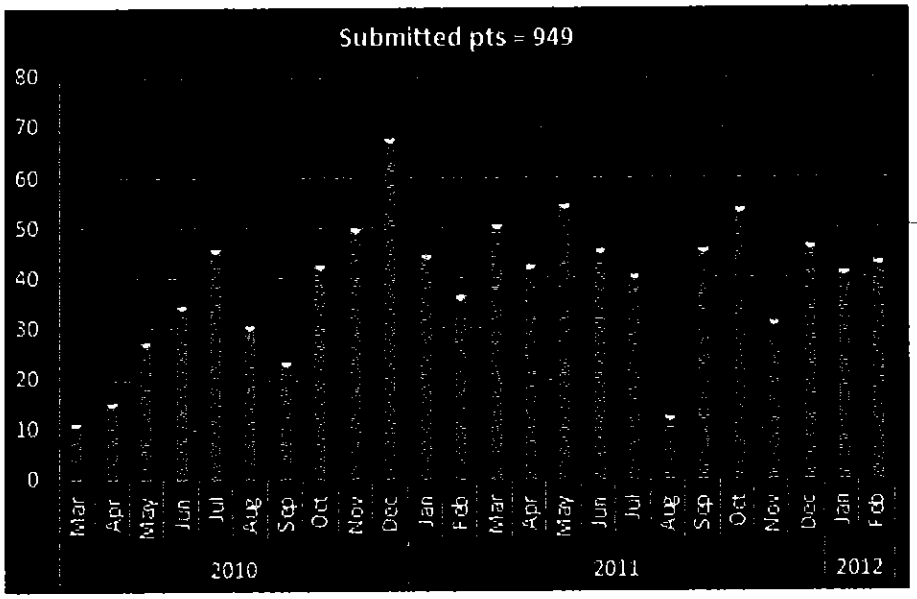
Feedback-CTV 'Used'



Cases submitted (as of 29-02-2012)

	2010												2011												2012		Grand Total
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb		
Center 1	0	0	4	4	1	3	2	2	3	1	3	3	1	1	2	3	3	0	4	3	3	4	4	1		52
Center 2	0	0	7	4	3	1	3	0	2	3	1	3	4	3	3	3	4	2	3	7	0	8	3	6		77
Center 3	0	0	0	4	3	3	0	3	4	6	3	0	3	1	1	1	1	0	0	1	1	0	0	0		37
Center 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0		4
Center 5	0	0	0	0	0	0	0	0	0	0	0	1	4	1	0	0	0	0	2	0	1	0	0	0		10
Center 6	2	2	3	4	1	3	3	2	4	7	3	4	5	2	3	7	4	2	4	4	4	4	3	4		83
Center 7	0	0	0	0	0	1	0	0	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0		12
Center 8	0	0	0	0	0	3	1	3	1	1	1	4	4	4	3	3	1	0	1	1	0	4	1	7		56
Center 9	0	0	1	1	1	1	1	0	1	4	1	1	4	2	2	3	3	0	0	1	0	0	1	1		43
Center 10	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	1	0	0	1	0	0	0	1		15
Center 11	0	0	0	4	1	0	1	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		18
Center 12	0	0	0	1	0	1	1	1	5	7	4	1	4	4	1	1	1	0	1	4	4	4	4	4		72
Center 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	1	1		10
Center 14	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0		6
Center 15	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1		34
Center 16	0	0	0	0	0	0	0	0	0	0	4	1	1	4	3	3	4	1	4	1	1	3	4	2		44
Center 17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		65
Center 18	1	10	1	0	14	1	1	1	1	12	1	4	1	10	7	7	6	0	11	1	1	11	10	1		180
Center 19	0	0	0	0	0	0	1	1	1	1	1	1	1	2	3	3	4	0	4	1	1	1	1	1		73
Center 20	0	1	1	0	4	1	1	1	1	4	1	0	0	1	4	4	1	0	1	0	0	0	1	4		48
Total	12	16	28	35	46	31	24	43	30	68	43	37	51	43	33	46	41	13	46	34	32	47	42	44		

Cases submitted (as of 29-02-2012)



Localisation (as of 29-02-2012)

Low	416	43.8%
Low-Med	52	5.5%
Low-High	4	0.4%
Med	246	25.9%
Med-High	51	5.4%
High	171	18.0%
Not provided	9	0.9%

Modifications (as of 29-02-2012)

	Cases submitted	nr. of modified	% modified
Center 1	62	58	93.5%
Center 2	77	70	90.9%
Center 3	37	33	89.2%
Center 4	4	4	100.0%
Center 5	10	9	90.0%
Center 6	85	51	60.0%
Center 7	12	11	91.7%
Center 8	56	43	76.8%
Center 9	43	37	86.0%
Center 10	15	15	100.0%
Center 11	18	18	100.0%
Center 12	72	52	72.2%
Center 13	10	9	90.0%
Center 14	6	3	50.0%
Center 15	34	28	82.4%
Center 16	44	32	72.7%
Center 17	65	54	83.1%
Center 18	180	40	22.2%
Center 19	71	66	93.0%
Center 20	48	45	93.8%

Review outcome (as of 29-02-2012)

Center 1	58	53	3	2	0
Center 2	70	50	0	9	11
Center 3	33	30	1	2	0
Center 4	4	0	0	3	1
Center 5	9	1	0	6	2
Center 6	51	48	0	1	2
Center 7	11	1	3	7	0
Center 8	43	30	0	13	0
Center 9	37	24	12	1	0
Center 10	15	12	1	1	1
Center 11	18	0	0	0	18
Center 12	52	23	0	29	0
Center 13	9	5	1	2	1
Center 14	3	2	0	0	1
Center 15	28	23	0	4	1
Center 16	32	22	3	5	2
Center 17	54	53	1	0	0
Center 18	40	22	1	17	0
Center 19	66	49	3	7	7
Center 20	45	25	0	18	2
Total	678	473	29	127	49
Total (%)	100.0%	69.8%	4.3%	18.7%	7.2%

