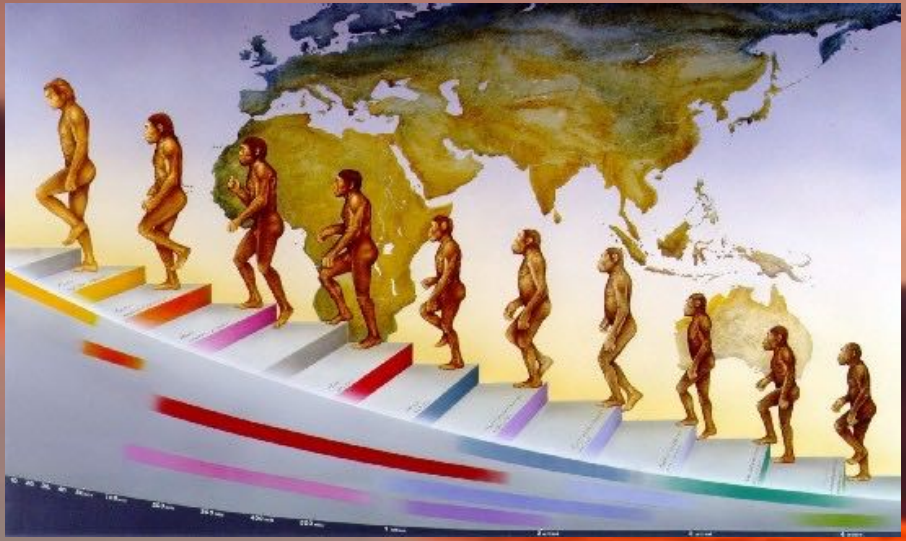
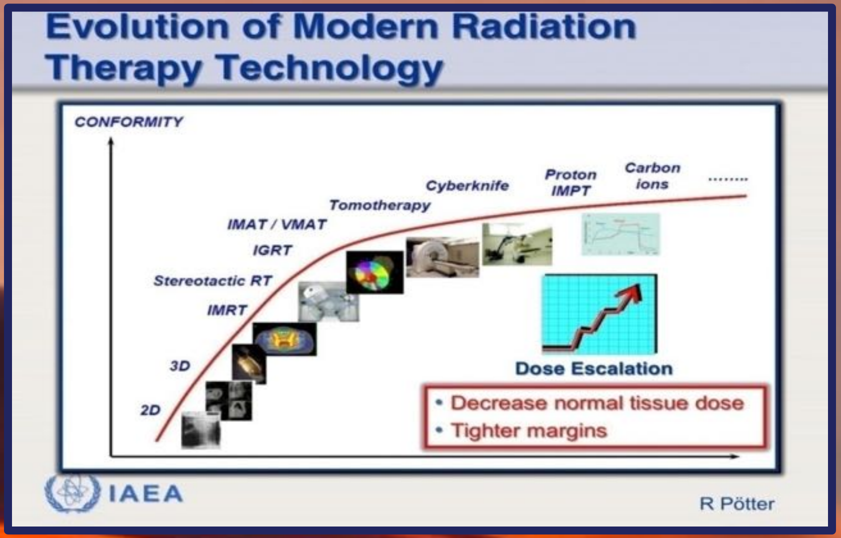
Diffusione in Italia di apparecchiature e tecniche ad alta conformazione del fascio e loro impiego in RT palliativa

Giovanni Mandoliti
SOC Radioterapia Oncologica
Azienda ULSS 18 - Rovigo

GRUPPO DI STUDIO
Cure Palliative e Terapia di Supporto

L'**<u>EVOLUZIONE</u>** tecnologica delle apparecchiature, l'introduzione dell'*imaging* e lo sviluppo dell'informatica per l'ottimizzazione dei trattamenti, hanno determinato una **<u>RIDEFINIZIONE DEL RUOLO DELLA RADIOTERAPIA IN AMBITO ONCOLOGICO</u>**





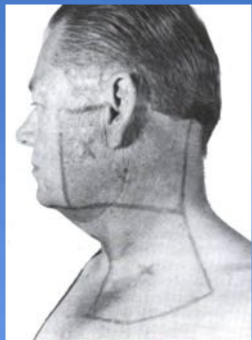
1D: navigazione a vista

2D: navigazione su un piano

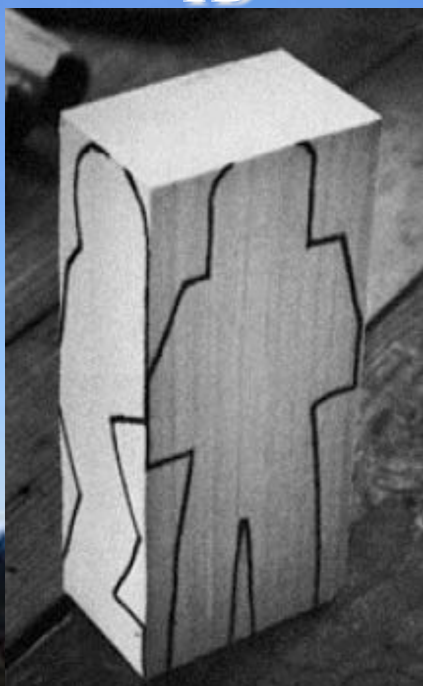
3D: navigazione in un volume

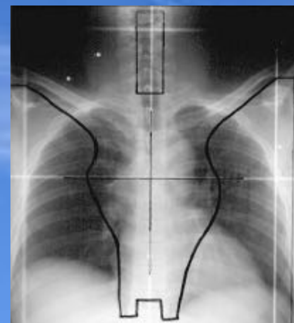
4D: navigazione nel tempo

5D: navigazione nella biologia

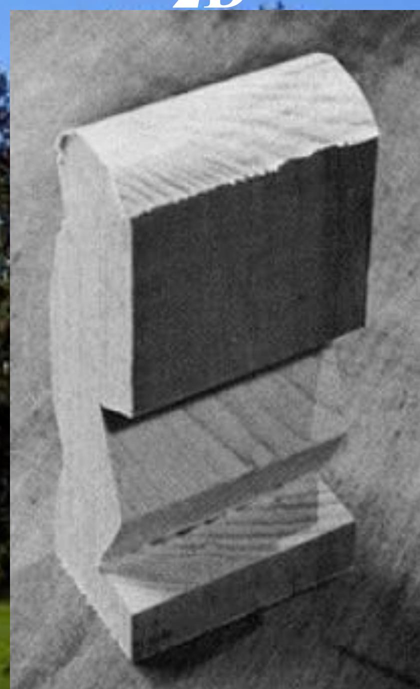


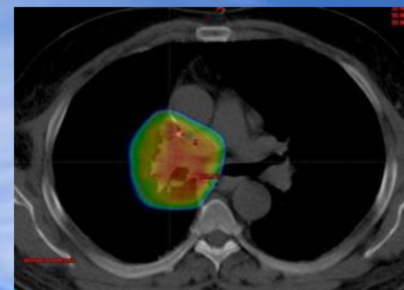
1D



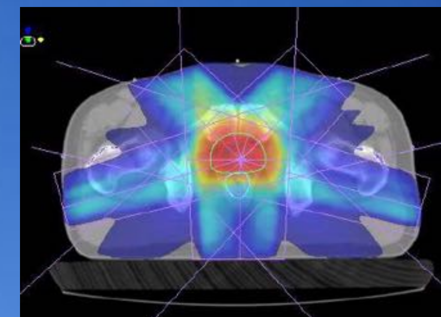


2D





3D



IMRT

3 “rivoluzioni” tecnologiche in Radioterapia

1. Inizio anni ’90 → **PIANIFICAZIONE** → 3D-CRT

2. Fine anni ’90 → **EROGAZIONE** → IMRT

3. > 2000 → **VERIFICA** → IGRT

PRECISIONE NEL DEPOSITARE LA DOSE
3D-CRT, IMRT, SRS…

PRECISIONE NEL “*TARGETING*”
IGRT

J Med Phys. 2012 Oct-Dec; 37(4): 1741-182

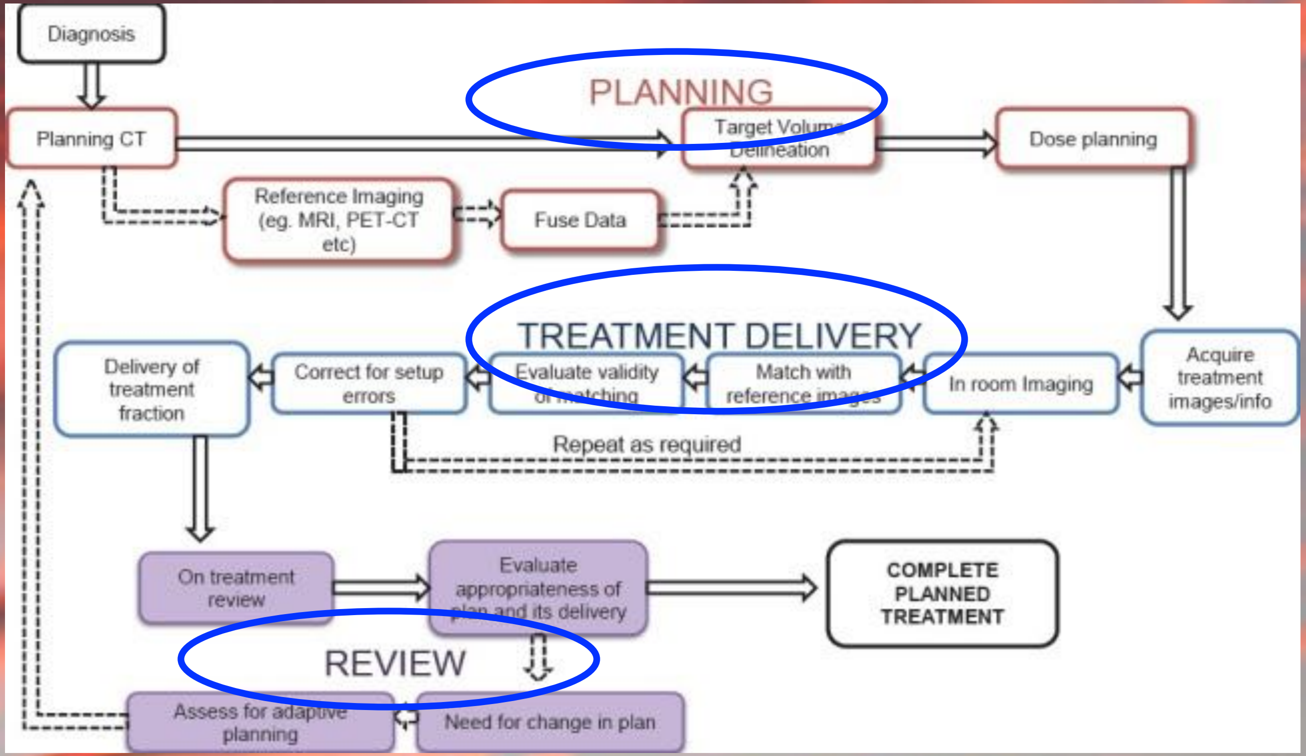
Image-guided radiation therapy: Physician's perspectives