OARs (as of 29-02-2012)

All cases	949	
	OAR present	
Femoral heads	747	78.7%
Bladder	855	90.1%
Small bowel	583	61.4%

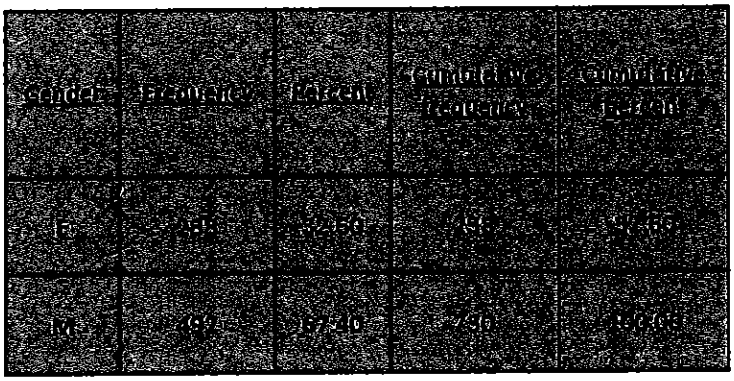
- Current status
- Review procedure
- **Analysis of results**
- Conclusion

Analysis

- Analysed period: between March 2010 and September 2011
- The dataset was evaluated by a statistician
  -David Jegou- from the Belgian Cancer Registry

Belgian Cancer Registry

Gender repartition



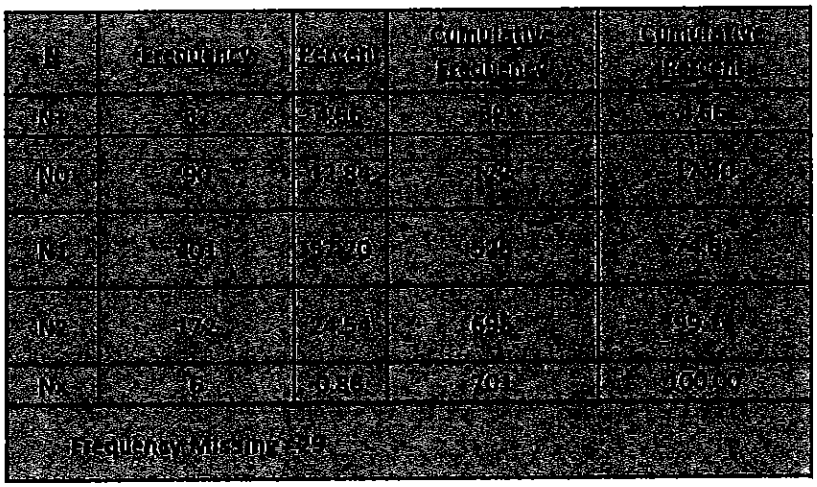
Age analysis

Nr	Mean	Std Dev	Median	Lower Quartile	Upper Quartile	Minimum	Maximum
705	65.5	[illegible]	66.0	58.5	75.6	[illegible]	[illegible]

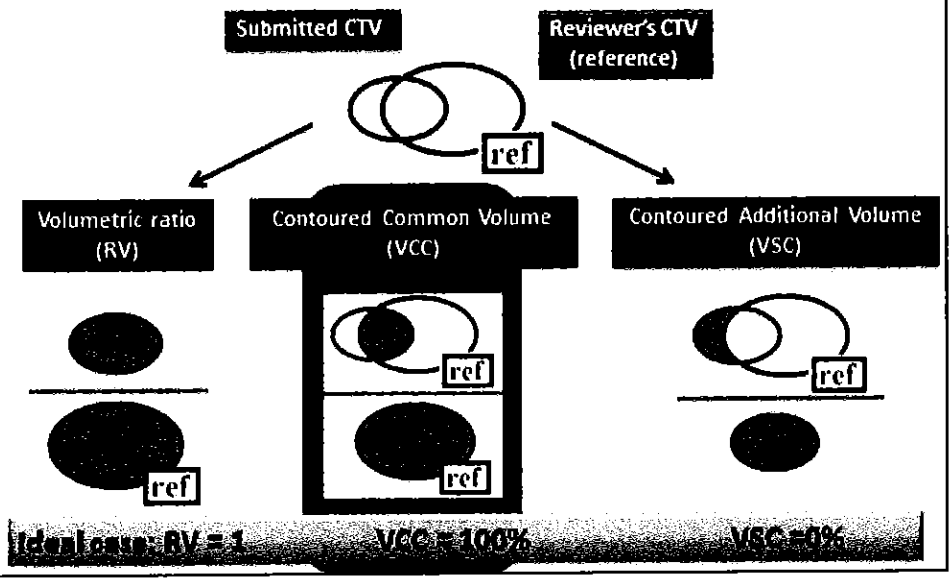
TNM Classification

T	Frequency	Percent	Cumulative Frequency	Cumulative Percent
T1	5	0.72	5	[illegible]
T2	76	10.96	81	[illegible]
T3	574	[illegible]	[illegible]	[illegible]
T4	[illegible]	[illegible]	710	99.72
X	2	0.28	712	100.00
Frequency Missing = 18				

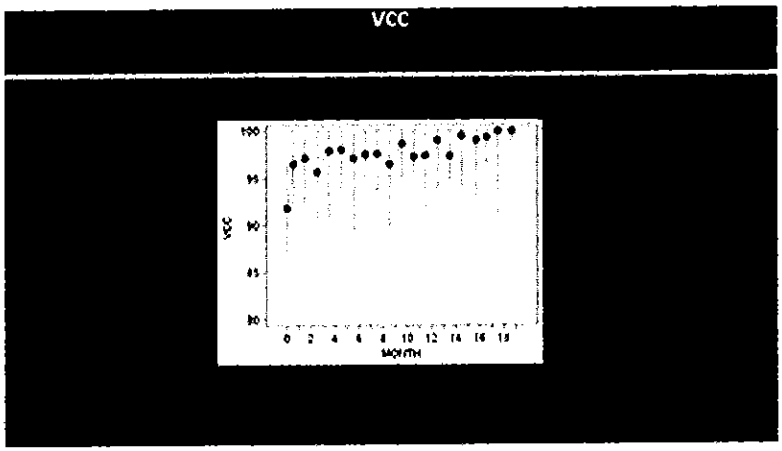
TNM Classification



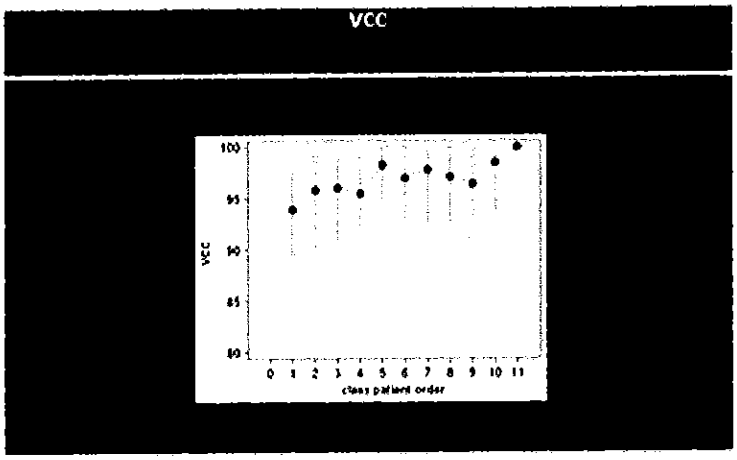
Evaluation vs. "reference" volume



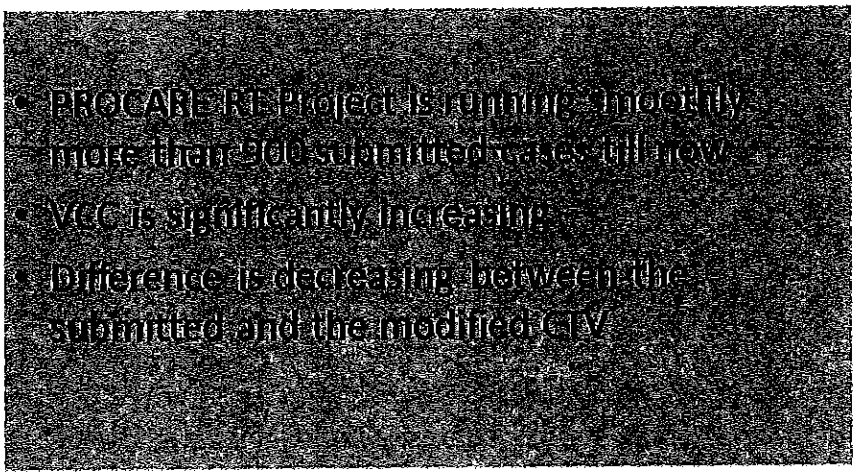
VCC by month



VCC by categorical patient order



Conclusion


• PROCARE RT Project is running smoothly
more than 200 submitted cases till now
• VCC is significantly increasing
• Difference is decreasing between the
submitted and the modified CTV

3. Incident report systems

Prof. Dr. P. Scalliet
Prof. Dr. C. Weltens

ADHECO

An incident management system used for incident registration and benchmarking is proposed by Adheco (http://www.adheco.be/). The proposed system is the PRISMA RT system. In this system both the analysis and classification of the incidents are performed by trained personnel of the department itself, but benchmarking with other departments (national, international) is also possible.

Quality management systems (QMS)

C. WELTENS

The implementation of a Quality Managment System in the Belgian Radiotherapy departments is coordinated by the College. This project consists of 3 sub-projects:

1) Installation of an INCIDENT REPORT SYSTEM
2) Participation to external dosimetry audits (see chapter about Beldart)
3) Participation to on site audits (organized by the college, starts in 2011)

The installation of Quality management systems is funded by the "Nationaal Kanker Plan/Plan National Cancer". This plan includes the progressive installation of a QMS in all radiotherapy departments (5 departments start each year). The QMS consists of the installation of an incident reporting system and the participation to external dosimetry audits. Furthermore on site audits are planned.

In 2011 the College prepared the preparation of the implementation of the Incident Report System. Also the first 5 hospitals were audited. External beam dosimetry was continued.

1. Installation of an incident report system: PRISMA RT

Following steps were prepared in 2011:

A. Information to all radiotherapy departments about installation of PRISMA RT
B. Solving the software and hardware issues

Planning for 2012

1) Information national meeting about the practical installation of the system is planned on March, 1st 2012
2) Installation of the system in all radiotherapy departments in 2012
3) Education of the quality coordinators
4) Test of the software and interface, feedback and adaptation

Planning for 2013

1. Evaluation of the system
2. Organisation of a national and international benchmark

2. On Site Audits

See separate report by Prof. Scalliet

3. External Beam dosimetry

See separate report by B. Schaeken.

4. IMRT

M. Van Dijcke

F. Vanneste

IMRT TREATMENTS IN BELGIUM SURVEY

PART 2

Dear Colleagues,

The College of Radiotherapy has decided to realize a complementary survey more dedicated to the practical physics QC procedures related to the use of IMRT techniques in Belgium.

All the results will be published in the annual report of the College in an anonymous way.

The first survey was trying to evaluate the importance of IMRT for the treatments realised in Belgium and also the time dedicated for the different types of verification dedicated to this technique.