T. Gupta and C. Anand Narayan

PIANIFICAZIONE

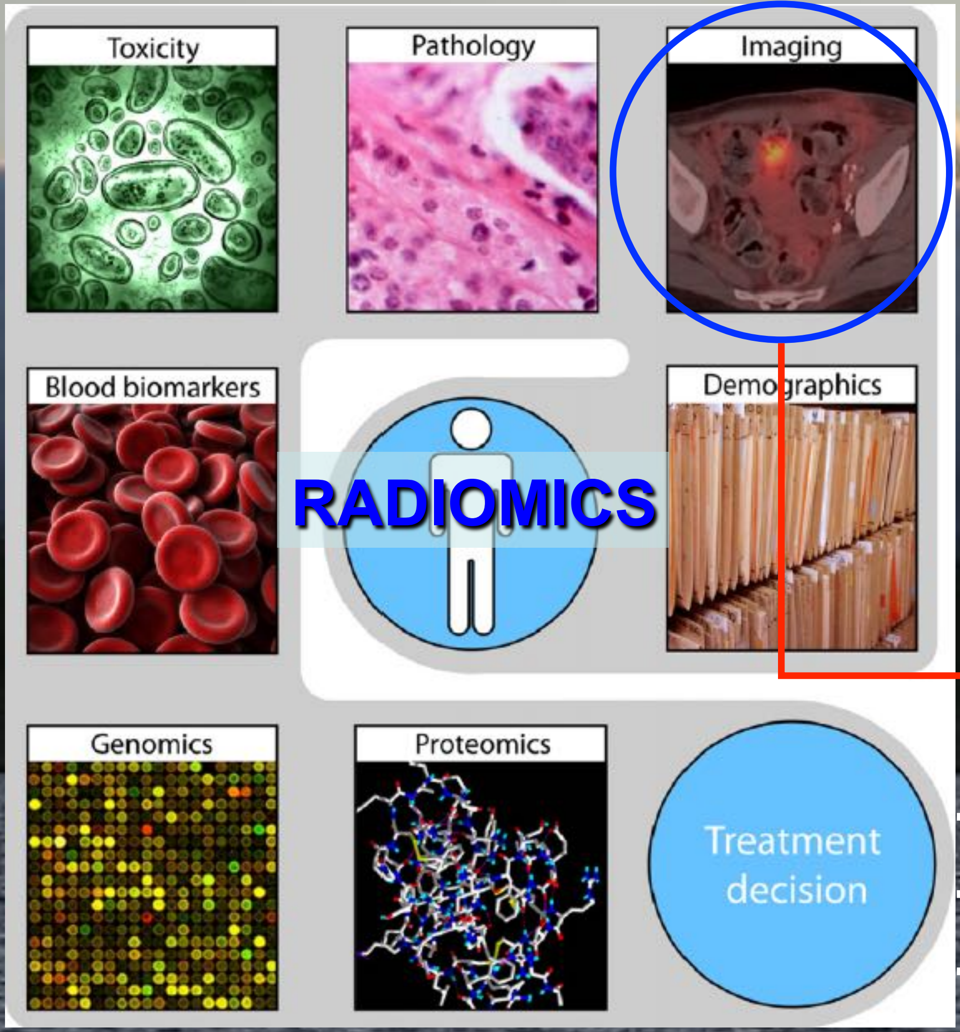
EROGAZIONE

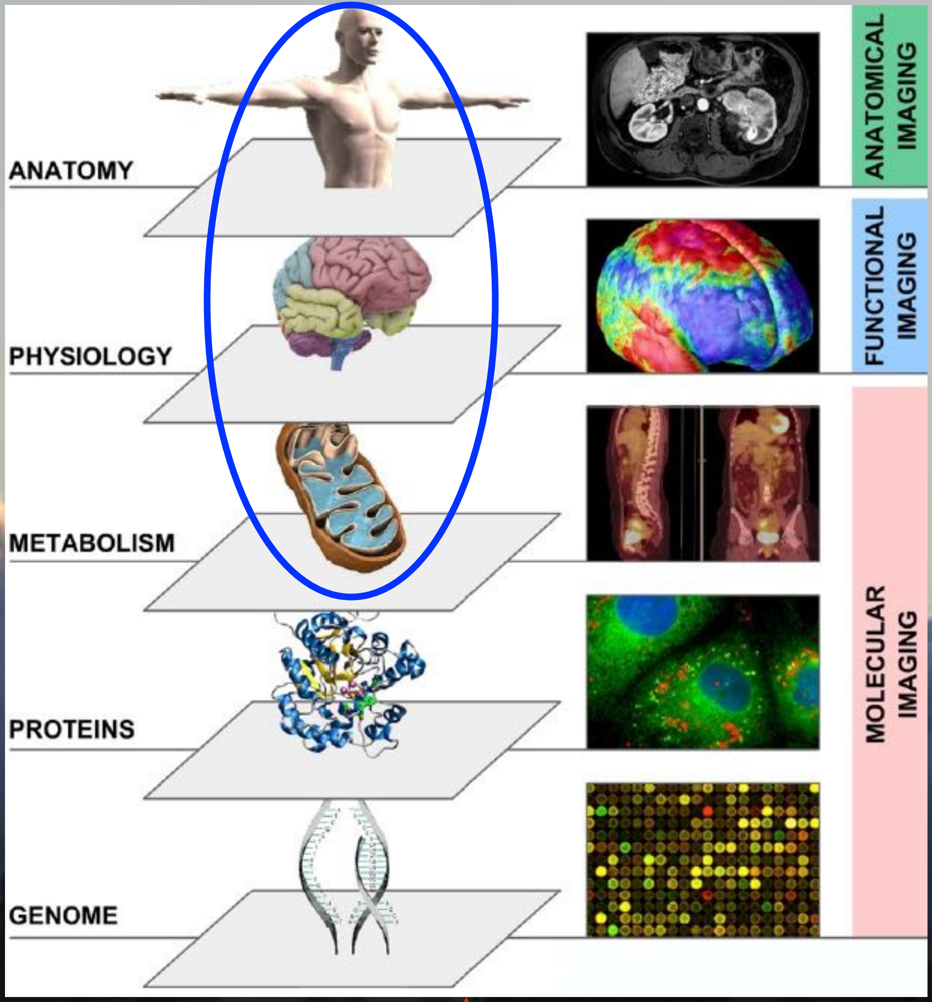
VERIFICA



Process map and workflow of IGRT showing a series of inter-connected steps of **treatment planning**, **delivery**, and **verification** with a feedback loop

Differenti fonti di informazione utilizzate per selezionare il trattamento ottimale





IMAGING

→ Anatomico

→ Funzionale

→ Molecolare

P. Lambin, EJC, 2012

Come si inserisce la MODERNA RADIOTERAPIA nel trattamento delle metastasi

- Il concetto di **oligometastasi** e della possibile miglior prognosi ad esse associate
- La nozione che la "**palliazione**" oltre al controllo dei sintomi può aumentare la sopravvivenza del malato senza effetti collaterali di rilievo
- L'utilizzo sempre più diffuso **di tecniche ad alta conformazione del fascio** (soprattutto la **RT stereotassica**) anche nel paziente metastatico
- La maggiore diffusione nella pratica clinica della **re-irradiazione** delle metastasi

"…the **GOALS OF RADIATION THERAPY** in patients with bone metastases are to palliate pain, decrease the use of narcotic analgesics, improve ambulation and restore function, and prevent complications of pathological fracture and spinal cord compression…"

DALLA PALLIAZIONE ALLA CURA

Breast Cancer Res Treat (2009) 115:601–608
DOI 10.1007/s10549-008-0157-4

CLINICAL TRIAL

Oligometastatic breast cancer treated with curative-intent stereotactic body radiation therapy

Michael T. Milano · Hong Zhang · Su K. Metcalfe ·
Ann G. Muhs · Paul Okunieff

2719 Dosimetric Comparison of Two-Dimensional (2D) vs. Three-Dimensional (3D) Planning for Bone Metastases

A. E. Potter, M. Holwell, D. Fitzpatrick, A. Bezjak, M. McLean, W. Levin, R. Dinniwell, L. Zurawel-Balaura, R. Wong

Department of Radiation Oncology, Princess Margaret Hospital/University Health Network and University of Toronto, Toronto, ON, Canada

Purpose/Objective(s): 2D field based planning remains standard practice in many radiotherapy (RT) centres for treatment of bone metastases. Even if simple plans (non conformal/non IMRT) remain the preferred technique, 3D CT based planning can improve target localization, dose coverage of targets and sparing of normal tissue. We prospectively evaluated the dosimetric impact of 2D field based vs 3D volume based RT planning for bone metastases.

M[...] st[...] in[...] pl[...]

Changes to the final GTV and the reasoning were recorded. A 3D plan was created using ≥3 non-IMRT beams to cover the final PTV with 95% while minimizing normal tissue dose. Dosimetric indices were calculated for 2D and 3D plans with 95% as the reference isodose (RI). Two indices assessed target coverage: the proportion of PTV covered by RI (PTV conformity factor: PTVCF), and the ratio of minimum isodose covering PTV to RI (RTOG quality of coverage: QC). Two indices compared dose to normal tissues: the healthy tissue volume covered by RI as a proportion of PTV (healthy tissue overdosage factor: HTOF) and the ratio of PTV to total volume covered by RI (healthy tissue conformity index: CIHT). Two sided *t* tests were used to compare means for each index.

Results: 51 patients receiving RT to 57 bone sites provided data. 29/57 (50.9%) cases received treatment to the spine. 38/57 had diagnostic CT and/or MRI scans available for review. After evaluating the full planning CT dataset, oncologists documented changes in fields and/or PTV in 31/57 (54.4%) cases, due to local disease extent in 22/31 (71.0%) and clinically important distant disease in others. The study 2D plans used single fields in 17/57 and parallel pairs in 40/57, compared to the final 3D plans which used fewer single fields (6/57), more parallel pairs (50/57) and one 3-field technique. PTV coverage in 3D plans was superior to 2D plans as measured by mean QC (88% vs 46%, $p<0.001$) and mean PTVCF (93% vs 77%, $p<0.001$). 3D plans improved healthy tissue sparing compared to 2D plans, with mean HTOF 2.56 vs 4.89 ($p = 0.112$) and mean CIHT 0.34 vs 0.25 ($p<0.01$).

Conclusions: 3D planning for RT to bone metastases resulted in more plans with ≥2 fields compared to 2D field based plans. 3D plans provided superior PTV coverage and improved healthy tissue sparing. The clinical impact of 3D planning in this setting requires further investigation.

La 3D-CRT è da raccomandarsi in caso di prognosi favorevole, volumi di trattamento molto estesi…

Volume: 75, Issue: 3, Supplement, November 1, 2009, pp. S505

Int. J. Radiation Oncology Biol. Phys., Vol. 79, No. 4, pp. 965–976, 2011

0360-3016/$ - see front matter

doi:10.1016/j.ijrobp.2010.11.026

ASTRO GUIDELINE

PALLIATIVE RADIOTHERAPY FOR BONE METASTASES: AN ASTRO EVIDENCE-BASED GUIDELINE

Stephen Lutz, M.D.,* Lawrence Berk, M.D., Ph.D.,† Eric Chang, M.D.,‡ Edward Chow, M.B.B.S.,§ Carol Hahn, M.D.,¶ Peter Hoskin, M.D.,‖ David Howell, M.D.,# Andre Konski, M.D.,** Lisa Kachnic, M.D.,†† Simon Lo, M.B., Ch.B.,‡‡ Arjun Sahgal, M.D.,§§ Larry Silverman, M.D.,¶¶ Charles von Gunten, M.D., Ph.D., F.A.C.P.,‖‖ Ehud Mendel, M.D., F.A.C.S.,## Andrew Vassil, M.D.,*** Deborah Watkins Bruner, R.N., Ph.D.,††† and William Hartsell, M.D.‡‡‡

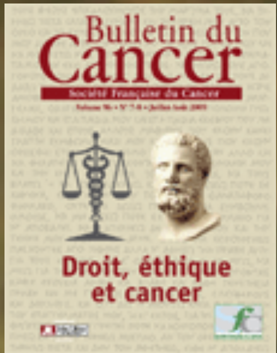
*Department of Radiation Oncology, Blanchard Valley Regional Cancer Center, Findlay, OH; †Department of Radiation Oncology, Moffitt Cancer Center, Tampa, FL; ‡Department of Radiation Oncology, University of Texas M.D. Anderson Cancer Center, Houston, TX; §Department of Radiation Oncology, Sunnybrook Odette Cancer Center, University of Toronto, Toronto, ON, Canada; ¶Departmen… Duke University, Durham, NC; ‖Mount Vernon Centre for …lesex, United Kingdom; …Oncology, University of Michigan, Mt. Pleasant, MI; … Oncology, Wayne Sta…; ††Department of Radiation Oncology, Boston Medical C… partment of Radiation Oncology, Ohio State University, Columbus, OH; §§Department of Radiation Oncology, Sunnybrook Odette Cancer Center and the Princess Margaret Hospital, University of Toronto, Toronto, ON, Canada; ¶¶21st Century Oncology, Sarasota, FL; ‖‖The Institute for Palliative Medicine, San Diego Hospice, San Diego, CA; ##Neurological Surgery, Ohio State University, Columbus, OH; ***Department of Radiation Oncology, Cleveland Clinic Foundation, Cleveland, OH; †††University of Pennsylvania School of Nursing, Philadelphia, PA; ‡‡‡Department of Radiation Oncology, Good Samaritan Cancer Center, Downers Grove, IL

3D-CRT → SBRT

Table 2 - ASTRO task force questions and guideline statements regarding palliative radiation therapy for bone metastasis

La radioterapia stereotassica è una modalità di trattamento che garantisce un elevato gradiente di dose per metastasi vertebrali…; consente di risparmiare le strutture nervose adiacenti…

Questions	Guideline statements
1. Which fractionation schemes have been shown to be effective for the t… riphe…	Although various fractionation schemes can provide good rates of pal- … hat 30 Gy … y in a sin- … e effects.
2. Whe… pain… meta…	… gle 8-Gy … ore pro-
3. Are t… single fraction therapy?	… how any significant difference in long-term toxicity between a single 8-Gy fraction and more prolonged RT courses for uncomplicated, painful bone metastases. No additional studies are suggested to confirm this recommendation at this time.
4. When should patients receive repeat treatment with RT for peripheral bone metastases?	The rates of repeat treatment have been 20% with single-fraction palliative RT schedules compared with 8% with lengthier RT courses. The Task Force recommends that, whenever possible, patients should be included in prospective randomized trials.
5. When should patients receive repeat treatment with RT to spinal lesions causing recurrent pain?	Sites of recurrent pain in spinal bones can be successfully palliated with EBRT repeat treatment. Care must be taken when the re-irradiated volume contains the spinal cord, and it might be appropriate to sum the biologically effective doses from the initial and repeat treatment regimens to estimate the risk of radiation myelopathy.
6. What promise does highly conformal RT hold for the primary treatment of painful bone metastasis?	Stereotactic body RT is a technology that delivers high doses to metastatic spinal disease with a steep dose gradient that might allow superior sparing of the adjacent neural structures, including the spinal cord and cauda equina. SBRT should not be the primary treatment of vertebral bone lesions causing spinal cord compression.
7. When should highly conformal RT be considered for repeat treatment of spinal lesions causing recurrent pain?	Some early data have suggested that repeat treatment to spinal lesions with SBRT might be feasible, effective, and safe, although the Task Force believes that the use of this approach should be limited to the setting of clinical trial participation.
8. Does the use of surgery, radionuclides, bisphosphonates, or kyphoplasty/vertebroplasty obviate the need for palliative RT for painful bone metastasis?	The available data have suggested that surgery, systemic radiopharmaceuticals, bisphosphonates, or kyphoplasty/vertebroplasty does not obviate the need for EBRT for patients with bone metastases.



RADIOTHÉRAPIE DES CANCERS MÉTASTATIQUES OU OLIGOMÉTASTATIQUES EN DEHORS DES IRRADIATIONS À VISÉE ANTALGIQUE. ÉTAT DES LIEUX EN 2010 AVEC FOCUS SUR L'ASCO 2010

BULLETIN DU CANCER.
Volume 97, Numéro 12, 1467-76, décembre 2010

J Thariat, PY Marcy, JL Lagrange

"…La radiothérapie est le plus souvent prescrite dans une intention palliative en cas de maladie métastatique…

Cependant, **DANS DES CAS SÉLECTIONNÉS DE MALADIE OLIGOMÉTASTATIQUE, ELLE PEUT ÊTRE PRESCRITE À INTENTION POTENTIELLEMENT CURATIVE EN UTILISANT LES NOUVELLES TECHNIQUES D'IRRADIATION** et notamment la radiothérapie stéréotactique extracrânienne (SBRT)…

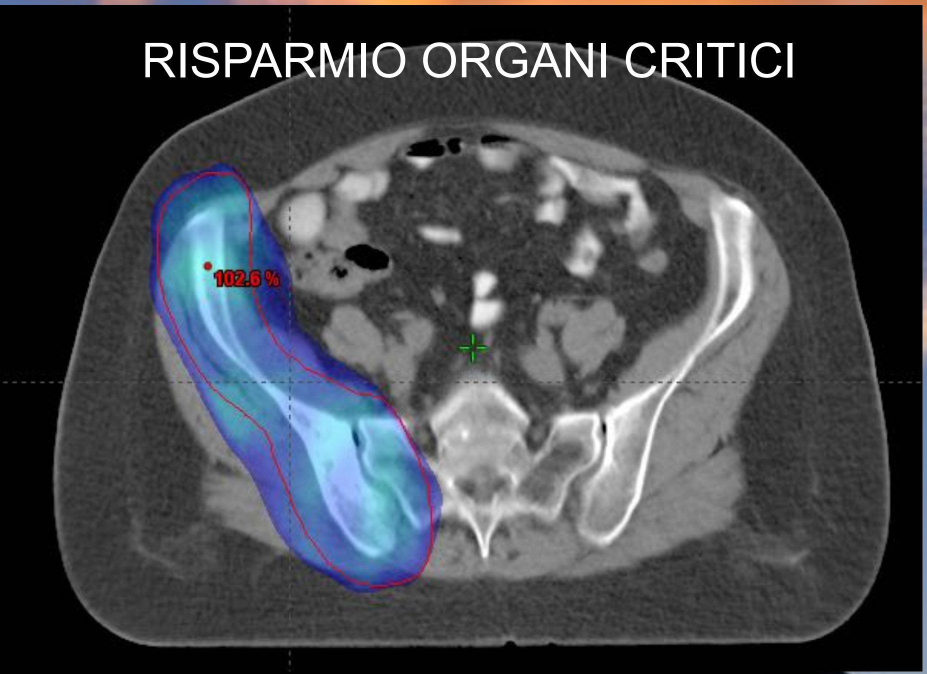
…Les nouvelles techniques sont aussi particulièrement intéressantes pour les métastases spinales… les **RÉIRRADIATIONS…**

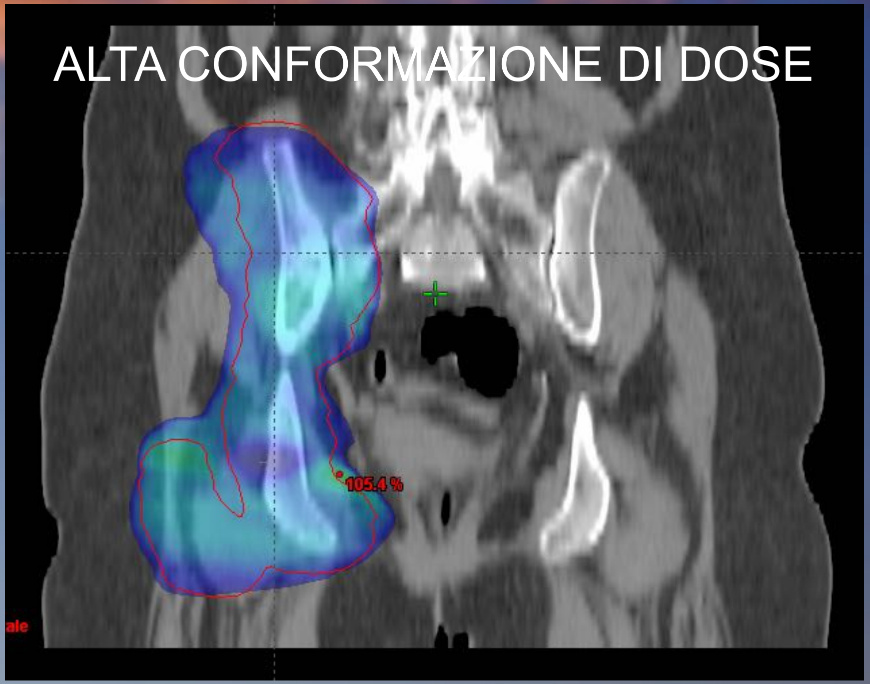
i supplementi di Tumori, vol. 12, No 3: S12-S17, 2011

Radiation therapy for bone metastases

Lucio Trodella[1], Sara Ramella[1], Rolando Maria D'Angelillo[1], Roberto Orecchia[2], Paolo Muto[3], Giovanni Mandoliti[4]

[1]Radioterapia Oncologica, Università Campus Bio-Medico, Roma; [2]Direttore Divisione di Radioterapia, Istituto Europeo di Oncologia, Milano; [3]Direttore Radioterapia, Istituto Nazionale Tumori Fondazione Pascale, Napoli; [4]Responsabile Radioterapia SOC, Ospedale Santa Maria della Misericordia, Rovigo





…Moreover, modern radiation therapy techniques may allow a high conformal dose distribution in order to reduce normal tissue toxicity…

Int. J. Radiation Oncology Biol. Phys., Vol. 71, No. 3, pp. 652–665, 2008

0360-3016/08/$–see front matter

ELSEVIER

doi:10.1016/j.ijrobp.2008.02.060

CRITICAL REVIEW

STEREOTACTIC BODY RADIOSURGERY FOR SPINAL METASTASES: A CRITICAL REVIEW

Arjun Sahgal, M.D.,*† David A. Larson, M.D. Ph.D.,† and Eric L. Chang, M.D.‡

*Department of Radiation Oncology, Sunnybrook Odette Cancer Center, University of Toronto, Toronto, Ontario, Canada; †Department of Radiation Oncology, University of California San Francisco, San Francisco, CA; and ‡Department of Radiation Oncology, The University of Texas, M.D. Anderson Cancer Center, Houston, TX

Table 2. A summary of specified relative inclusion and exclusion criteria for spine SBRS

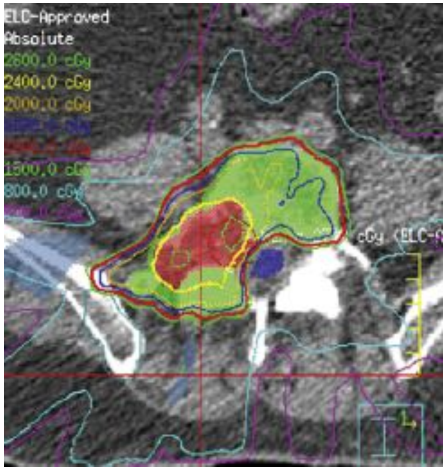
Inclusion
• Solitary or oligometastatic disease or bone only disease in otherwise high-performance status patients*
• Maximum of two consecutive (28) or noncontiguous (8, 17) spinal segments involved by tumor
• Failure of prior XRT (up to one course and 45 Gy maximum) or surgery (8, 17)
• Nonmyeloma tumor type (8, 17)
• Gross residual disease or deemed high risk for recurrence postsurgery (17)
• Patient refusal or medical comorbidities precluding surgery (17)
• Gross tumor optimally more than 5 mm from the spinal cord (17)†
• Karnofsky performance status >40–50 (17, 50, 51)
• MRI- or CT-documented spinal tumor (17, 20)
• Histologic confirmation of neoplastic disease (17, 20)
• Age >18 (50)
Exclusion
• Pacemaker such that MRI cannot be performed or the treatment cannot be delivered safely (17)
• Scleroderma or connective tissue disease as a contraindication to radiotherapy*
• Unable to lie flat (*i.e.*, tolerate treatment)*
• Treated with ^{89}Sr or systemic chemotherapy within 30 days before SBRT (8, 17)
• External beam radiotherapy to the same area within 3 months before SBRT (8, 17, 28)
• Significant or progressive neurologic deficit (8, 17, 23)
• >25% spinal canal compromise (23)
• Malignant epidural spinal cord compression (8, 19) or cauda equina syndrome (19)‡
• Spine instability (8, 17, 19) or neurologic deficit resulting from bony compression of neural structures (50)

Abbreviations: SBRS = stereotactic body radiosurgery; XRT = X-ray therapy; MRI = magnetic resonance imaging; CT = computed tomography; SBRT = stereotactic body radiotherapy; MDACC = M.D. Anderson Cancer Center.

* These represent unpublished specific criteria and included per the authors' recommendation as general criteria to be considered.

† This criteria, according to the MDACC, is relaxed should the multidisciplinary team judge the case still suitable for spine SBRS.

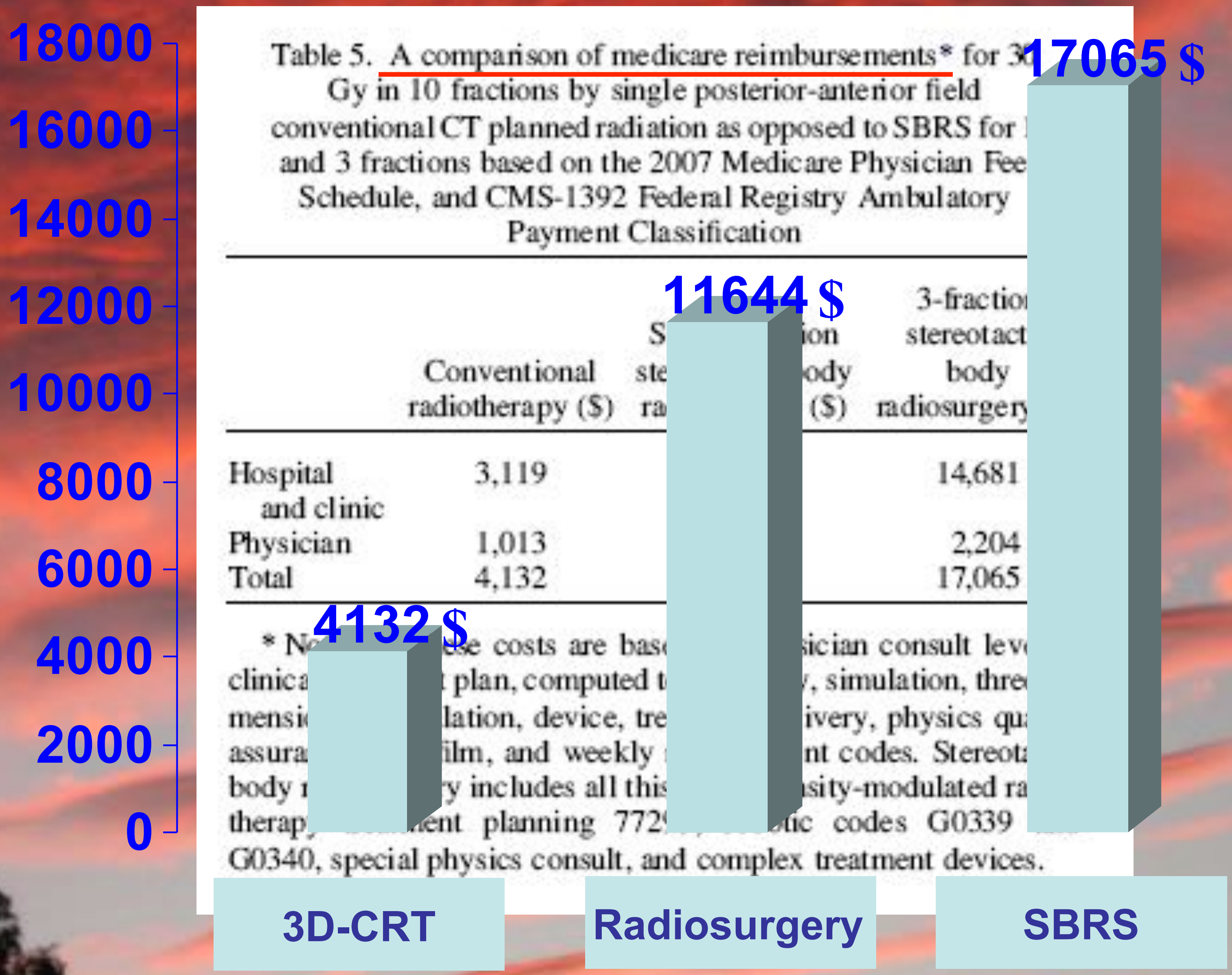
‡ Malignant epidural spinal cord compression has been allowed by some investigators and treated with radiosurgery alone (11).