In the actual survey we would like to monitor more in details the following items:

- type of pre-treatment dosimetric verifications
- analysis methodology
- tolerances
- dedicated Linac or Machine QC (daily…)

Additionally, the radiotherapy community is very interested to have an idea of the mean number of monitors. **All the information will also serve to prepare the Beldart 2 project (and to end testing)**

General information

Centre:

Questionnaire filled in by (local contact):

Position:

E-mail:

Are you performing IMRT: □ YES □ **NO, if no please return this page only**

Do you foresee to use one of these modalities within the coming 3 years? □ YES □ **NO**

				If yes go to page
Modality:	SMLC (Step and Shoot)	□ Yes	□ No	20
	DMLC (Dynamic)	□ Yes	□ No	4
	Rotational	□ Yes	□ No	12
	Helicoïdal	□ Yes	□ No	28
	Cyberknife	□ Yes	□ No	
	Gammaknife	□ Yes	□ No	
	Other	□ Yes	□ No	

Contents

A) DMLC Technique (dynamic IMRT)

Pre-treatment verifications (patient oriented)

At which frequency do you perform this type of measurement?

- □ For no patient at all
- □ For some patients
- □ For all patients
- □ How many times per patient ?

a) Point dose verifications

Point doses are generally measured with an ionisation chamber in a flat phantom from gantry 0 degree for every beam (fluence) or in a geometrical or anatomical phantom from the planned gantry angles.

Do you perform point dose measurements? □ YES □ NO

If YES:

Phantom:	Flat	semi-anatomical
Type of detector used:	Detector Volume:	CC
Each field at gantry 0?	□ YES	□ NO
Individual field fluence control?	□ YES	□ NO
Dose points in homogenous dose region?	□ YES	□ NO
Special dose points in region of critical organs?	□YES	□ NO

Total number of verified dose points/field?

Do you use on your TPS "point doses" values or do you take into account the size of your ionisation chamber and use a mean dose value in the chamber?

□ point dose □ mean dose

Tolerances for point dose verification results:

Localisation	Prostate	Head and Neck	Other
	Tolerance in %	Tolerance in %	Tolerance in %
Individual Fluence			
Total dose			
Organs at risk 1			
Organs at risk 2			

In case some point doses would be out of tolerance, how are you dealing with this situation?

Do you have a local protocol for this situation ☐ Yes ☐ No

If yes please summarize in few lines

Who is taking the final decision, the clinician or the physicist?

☐ Clinician ☐ Physicist ☐ Both

b) 2D Distribution

Are you performing fluence verifications for each patient?	□YES	□ NO
Do you analyse each field individually?	□YES	□ NO
Do you use gantry at 0 degree for each field?	□YES	□ NO

Which type of measuring device are you using?

□ 2D-Array system

□ Gafchromic

□ EDR2

□ Film

□ Other

Vidar:

Other scanner:

Analyzing software:

□ EPID

□ Portal Dosimetry

□ Epiga

□ Other

Are your comparisons performed in?

□ Absolute dose □ Relative dose

In case of relative dose comparisons, do you perform an additional absolute dose control with an ionisation chamber?

□ YES □ NO

Remarks:

c) 3D distributions

This is the case when the treatment data are transferred on a semi-anatomical phantom for combined dose distributions control.

Are you performing fluence verifications for each patient?

□ YES □ NO

Do you acquire data for each field individually?

□ YES □ NO

Which type of measuring device are you using?

□ TLD

□ 2DARRAY system

□ 3 DARRAY (Delta 4, arc check)

□ Film

□ Other

□ Chamber

Do you measure doses in?

□ Coronal planes

□ Transverse planes

□ Sagittal planes

□ Multiple planes

d) Tolerances for IMRT Verifications

The classical comparison methodology is based on the use of % of difference coupled to the DTA (distance to agreement), giving a value to the Gamma Index.

Nowadays it is not very simple to apply this concept in IMRT verifications and quite often is it difficult to compare results between different centres.

Before comparing values of Gamma Index it is important to specify some aspects of the comparison parameters.

1) When we will compare the calculated and the measured fluence, we will compare a quite important number of point doses and of course the dose for each point can vary a lot. Will the comparison parameters (%, DTA) be the same for high dose values and for low dose values? The ESTRO booklet 9 is giving some recommendations to try to resolve this problem.

Table 7.4 Proposed values of the confidence limits and action levels for IMRT treatments (from Palta *et al.*, 2003).

Region	*Confidence Limit**	*Action Level*
High dose, low dose gradient	3%	5%
High dose, high dose gradient	10% or 2mm DTA	15% or 3mm DTA
Low dose, low dose gradient	4%	7%
Dose fall off ($d_{80\%-20\%}$)	2mm DTA	3mm DTA

* The confidence limit is defined as the sum of the average deviation and 1.96 SD. The average deviation used in the calculation of confidence limit for all regions is expressed as a percentage of the prescribed dose according to the formula: $100\% \times (D_{calc}-D_{meas}/D_{prescribed})$

When we will realize the comparison, we will also exclude "background" points to take into account only the representative points in the matrix. Different possibilities exist to eliminate the background.

Analysis of the results

In addition to your Gamma Index parameters (% diff, DTA), please enter your "acceptance" levels values of your clinical protocol.

Example:

Clinical Site	Prostate
Dose/DTA criterion	4% 4mm
Tolerance	98% of pixels inside the 20% isodose ROI

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

Clinical site	Prostate	Head and Neck	Other
Dose/DTA Values			
Tolerance (% of points with gamma index <=1)			
Local dose comparison (?).	YES NO	YES NO	YES NO
Maximum Weighted	YES NO	YES NO	YES NO
User value Weighted	YES NO	YES NO	YES NO
Increase tolerance/low doses	Tol: % Doses :	Tol: % Doses :	Tol: % Doses :
Background Subs.	Value : %	Value : %	Value : %
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO
Do you take into account the points outside the path of the leaves?	YES NO	YES NO	YES NO
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO
Do you take into account the points outside the path o the leaves?	YES NO	YES NO	YES NO

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

In your clinical routine, are the proposed values of Booklet 9 (ESTRO) gamma criteria frequently used (see table below) ?

Approach	Average Gamma	Maximum gamma	% gamma >1
Acceptable	< 0.5	< 1.5	0-5 %
Need further evaluation	0.5-0.6	1.5-2.0	5-10%
Not acceptable	>0.6	>2.0	>10%

Table 7.5 Criteria for acceptability of gamma evaluation of pre-treatment verification of IMRT beams (from Stock et al., 2005)

Your answer: □ YES □ NO

Comment:

If no:

e) Monitor units

The purpose of this question is to try to have an idea of the number of monitor units delivered for specific localisations in the different centres in Belgium.

We would like to obtain a mean value for the specified treatments.

To give us the possibility to perform a comparison, it is very important to provide some information regarding beam calibration.

Which photon energy is used for IMRT?

MU reference conditions: 1 MU = 1 cGy at SSD = cm
DEPTH = cm

Localisation	Technique: Dynamic	Typical Number of MU for 2 Gy at Ref. Point
Prostate		
Brain (no stereo)		
Head and Neck		

B) ROTATIONAL IMRT Technique

Type of technique: ◻ RapidArc ◻ VMAT ◻ Other

Do you treat all your IMRT patients with ArcTherapy? ◻ YES ◻ NO

IF NO, which localisations are dedicated for this technique?

Localisations:

Pre-treatment verifications (patient oriented)

At which frequency do you perform this type of measurement?

◻ For no patient at all

◻ For some patients

◻ For all patients

◻ How many times per patient ?

a) Point dose verifications

Point doses are generally measured with an ionisation chamber in a flat phantom from gantry 0 degree for every beam (fluence) or in a geometrical or anatomical phantom from the planned gantry angles.

Do you perform point dose measurements? ◻ YES ◻ NO

If YES:

Phantom:	Flat	semi-anatomical
Type of detector used:	Detector Volume:	CC
Each field at gantry 0?	◻ YES	◻ NO
Individual field fluence control?	◻ YES	◻ NO
Dose points in homogenous dose region?	◻ YES	◻ NO

Special dose points in region of critical organs? ◻YES ◻ NO

Total number of verified dose points/field?

Do you use on your TPS "point doses" values or do you take into account the size of your ionisation chamber and use a mean dose value in the chamber?

◻ point dose ◻ mean dose

Tolerances for point dose verification results:

Localisation	Prostate	Head and Neck	Other
	Tolerance in %	Tolerance in %	Tolerance in %
Individual Fluence			
Total dose			
Organs at risk 1			
Organs at risk 2			

In case some point doses would be out of tolerance, how are you dealing with this situation?

Do you have a local protocol for this situation ◻ Yes ◻ No

If yes please summarize in few lines

(leave some space to write a few lines)

Who is taking the final decision, the clinician or the physicist?

◻ Clinician ◻ Physicist ◻ Both

b) 2D Distribution

Are you performing fluence verifications for each patient?	□YES	□ NO
Do you analyse each field individually?	□YES	□ NO
Do you use gantry at 0 degree for each field?	□YES	□ NO

Which type of measuring device are you using?

□ 2D-Array system

□ Gafchromic

□ EDR2

□ Film

□ Both

Vidar:

Other scanner:

Analyzing software:

□ EPID

□ Portal Dosimetry

□ Epiga

□ Other

Are your comparisons performed in?

□ Absolute dose □ Relative dose

In case of relative dose comparisons, do you perform an additional absolute dose control with an ionisation chamber?

□ YES □ NO

Remarks:

c) 3D distributions

This is the case when the treatment data are transferred on a semi-anatomical phantom for combined dose distributions control.

Are you performing fluence verifications for each patient?

□ YES □ NO

Do you acquire data for each field individually?

□ YES □ NO

Which type of measuring device are you using?

□ TLD

□ 2DARRAY system

□ 3 DARRAY (Delta 4, arc check)

□ Film

□ Other

□ Chamber

Do you measure doses in?

□ Coronal planes

□ Transverse planes

□ Sagittal planes

□ Multiple planes

d) Tolerances for IMRT Verifications

The classical comparison methodology is based on the use of % of difference coupled to the DTA (distance to agreement), giving a value to the Gamma Index.

Nowadays it is not very simple to apply this concept in IMRT verifications and quite often is it difficult to compare results between different centres.

Before comparing values of Gamma Index it is important to specify some aspects of the comparison parameters.

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Region	*Confidence Limit* *	*Action Level*
High dose, low dose gradient	+/- 3%	+/- 5%
High dose, high dose gradient	10% or 2mm DTA	15% or 3mm DTA
Low dose, low dose gradient	4%	7%
Dose fall off ($d_{50\ cm}$)	2mm DTA	3mm DTA

* The confidence limit is defined as the sum of the average deviation and 1.90 SD. The average deviation used in the calculation of confidence limit for all regions is expressed as a percentage of the prescribed dose according to the formula: $100\% \times (D_{calc}-D_{meas})/D_{prescribed}$

When we will realize the comparison, we will also exclude "background" points to take into account only the representative points in the matrix. Different possibilities exist to eliminate the background.

Analysis of the results

In addition to your Gamma Index parameters (% diff. DTA), please enter your "acceptance" levels values of your clinical protocol.