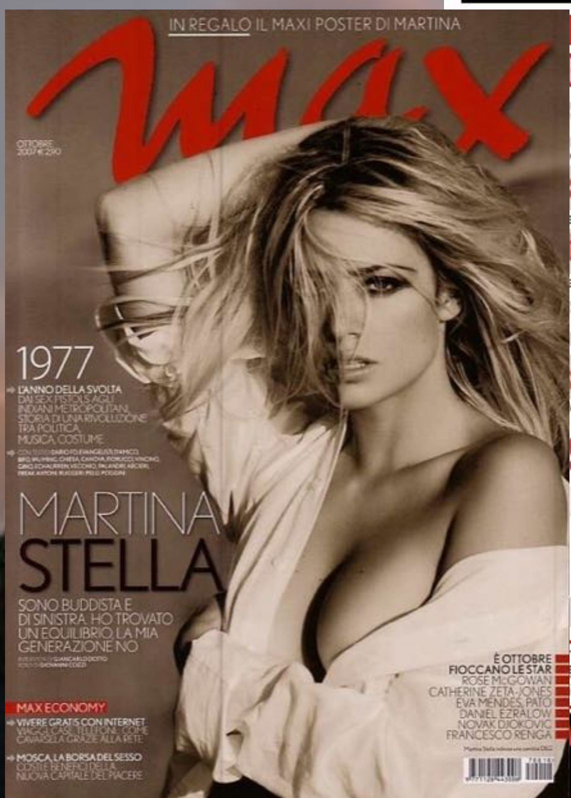
PATOLOGIA	INCIDENZA	Trattabili con tecniche ad alto gradiente di dose
MAV	130	30%
Meningiomi	2.408	5%
Neurinomi	300	15%
Adenoma ipofisario	750	10%
Cordoma/condrosarcoma	135	100%
Craniofaringioma	30	100%
Tumori primitivi SNC	2.600	10%
Metastasi cerebrali	39.000	20%
Polmone primitivo	31.000	5%
Metastasi polmonari	33.406	20%
ORL (ritrattamenti)	6.780	5%
Fegato	10.617	5%
Tumori maligni dell'orbita	310	100%
Pancreas	9.050	56%
Metastasi ossee	35.000	10%
Recidive pelviche	700	50%

18.512 pazienti

ASSOCIAZIONE ITALIANA REGISTRI TUMORI (AIRTUM)


18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Table 5. A comparison of medicare reimbursements* for 3
Gy in 10 fractions by single posterior-anterior field
conventional CT planned radiation as opposed to SBRS for
and 3 fractions based on the 2007 Medicare Physician Fee
Schedule, and CMS-1392 Federal Registry Ambulatory
Payment Classification
Conventional radiotherapy ($)
Hospital and clinic 3,119 14,681
Physician 1,013 2,204
Total 4,132 17,065
G0340, special physics consult, and complex treatment devices.
4132 $
11644 $
17065 $
3D-CRT
Radiosurgery
SBRS

Media



IN REGALO IL MAXI POSTER DI MARTINA
max
1977
L'ANNO DELLA SVOLTA
MARTINA
STELLA
SONO BUDDISTA E
DI SINISTRA. HO TROVATO
UN EQUILIBRIO LA MIA
GENERAZIONE NO
MAX ECONOMY
VIVERE GRATIS CON INTERNET
MOSCA, LA BORSA DEL SESSO
È OTTOBRE
FIOCCANO LE STAR
ROSE McGOWAN
CATHERINE ZETA-JONES
EVA MENDES, PATO
DANIEL EZRALOW
NOVAK DJOKOVIC
FRANCESCO RENGA

max
HOT FASHION NIGHTLIFE SPORT GIRLS CITYGUIDE OROSCOPO MAXCLUB
TREND | WORLD | CINEMA | MUSICA
RSS
MAXCLUB Login Pw REGISTRATI
In Max
Home > Hot > Trend > Cyberknife, chirurgo elettronico
TECH
Cyberknife, chirurgo elettronico
IL ROBOT CHIRURGO CHE TAGLIA SENZA LAME
Il nome, CyberKnife, fa pensare a una specie di Edward-mani-di-forbici in versione chirurgica. Ma visto da vicino, il bisturi cibernetico della Accuray appena installato (quarto in Italia) nella ze dai supertecnici di ab medica ricorda piuttosto, nella mole e nelle movenze, un mansueto dromedario. Che opera, sì, e con estrema precisione, facendo strage di alcuni tumori particolarmente insidiosi, ma senza colpo ferire. Perché i trattamenti di radioterapia che il robot può erogare sono chirurgia solo in senso figurato: il "coltello" non taglia, non è invasivo e non provoca dolore, ma riesce a centrare in modo molto mirato, con fasci ionizzanti di diversa ampiezza, le neoplasie da eliminare. E senza ledere i tessuti circostanti, grazie a un sofisticato sistema di tracciamento e visualizzazione 3D del corpo del paziente, che permette di correggere il tiro seguendone i minimi, involontari movimenti durante l'operazione. Una seduta, in genere, è risolutiva: dopo
Nessuna donna
sarà più la stessa.
MAXNEWS 04/06/10 21:00
sarà lui a interpretare...
"THE WALL" IN TOUR NEL 2011
04/06/10 11:01
Roger Waters ha annunciato che a partire dal marzo del 2011 riporterà in tour il suo capolavoro, The wall: sono più di...
SUPER EROI IN 4D A LONDRA
04/06/10 09:58
Si intitola Marvel Super Heroes 4D, ed è l'ultimissima attrazione di Madame Tussaud, il museo delel cere londinese. Ma...
ARRESTATA POCAHONTAS
03/06/10 18:30
Vi ricordate The New World, il film di Terrence Malick con
VEDI TUTTI

Media

CORRIERE DELLA SERA

SALUTE PIÙ POTENTE E MENO TOSSICO DELLA RADIOTERAPIA CLASSICA, IL PRIMO APPARECCHIO ALL'

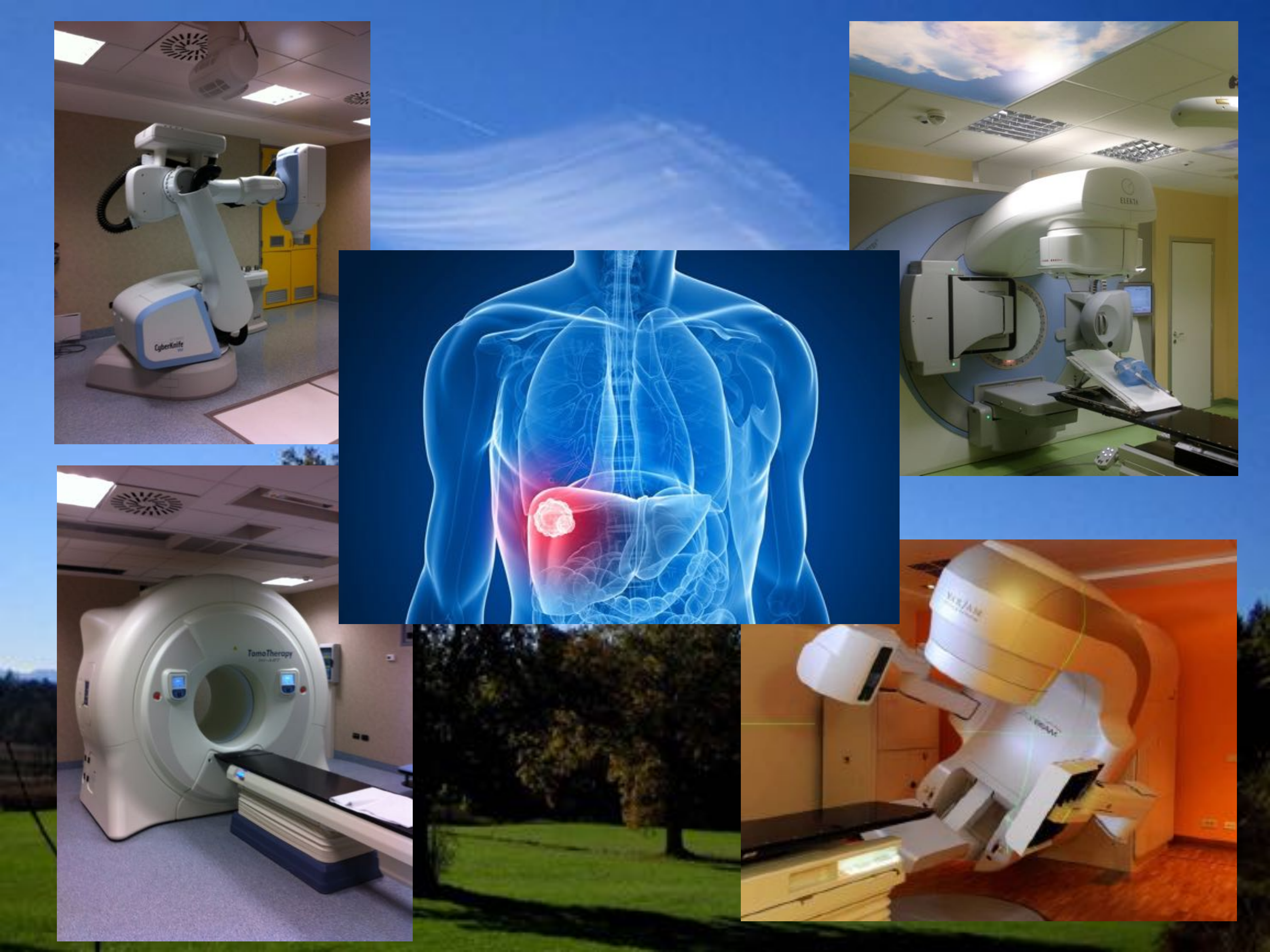
Tumori, il super-raggio intelligente che sostituisce il bisturi

LA STAMPA dossier+

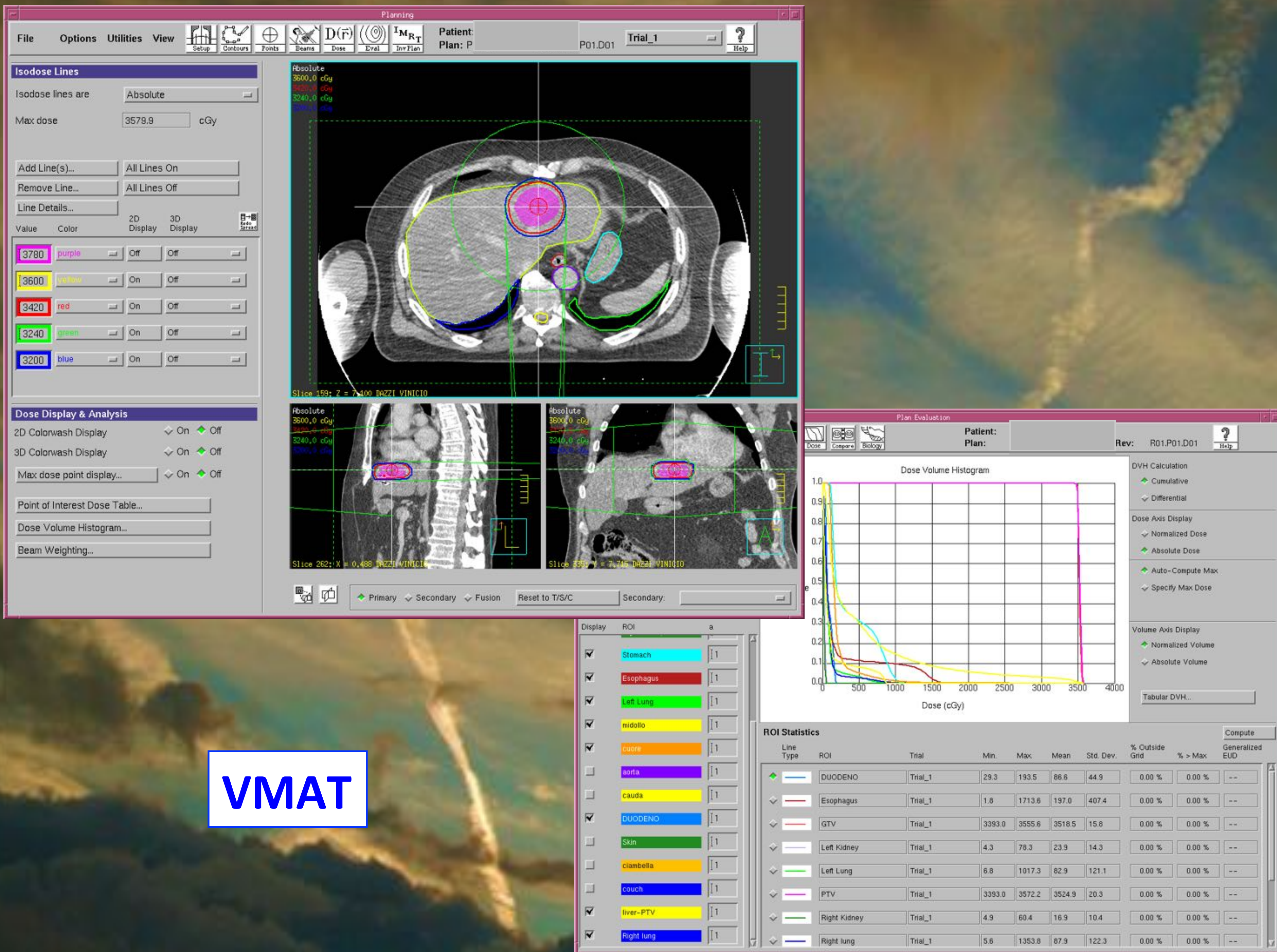
Data	18-05-2010
Pagina	11
Foglio	1

interventi di precisione con il bisturi cibernetico

SI TRATTA DI UN TRATTAMENTO RADIOTERAPICO MIRATO, DEL TUTTO INDOLORE, ESEGUITO IN REGIME AMBULATORIALE E ALTERNATIVO ALLA CHIRURGIA TRADIZIONALE


CyberKnife
TomoTherapy

VMAT



Planning
File
Options
Utilities
View
Patient:
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Trial_1
Isodose Lines
Isodose lines are
Absolute
Max dose
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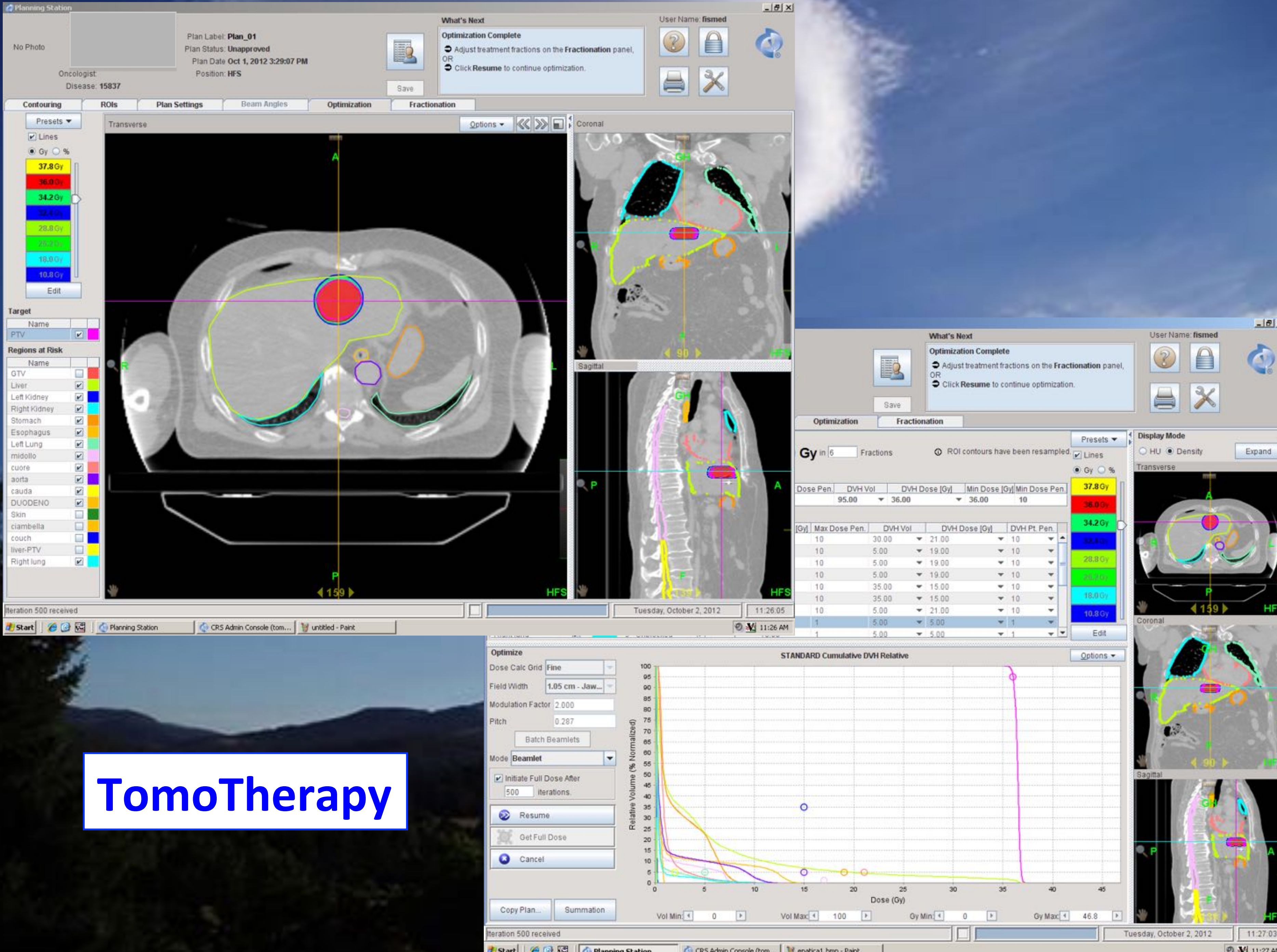
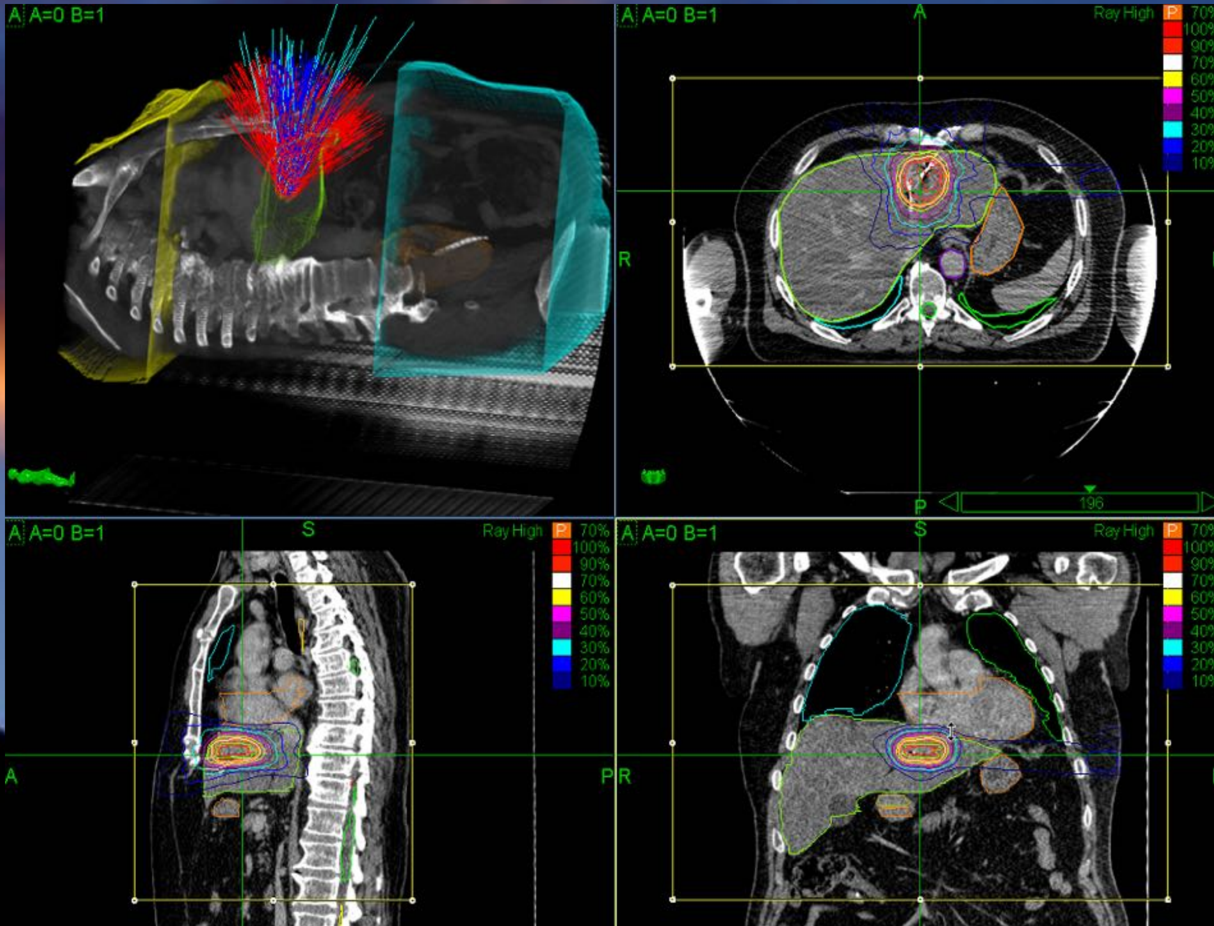
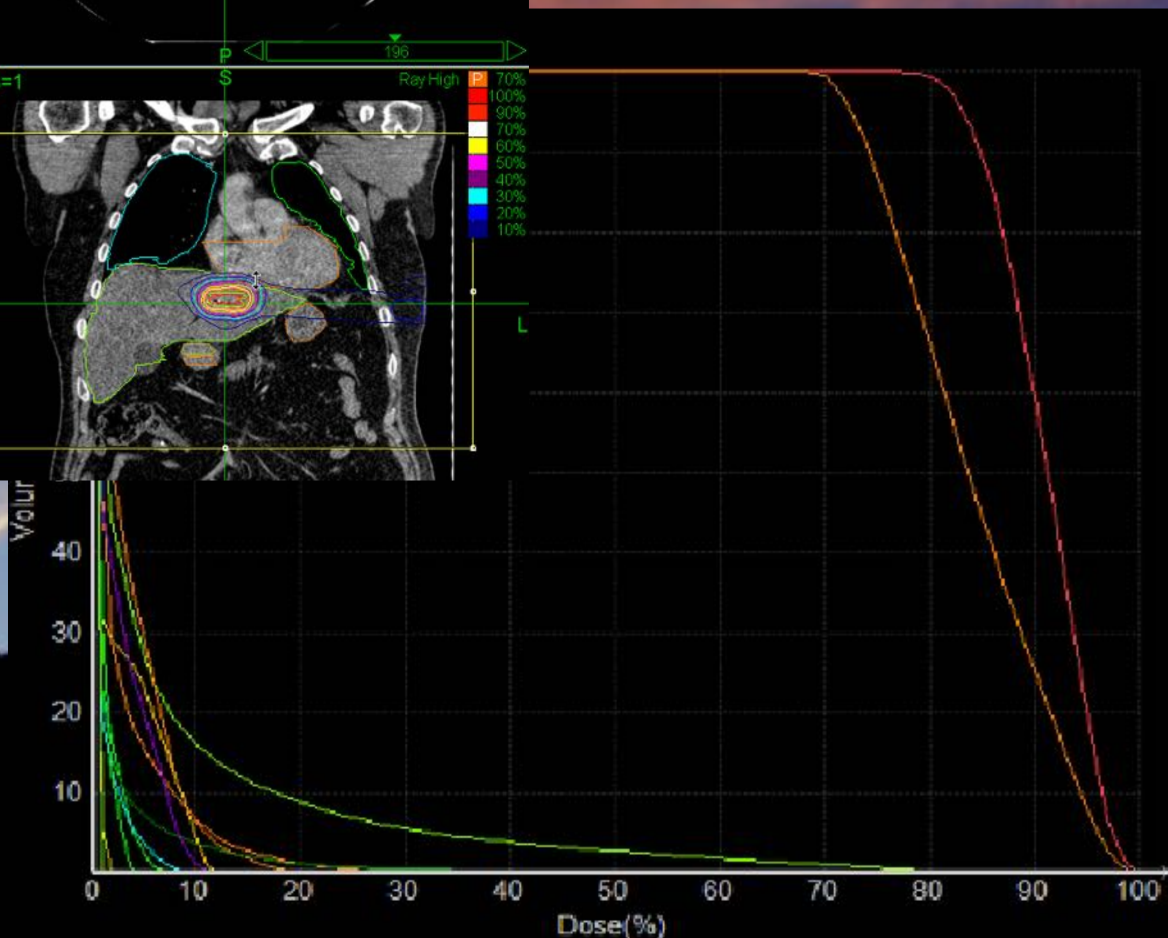
cGy
Add Line(s)...
All Lines On
Remove Line...
All Lines Off
Line Details...
Value
Color
2D Display
3D Display
3780
3600
3420
3240
3200
Dose Display & Analysis
2D Colorwash Display
3D Colorwash Display
Max dose point display...
Point of Interest Dose Table...
Dose Volume Histogram...
Beam Weighting...
Primary
Secondary
Fusion
Reset to T/S/C
Plan Evaluation
Dose Volume Histogram
Dose (cGy)
DVH Calculation
Cumulative
Differential
Dose Axis Display
Normalized Dose
Absolute Dose
Auto-Compute Max
Specify Max Dose
Volume Axis Display
Normalized Volume
Absolute Volume
Tabular DVH...
ROI Statistics
Compute
Stomach
Esophagus
Left Lung
midollo
cuore
aorta
cauda
DUODENO
Skin
ciambella
couch
liver-PTV
Right lung



TomoTherapy


A=0 B=1
Ray High
P 70%
100%
90%
70%
60%
50%
40%
30%
20%
10%
A
P
R
L
S
196


Volur
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100
Dose(%)

CyberKnife

	Liver *700 mL* *< 15 Gy*	**Heart** *Dmax* *< 30 Gy*	**Bowel** *Dmax* *< 30 Gy*	**Kidneys** *D35* *< 15 Gy*	**Stomach** *Dmax* *< 30 Gy*
CyberKnife	✓	✓	✓	✓	✓
VMAT	✓	✓	✓	✓	✓
TomoTherapy	✓	✓	✓	✓	✓

APPROPRIATEZZA


ASSOCIAZIONE ITALIANA DI RADIOTERAPIA ONCOLOGICA

L'APPROPRIATEZZA IN RADIOTERAPIA ONCOLOGICA: INDICAZIONI E CONSIDERAZIONI DELL'ASSOCIAZIONE ITALIANA DI RADIOTERAPIA ONCOLOGICA (AIRO)

Versione 01.2012

- Privilegiare la qualità dei trattamenti effettuati tanto nell'ambito della prescrizione quanto in quello dell'impostazione e dell'esecuzione