Example:

Clinical Site	Prostate
Dose/DTA criterion	4% 4mm

Tolerance	98% of pixels inside the 20% isodose ROI

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

Clinical site	Prostate	Head and Neck	Other
Dose/DTA Values			
Tolerance (% of points with gamma index <=1)			
Local dose comparison (?).	YES NO	YES NO	YES NO
Maximum Weighted	YES NO	YES NO	YES NO
User value Weighted	YES NO	YES NO	YES NO
Increase tolerance/low doses	Tol: % Doses :	Tol: % Doses :	Tol: % Doses :
Background Subs.	Value : %	Value : %	Value : %
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO
Do you take into account the points outside the path of the leaves?	YES NO	YES NO	YES NO
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO
Do you take into account the points	YES NO	YES NO	YES NO

outside the path o the leaves?			

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

In your clinical routine, are the proposed values of Booklet 9 (ESTRO) gamma criteria frequently used (see table below) ?

Approach	Average Gamma	Maximum gamma	% gamma >1
Acceptable	< 0.5	< 1.5	0-5 %
Need further evaluation	0.5-0.6	1.5-2.0	5-10%
Not acceptable	>0.6	>2.0	>10%

Table 7.5 Criteria for acceptability of gamma evaluation of pre-treatment verification of IMRT beams (from Stock et al., 2005)

Your answer: ☐ YES ☐ NO

Comment:

If no:

e) Monitor units

The purpose of this question is to try to have an idea of the number of monitor units delivered for specific localisations in the different centres in Belgium.

We would like to obtain a mean value for the specified treatments.

To give us the possibility to perform a comparison, it is very important to provide some information regarding beam calibration.

Which photon energy is used for IMRT?

MU reference conditions: 1 MU = 1 cGy at SSD = cm
DEPTH = cm

Localisation	Technique: Dynamic	Typical Number of MU for 2 Gy at Ref. Point
Prostate		
Brain (no stereo)		
Head and Neck		

C) STEP-SHOOT IMRT Technique

Pre-treatment verifications (patient oriented)

At which frequency do you perform this type of measurement?

- ◻ For no patient at all
- ◻ For some patients
- ◻ For all patients
- ◻ How many times per patient ?

a) Point dose verifications

Point doses are generally measured with an ionisation chamber in a flat phantom from gantry 0 degree for every beam (fluence) or in a geometrical or anatomical phantom from the planned gantry angles.

Do you perform point dose measurements? ◻ YES ◻ NO

If YES:

Phantom:	Flat	semi-anatomical
Type of detector used:	Detector Volume:	CC
Each field at gantry 0?	◻ YES	◻ NO
Individual field fluence control?	◻ YES	◻ NO
Dose points in homogenous dose region?	◻ YES	◻ NO
Special dose points in region of critical organs?	◻YES	◻ NO

Total number of verified dose points/field?

Do you use on your TPS "point doses" values or do you take into account the size of your ionisation chamber and use a mean dose value in the chamber?

□ point dose □ mean dose

Tolerances for point dose verification results:

Localisation	Prostate	Head and Neck	Other
	Tolerance in %	Tolerance in %	Tolerance in %
Individual Fluence			
Total dose			
Organs at risk 1			
Organs at risk 2			

In case some point doses would be out of tolerance, how are you dealing with this situation?

Do you have a local protocol for this situation □ Yes □ No

If yes please summarize in few lines

(leave some space to write a few lines)

Who is taking the final decision, the clinician or the physicist?

□ Clinician □ Physicist □ Both

b) 2D Distribution

Are you performing fluence verifications for each patient?	□YES	□ NO
Do you analyse each field individually?	□YES	□ NO
Do you use gantry at 0 degree for each field?	□YES	□ NO

Which type of measuring device are you using?

- □ 2D-Array system
- □ Gafchromic
- □ EDR2
- □ Film
- □ Both

Vidar:

Other scanner:

Analyzing software:

- □ EPID
- □ Portal Dosimetry
- □ Epiga
- □ Other

Are your comparisons performed in?

□ Absolute dose □ Relative dose

In case of relative dose comparisons, do you perform an additional absolute dose control with an ionisation chamber?

□ YES □ NO

Remarks:

c) 3D distributions

This is the case when the treatment data are transferred on a semi-anatomical phantom for combined dose distributions control.

Are you performing fluence verifications for each patient?

□ YES □ NO

Do you acquire data for each field individually?

□ YES □ NO

Which type of measuring device are you using?

□ TLD

□ 2DARRAY system

□ 3 DARRAY (Delta 4, arc check)

□ Film

□ Other

□ Chamber

Do you measure doses in?

□ Coronal planes

□ Transverse planes

□ Sagittal planes

□ Multiple planes

d) Tolerances for IMRT Verifications

The classical comparison methodology is based on the use of % of difference coupled to the DTA (distance to agreement), giving a value to the Gamma Index.

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Analysis of the results

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Example:

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Tolerance	98% of pixels inside the 20% isodose ROI

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

Clinical site	Prostate	Head and Neck	Other
Dose/DTA Values			
Tolerance (% of points with gamma index <=1)			
Local dose comparison (?).	YES NO	YES NO	YES NO
Maximum Weighted	YES NO	YES NO	YES NO
User value Weighted	YES NO	YES NO	YES NO
Increase tolerance/low doses	Tol: % Doses :	Tol: % Doses :	Tol: % Doses :
Background Subs.	Value : %	Value : %	Value : %
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO
Do you take into account the points outside the path of the leaves?	YES NO	YES NO	YES NO
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO
Do you take into account the points	YES NO	YES NO	YES NO

outside the path o the leaves?			

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

In your clinical routine, are the proposed values of Booklet 9 (ESTRO) gamma criteria frequently used (see table below) ?

Approach	Average Gamma	Maximum gamma	% gamma >1
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Not acceptable	>0.6	>2.0	>10%

Table 7.5 Criteria for acceptability of gamma evaluation of pre-treatment verification of IMRT beams (from Stock et al., 2005)

Your answer: ◻ YES ◻ NO

Comment:

If no:

e) Monitor units

The purpose of this question is to try to have an idea of the number of monitor units delivered for specific localisations in the different centres in Belgium.

We would like to obtain a mean value for the specified treatments.

To give us the possibility to perform a comparison, it is very important to provide some information regarding beam calibration.

Which photon energy is used for IMRT?

MU reference conditions: 1 MU = 1 cGy at SSD = cm
DEPTH = cm

Localisation	Technique: Dynamic	Typical Number of MU for 2 Gy at Ref. Point
Prostate		
Brain (no stereo)		
Head and Neck		

D) HELICOIDAL IMRT Technique

Pre-treatment verifications (patient oriented)

At which frequency do you perform this type of measurement?

- ◻ For no patient at all
- ◻ For some patients
- ◻ For all patients
- ◻ How many times per patient ?

a) Point dose verifications

Point doses are generally measured with an ionisation chamber in a flat phantom from gantry 0 degree for every beam (fluence) or in a geometrical or anatomical phantom from the planned gantry angles.

Do you perform point dose measurements? ◻ YES ◻ NO

If YES:

Phantom:	Flat	semi-anatomical
Type of detector used:	Detector Volume:	CC
Each field at gantry 0?	◻ YES	◻ NO
Individual field fluence control?	◻ YES	◻ NO
Dose points in homogenous dose region?	◻ YES	◻ NO
Special dose points in region of critical organs?	◻YES	◻ NO

Total number of verified dose points/field?

Do you use on your TPS "point doses" values or do you take into account the size of your ionisation chamber and use a mean dose value in the chamber?

□ point dose □ mean dose

Tolerances for point dose verification results:

Localisation	Prostate	Head and Neck	Other
	Tolerance in %	Tolerance in %	Tolerance in %
Individual Fluence			
Total dose			
Organs at risk 1			
Organs at risk 2			

In case some point doses would be out of tolerance, how are you dealing with this situation?

Do you have a local protocol for this situation □ Yes □ No

If yes please summarize in few lines

(leave some space to write a few lines)

Who is taking the final decision, the clinician or the physicist?

□ Clinician □ Physicist □ Both

b) 2D Distribution

Are you performing fluence verifications for each patient?	□YES	□ NO
Do you analyse each field individually?	□YES	□ NO
Do you use gantry at 0 degree for each field?	□YES	□ NO

Which type of measuring device are you using?

- □ 2D-Array system
- □ Gafchromic
- □ EDR2
- □ Film
- □ Both

Vidar:

Other scanner:

Analyzing software:

- □ EPID
- □ Portal Dosimetry
- □ Epiga
- □ Other

Are your comparisons performed in?

□ Absolute dose □ Relative dose

In case of relative dose comparisons, do you perform an additional absolute dose control with an ionisation chamber?

□ YES □ NO

Remarks:

c) 3D distributions

This is the case when the treatment data are transferred on a semi-anatomical phantom for combined dose distributions control.

Are you performing fluence verifications for each patient?

□ YES □ NO

Do you acquire data for each field individually?

□ YES □ NO

Which type of measuring device are you using?

□ TLD

□ 2DARRAY system

□ 3 DARRAY (Delta 4, arc check)

□ Film

□ Other

□ Chamber

Do you measure doses in?

□ Coronal planes

□ Transverse planes

□ Sagittal planes

□ Multiple planes

d) Tolerances for IMRT Verifications

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Before comparing values of Gamma Index it is important to specify some aspects of the comparison parameters.

1) When we will compare the calculated and the measured fluence, we will compare a quite important number of point doses and of course the dose for each point can vary a lot. Will the comparison parameters (%, DTA) be the same for high dose values and for low dose values? The ESTRO booklet 9 is giving some recommendations to try to resolve this problem.

Table 7.4 Proposed values of the confidence limits and action levels for IMRT treatments (Fo *et al.*, 2003).

Region	*Confidence Limit**	*Action Level*
High dose, low dose gradient	+/-3%	+/- 5%
High dose, high dose gradient	10% or 2mm DTA	15% or 3mm DT
Low dose, low dose gradient	4%	7%
Dose fall off (d_{80-20})	2mm DTA	3mm DTA

* The confidence limit is defined as the sum of the average deviation and 1.96 SD. The av viation used in the calculation of confidence limit for all regions is expressed as a percenta prescribed dose according to the formula: $100\% \times (D_{calc}-D_{meas}/D_{prescribed})$.

When we will realize the comparison, we will also exclude "background" points to take into account only the representative points in the matrix. Different possibilities exist to eliminate the background.

Analysis of the results

In addition to your Gamma Index parameters (% diff, DTA), please enter your "acceptance" levels values of your clinical protocol.

Example:

Clinical Site	Prostate

Dose/DTA criterion	4% 4mm
Tolerance	98% of pixels inside the 20% isodose ROI

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

Clinical site	Prostate	Head and Neck	Other
Dose/DTA Values			
Tolerance (% of points with gamma index <=1)			
Local dose comparison (?).	YES NO	YES NO	YES NO
Maximum Weighted	YES NO	YES NO	YES NO
User value Weighted	YES NO	YES NO	YES NO
Increase tolerance/low doses	Tol: % Doses :	Tol: % Doses :	Tol: % Doses :
Background Subs.	Value : %	Value : %	Value : %
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO
Do you take into account the points outside the path of the leaves?	YES NO	YES NO	YES NO
Use of a dose threshold to eliminate low dose points	YES NO	YES NO	YES NO
Increasing % tolerance for low dose points	YES NO	YES NO	YES NO

Do you take into account the points outside the path o the leaves?	YES NO	YES NO	YES NO

Institute of Physics and Engineering in Medecine, IPEMReport 96, Guidance for the Clinical Implementation of IMRT, 2008

In your clinical routine, are the proposed values of Booklet 9 (ESTRO) gamma criteria frequently used (see table below) ?