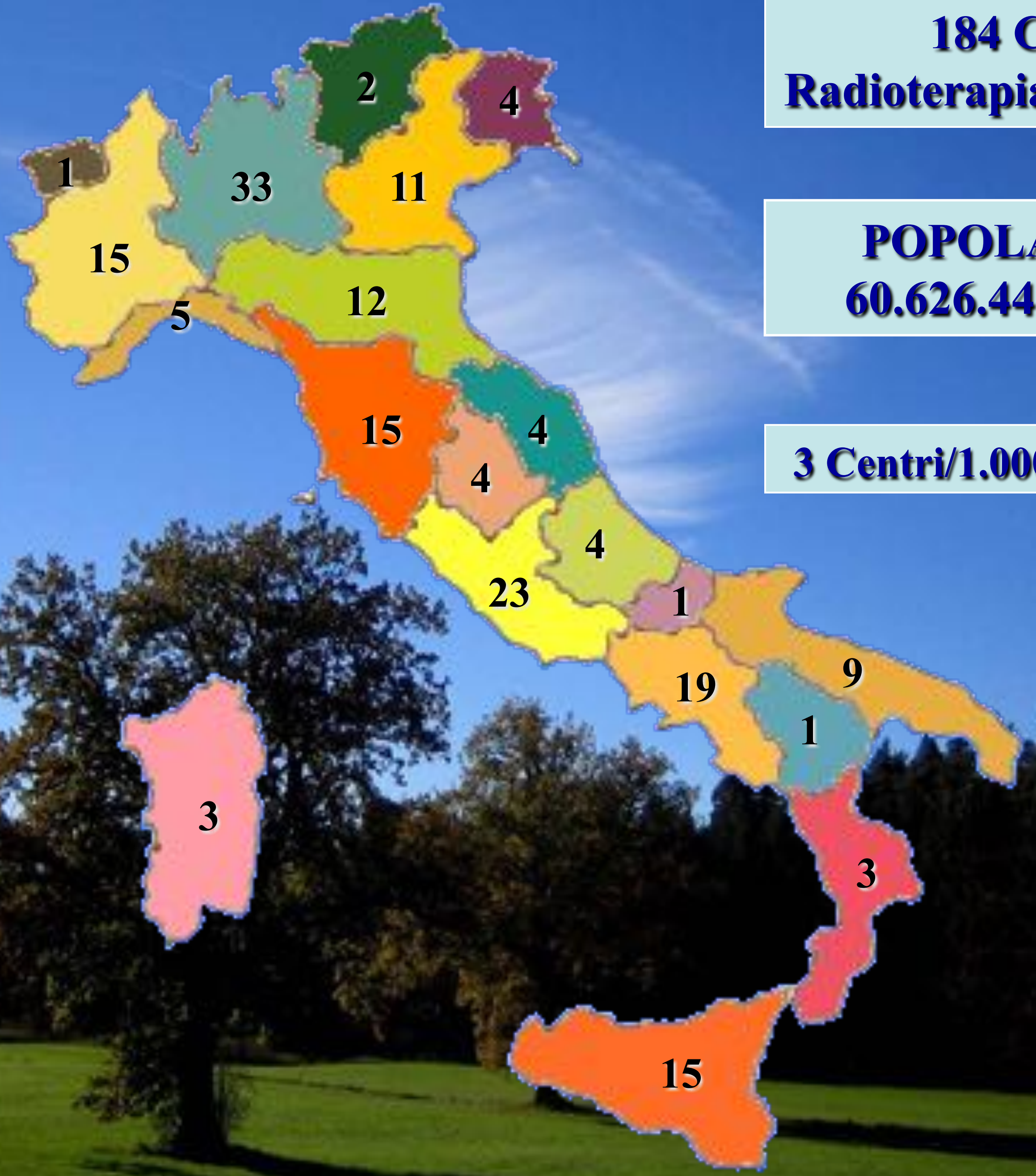
- Identificare standard operativi di livello elevato, implementandoli progressivamente e verificandone costantemente l'applicazione

- Realizzare tecniche di irradiazione innovative utilizzando le migliori risorse tecnologiche disponibili

184 Centri
Radioterapia Oncologica

POPOLAZIONE
60.626.442 abitanti

3 Centri/1.000.000 abitanti



Media Nazionale
3 Centri/1.000.000 abitanti

~ 3 Centri/1.000.000 abitanti

3,7 Centri/1.000.000 abitanti

2,6 Centri/1.000.000 abitanti

POPOLAZIONE
60.626.442 abitanti

184 Centri

83 Centri → 45%

27.763.261 ab. → 45,8%

51 Centri → 28%

13.612.468 ab. → 22,5%

50 Centri → 27%

19.250.713 ab. → 31,7%

DOTAZIONE TECNOLOGICA

Adroterapia
1

LinAc
361

~ 20%
≥ 10 anni

Tomotherapy
20

Cyberknife
8

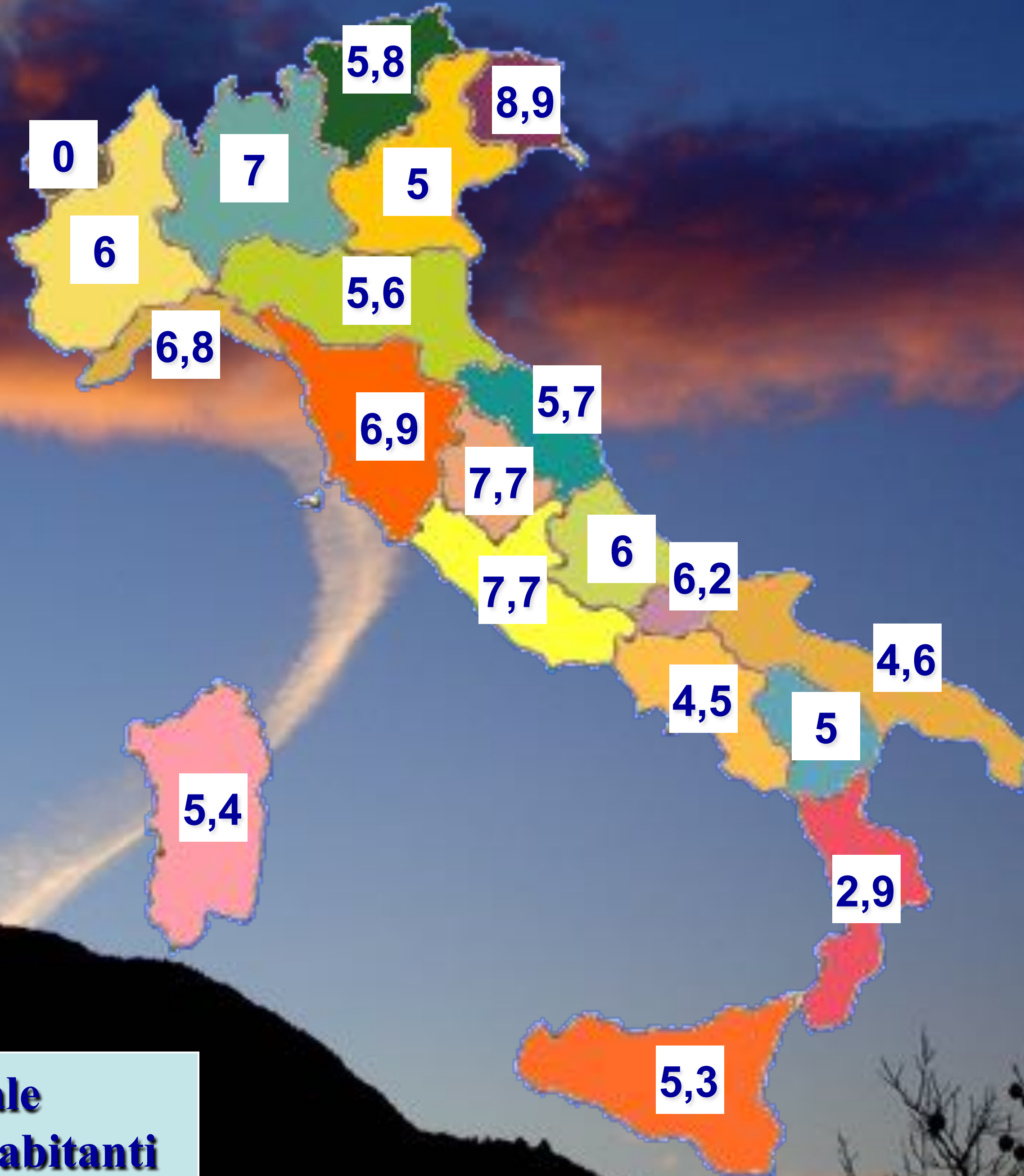
Vero
3

~ 60 LinAc dotati di sistemi IGRT [*Treatment Delivery Review*]

Gamma Knife
6

ACCELERATORI LINEARI

361

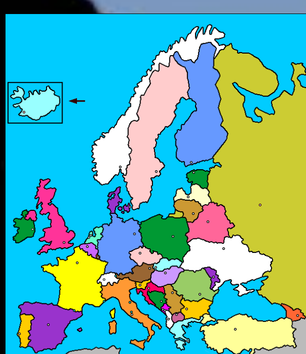


Media Nazionale
~ 6 LinAc/1.000.000 abitanti

Radiotherapy capacity in European countries: an analysis of the Directory of Radiotherapy Centres (DIRAC) database

E. Rosenblatt, Y. Anacak, Y. Pvinda, P. Scalliet, M. Boniol, P. Autier

Lancet Oncol Vol 14, Issue 2, Feb 2013



	Total population[10]	Number of radiotherapy centres	Number of megavoltage teletherapy machines	Mean number of megavoltage teletherapy machines per centre	Megavoltage teletherapy machines per million people	Number of linear accelerators	Number of cobalt-60 megavoltage teletherapy machines
Austria	8 443 018	16	43	2·7	5·1	42	1
Belgium	11 041 266	36	96	2·7	8·7	92	4
Bulgaria	7 327 224	13	15	1·2	2·0	5	10
Croatia	4 412 137	7	18	2·6	4·1	16	2
Cyprus	862 011	1	3	3·0	3·5	3	0
Czech Republic	10 504 203	34	59	1·7	5·6	45	14
Denmark	5 580 516	10	54	5·4	9·7	53	1
Estonia	1 339 662	2	4	2·0	3·0	4	0
Finland	5 401 267	13	45	3·5	8·3	45	0
France	65 397 912	177	426	2·4	6·5	416	10
Germany	81 843 809	289	529	1·8	6·5	508	21
Greece	11 290 785	27	48	1·8	4·3	37	11
Hungary	9 962 000	13	38	2·9	3·8	27	11
Iceland	319 575	1	2	2·0	6·3	2	0
Ireland	4 495 351	10	26	2·6	5·8	25	1
Italy	60 850 782	172	396	2·3	6·5	381	15
Latvia	2 042 371	4	11	2·8	5·4	9	2
Lithuania	3 199 771	5	11	2·2	3·4	9	2
Luxembourg	524 853	1	3	3·0	5·7	3	0
Macedonia	2 059 794	1	3	3·0	1·5	2	1
Malta	420 085	1	2	2·0	4·8	1	1
Norway	4 985 870	10	38	3·8	7·6	37	1
Poland	38 208 618	29	107	3·7	2·8	101	6
Portugal	10 541 840	21	48	2·3	4·6	46	2
Romania	21 355 849	19	28	1·5	1·3	12	16
Slovakia	5 404 322	14	26	1·9	4·8	16	10
Slovenia	2 055 496	1	7	7·0	3·4	6	1
Spain	46 196 277	117	250	2·1	5·4	216	34
Sweden	9 482 855	19	78	4·1	8·2	78	0
Switzerland	7 952 555	30	75	2·5	9·4	70	5
Netherlands	16 730 348	22	127	5·8	7·6	127	0
Turkey	74 724 269	95	201	2·1	2·7	143	58
United Kingdom	62 435 709	76	340	4·5	5·4	335	5
Total	597 392 400	1286	3157	2·5	5·3	2912	245

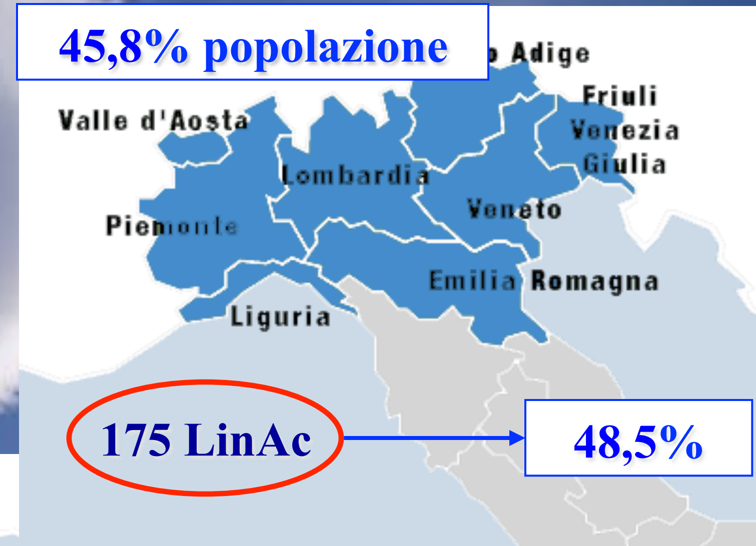
Table 1: Teletherapy centres and equipment in 33 European countries (July, 2012)

Media Nazionale
~ 6 LinAc/1.000.000 abitanti

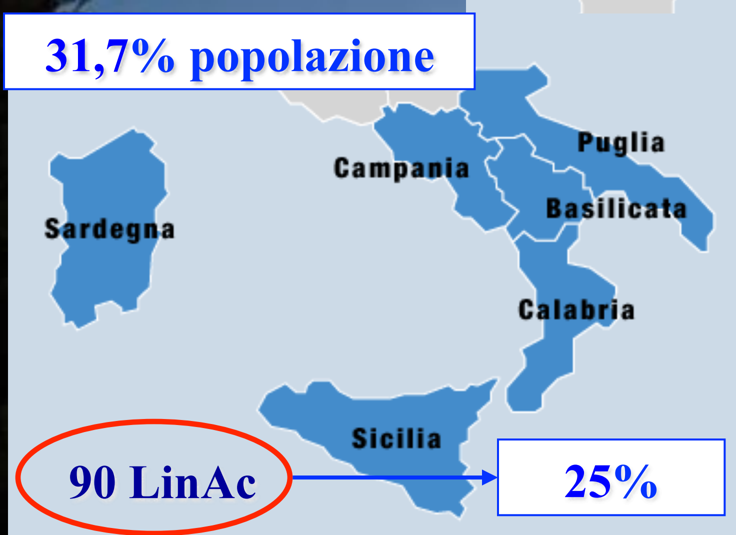
6,3 LinAc/1.000.000 abitanti

7 LinAc/1.000.000 abitanti

4,7 LinAc/1.000.000 abitanti


45,8% popolazione
Adige
Valle d'Aosta
Friuli
Venezia
Giulia
Lombardia
Piemonte
Veneto
Emilia Romagna
Liguria
175 LinAc
48,5%


22,5% popolazione
Toscana
Le Marche
Umbria
Abruzzo
Lazio
Molise
96 LinAc
26,5%


31,7% popolazione
Puglia
Campania
Basilicata
Sardegna
Calabria
Sicilia
90 LinAc
25%