Approach	Average Gamma	Maximum gamma	% gamma >1
Acceptable	<0.5	<1.5	0-5 %
Need further evaluation	0.5-0.6	1.5-2.0	5-10%
Not acceptable	>0.6	>2.0	>10%

Table 7.5 Criteria for acceptability of gamma evaluation of pre-treatment verification of IMRT beams (from Stock et al., 2005)

Your answer: ☐ YES ☐ NO

Comment:

If no:

e) Monitor units

The purpose of this question is to try to have an idea of the number of monitor units delivered for specific localisations in the different centres in Belgium.

We would like to obtain a mean value for the specified treatments.

To give us the possibility to perform a comparison, it is very important to provide some information regarding beam calibration.

Which photon energy is used for IMRT?

MU reference conditions: 1 MU = 1 cGy at SSD = cm
DEPTH = cm

Localisation	Technique: Dynamic	Typical Number of MU for 2 Gy at Ref. Point
Prostate		
Brain (no stereo)		
Head and Neck		

E) DAILY LINAC QC DEDICATED TO IMRT

Are you performing IMRT linac dedicated tests every day ?

Yes

No

If yes, please give a short description of your procedure.

5. Audits

College of radiotherapy - Clinical audits 2011

Auditors

1. Clinicians: P Scalliet, Y Lievens, P Van Houtte, K Vandeputte, D Van den Weyngaert.
2. RTT: G Vandevelde, P Thysebaert, P Bijdekerke, M De Baere.
3. Physicists: MT Hoornaert, M Van Dyke, D Verellen, K Feyen, S Vynckier.

Preparation

1. Methodology

The IAEA has developed in the late 90's a methodology and a handbook for comprehensive clinical audits [1]. This was initially intended for developing countries, but soon in the early development phase, the option was taken to cover all radiotherapy programs in all settings (affluent and non-affluent countries) with all levels of technology (including IMRT). The name of the handbook is QUATRO.
Over 50 audits have been carried out in Central and Western Europe (and more across Asia, Africa and South America), allowing to validate the methodology in a variety of economical environments. This methodology is now imported in Belgium under the auspices of the college of radiotherapy.

2. Training

15 auditors have been selected by the college at the end of 2010, 5 per profession (radiation oncologist, medical physicist and nurse/radiographer)according to the IAEA audit procedure.
A training seminar has been organised by the college in March 11th and 12th in Durbuy, with 4 supervisors previously trained at IAEA and with a broad experience in auditing: Pr. S. Vynckier (medical physicists UCL), Mrs Mary Coffey (radiographer, trinity college Dublin), Mr G. Vandevelde (radiographer KUL) and Pr. P. Scalliet (radiation oncologist UCL).
All aspects of the audit structure have been covered with particular emphasis on how to communicate the audit results to the audited department and how to draft the report (a template has been provided by IAEA).

3. Organisation

The first five hospitals have been selected on the basis of the Cancer Plan project in quality assurance. These 5 hospitals were the first to benefit from the project in 2010, as they were already engaged in a certification in quality (NIAS, ISO, etc).
The head of hospitals and their quality officers were consulted for practical organisation (date).

Hospitals:

1. Verviers : 12-14 December.
   Contact person: Dr Olivier De Hertog (olivier_dehertogh@hotmail.com)
   RTT: *G Vandevelde*
   clinician: *D Van den Weyngaert*
   physicist: *D Verellen*

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2. Hasselt : 25-27 January.
   Contact person: Dr Paul Bulens (paul.bulens@virgajesse.be)
   RTT: *G Vandevelde*
   clinician: *P Scalliet*
   physicist: *K Feyen*

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3. ULg Sart Tilman : 14-18 November (3 days to choose).
   Contact person: Prof. Philippe Coucke (pcoucke@chu.ulg.ac.be)
   RTT: *P Bijdekerke*
   clinician: *Y Lievens*
   physicist: *M Van Dycke*

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4. Namur (Ste Elisabeth): 11 – 13 janvier (3 days to choose).
   Contact person: dr V. Remouchamps
   (Vincent.REMOUCHAMPS@cmsenamur.be)
   RTT: *G Vandevelde*
   clinician: *P Van Houtte*
   physicist: *D Verellen*

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5. Turnhout (St Elisabeth): 12-14 December (3 days to choose).
   Contact person: Dr Jean Meyskens (Jean.Meyskens@sezkturnhout.be)
   RTT: *Mia De Baere*
   clinician: *K Vandeputte*
   physicist: *MT Hoornaert*

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6. Additional audit on request from Ministry of Health of Luxemburg: Esch-sur-Alzette: 5-7 December

RTT :	*G Vandevelde*
clinician:	*P Scalliet*
physicist :	*S Vynckier*

Results

At the end of the audit, an audit report is delivered to each hospital (head of department). It contains a complete description of the department structure and organisation, as well as a though review of treatment procedures and quality assurance program. Different conclusions can be reached: (a) there are severe deficiencies that need immediate remedial action followed by a verification audit, (b) deficiencies that do not prevent the department to further operate but need rapid correctives actions, (c) non-conformities that need to be addressed before the following audit (5 years), (d) there are no recommendations and the centre is declared "centre of competence".

All 5 Belgian hospitals have been declared "centre of competence" according to the IAEA terminology. There were no deficiencies identified needing immediate or delayed corrective actions. The quality and safety of patient treatments was ensured in all sites.

The five audit reports have been discussed during an auditor meeting in April 2012. A more detailed report is in preparation.

Follow-up

The next five hospitals will be audited in the fall (October-December 2012) by the same auditors teams. It is intended to keep these teams active for several years, allowing for build-up of expertise.

References

[1] Comprehensive Audits of Radiotherapy Practice: A Tool for Quality Improvement (Quality Assurance Team for Radiation Oncology – QUATRO).