Popolazione	Centri	LinAc
45,8%	45%	48,5%

Popolazione	Centri	LinAc
22,5%	28%	26,5%

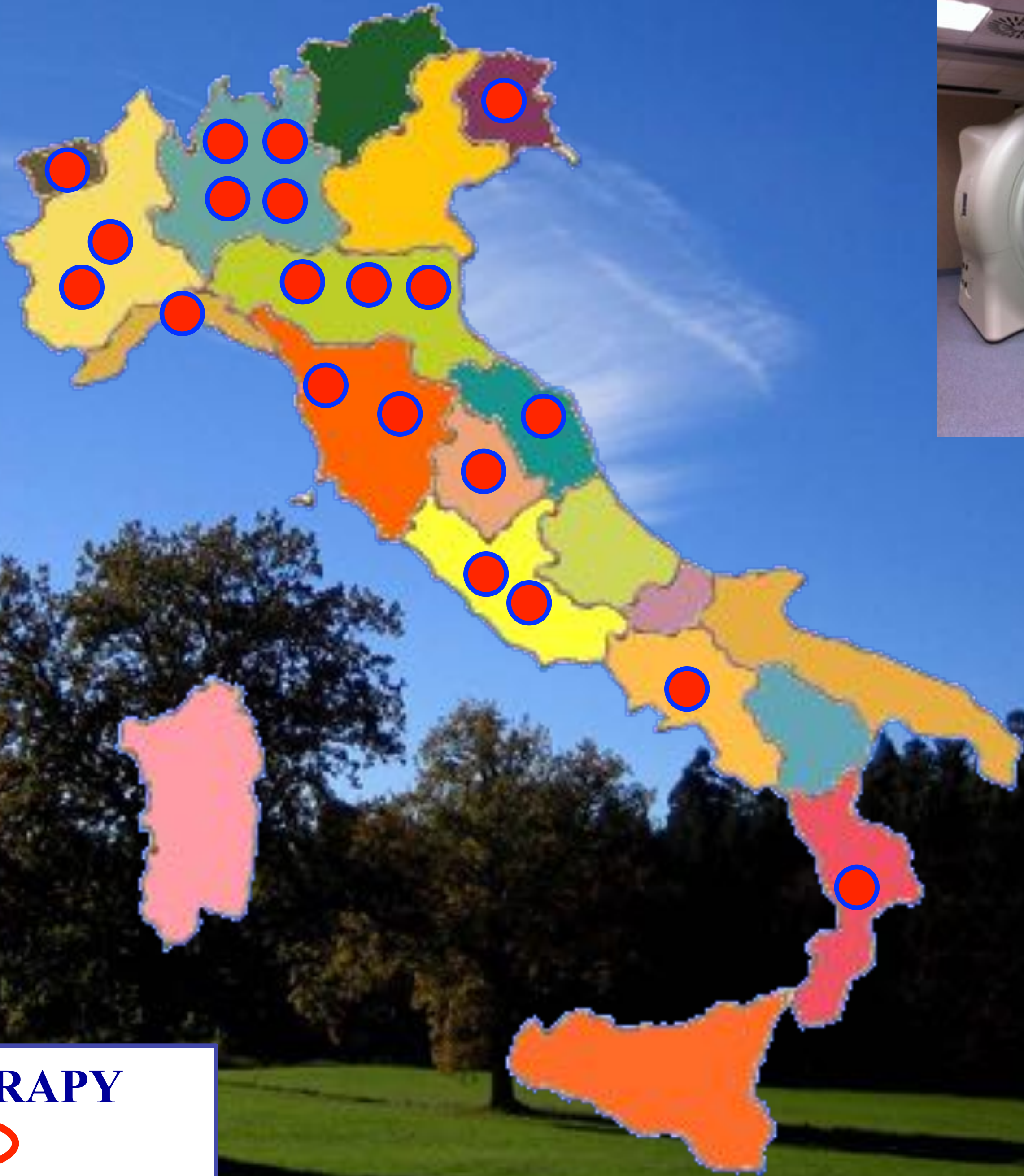
Popolazione	Centri	LinAc
31,7%	27%	25%

DOTAZIONE TECNOLOGICA

↓

DISOMOGENEITÀ TERRITORIALE

- Adeguata
- Sufficiente
- Inadeguata



TOMOTHERAPY

20

CYBERKNIFE

10

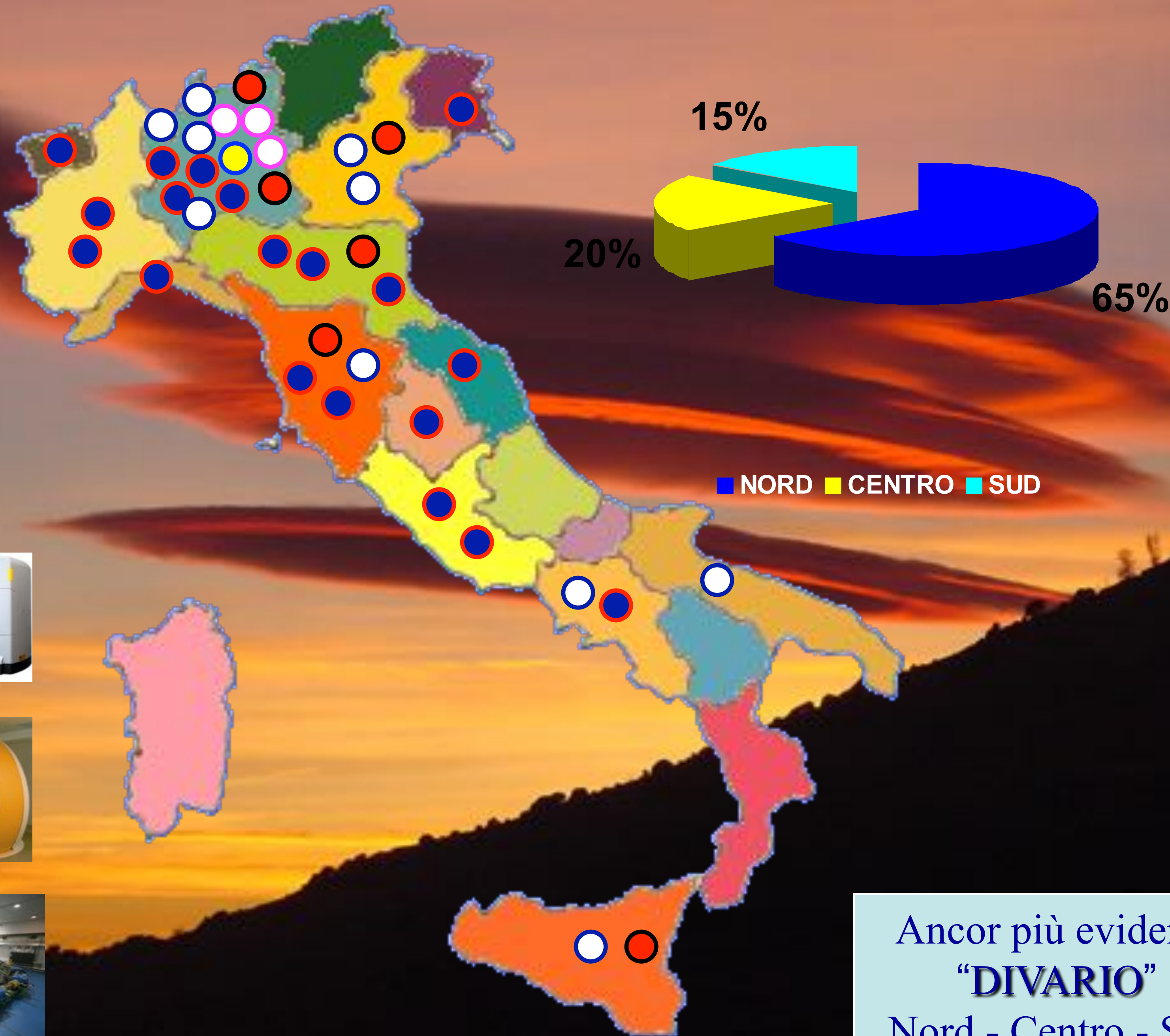
GAMMA KNIFE

6

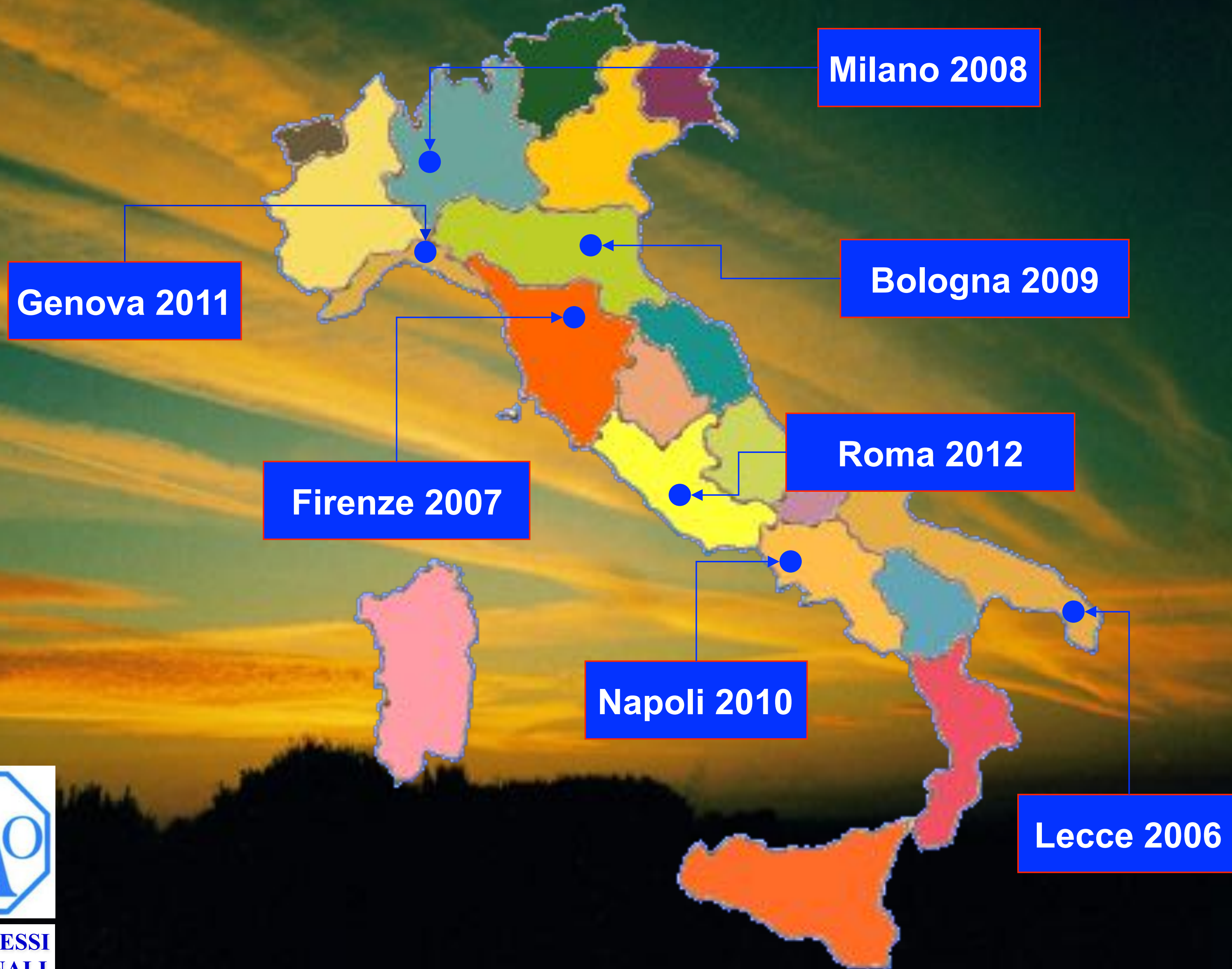

VERO
3

ADROTERAPIA

1

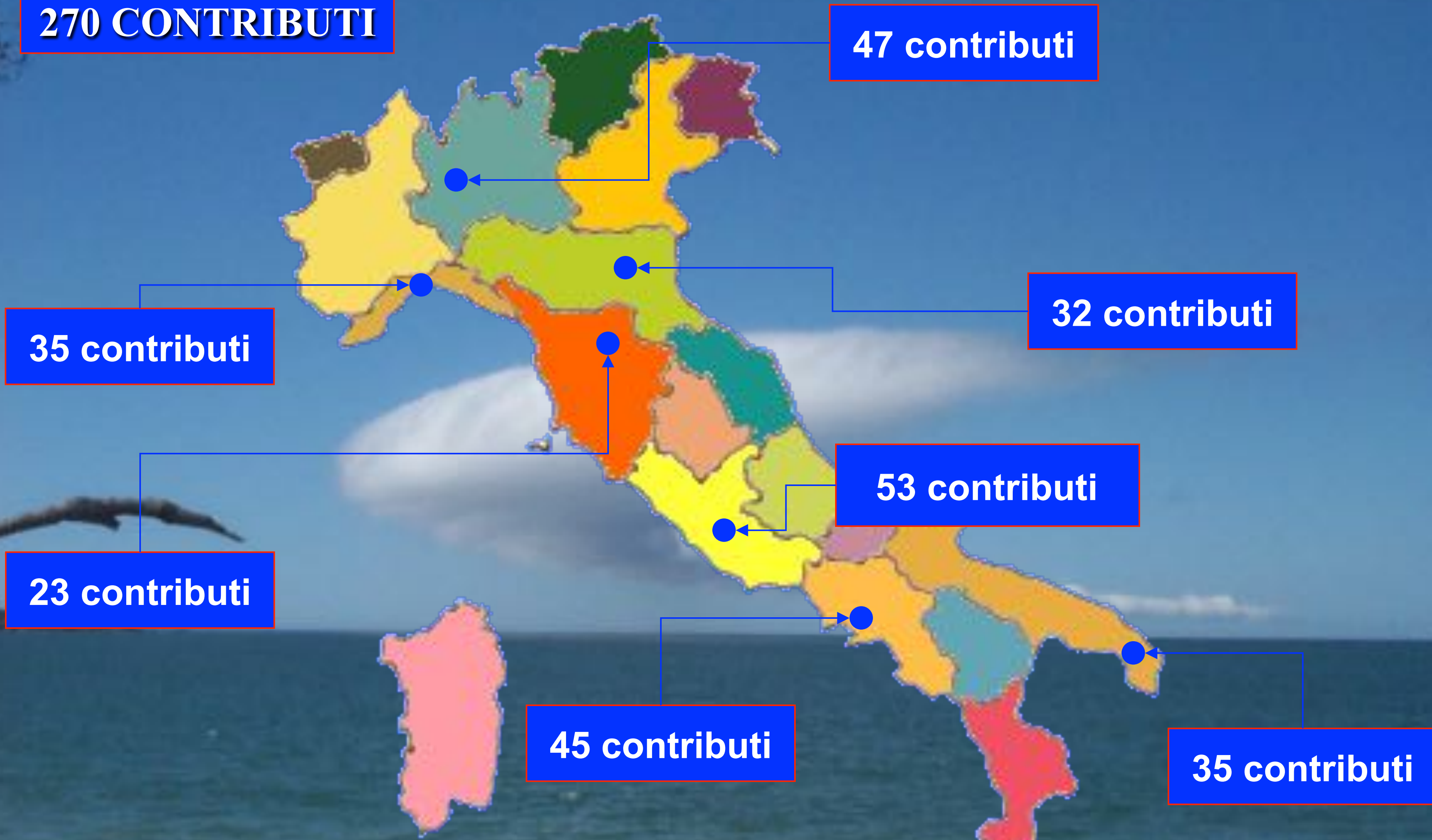


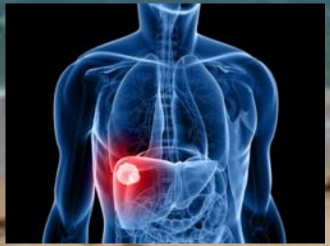
Ancor più evidente
"**DIVARIO**"
Nord - Centro - Sud

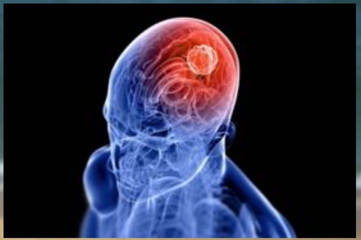


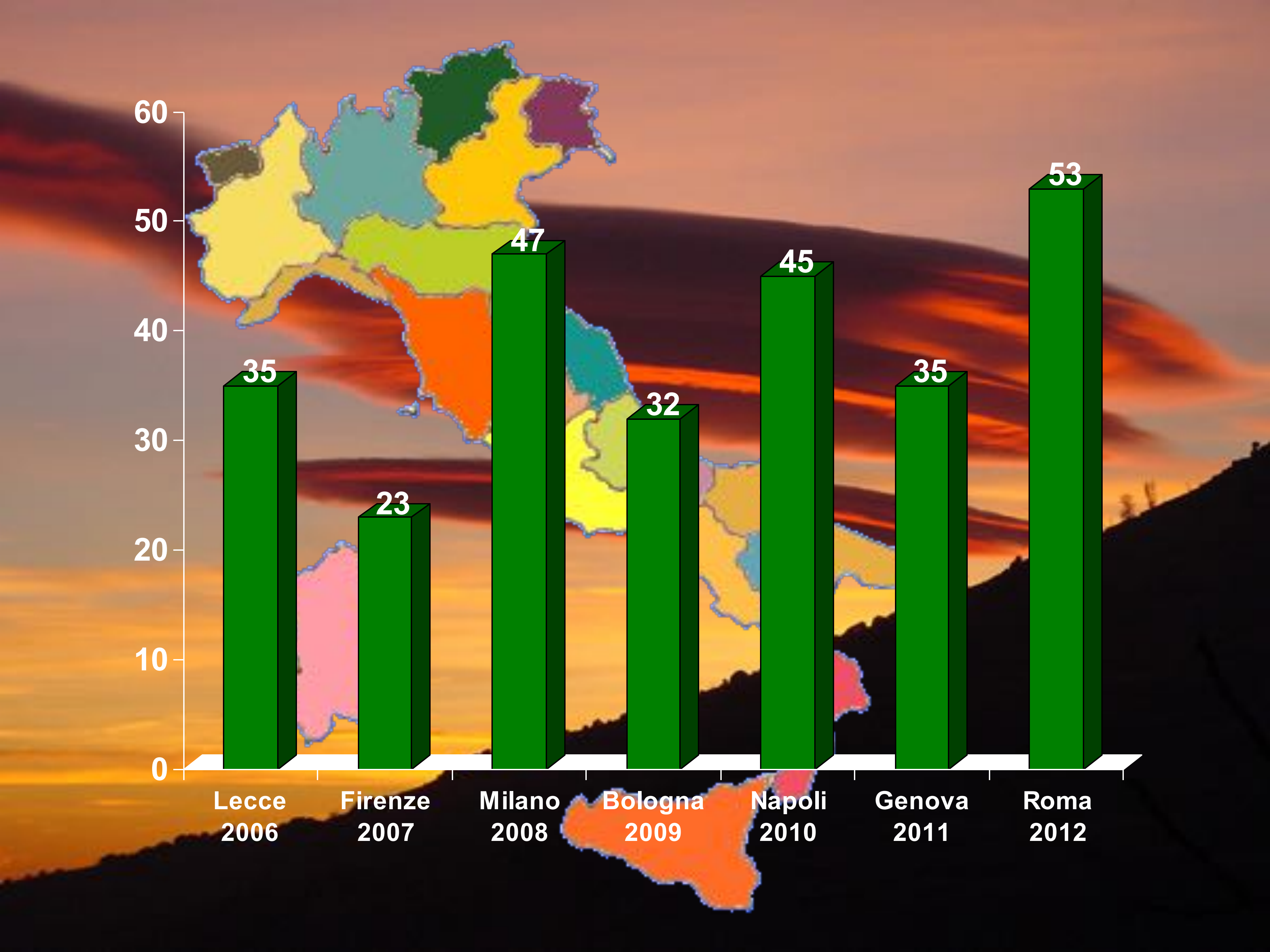
CONGRESSI
NAZIONALI

270 CONTRIBUTI







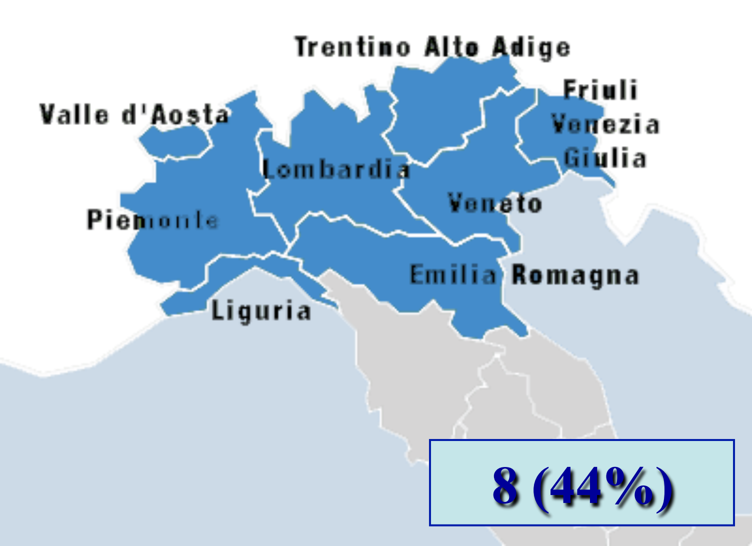

60
50
40
30
20
10
0
35
23
47
32
45
35
53
Lecce 2006
Firenze 2007
Milano 2008
Bologna 2009
Napoli 2010
Genova 2011
Roma 2012

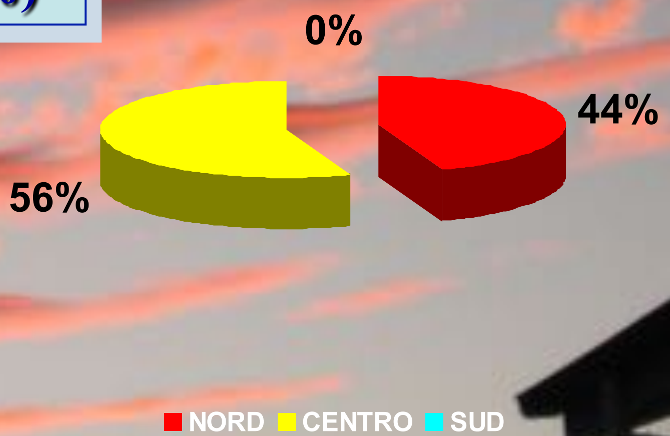
XVI Congresso Nazionale AIRO
Lecce 2006

35 contributi

TECNICHE AD ALTO GRADIENTE DI DOSE
18 (51,4%)

TECNICHE AD ALTO GRADIENTE DI DOSE
18 (51,4%)



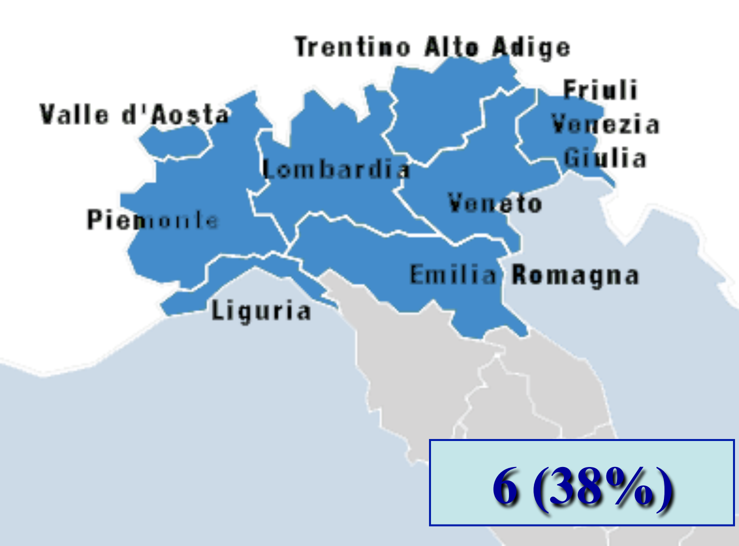


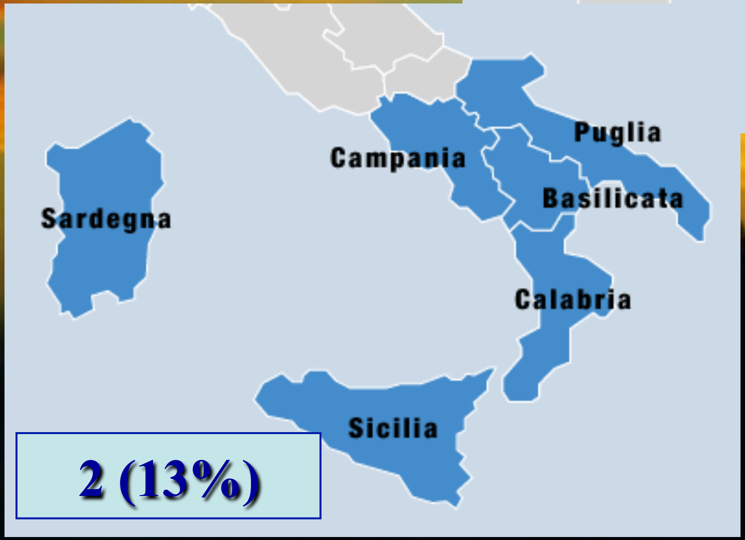
XVII Congresso Nazionale AIRO
Firenze 2007

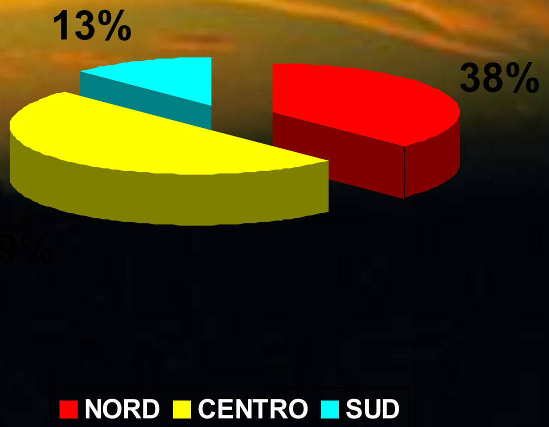
23 contributi

TECNICHE AD ALTO GRADIENTE DI DOSE
16 (69,6%)

TECNICHE AD ALTO GRADIENTE DI DOSE 16 (69,6%)





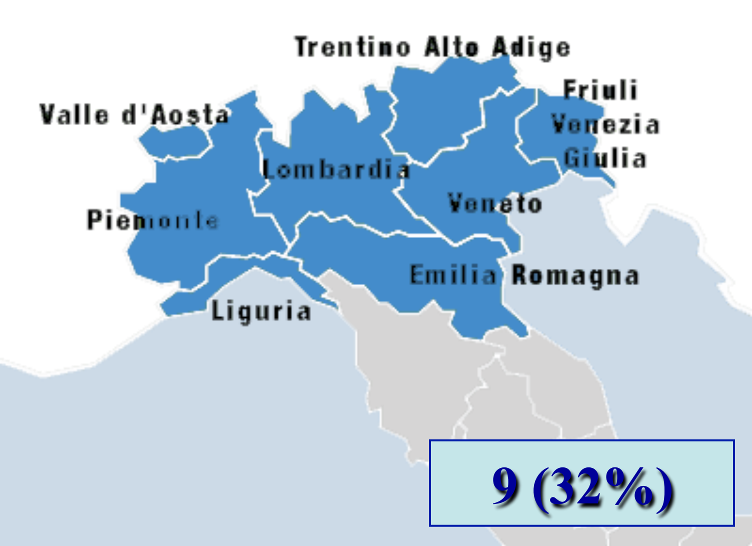


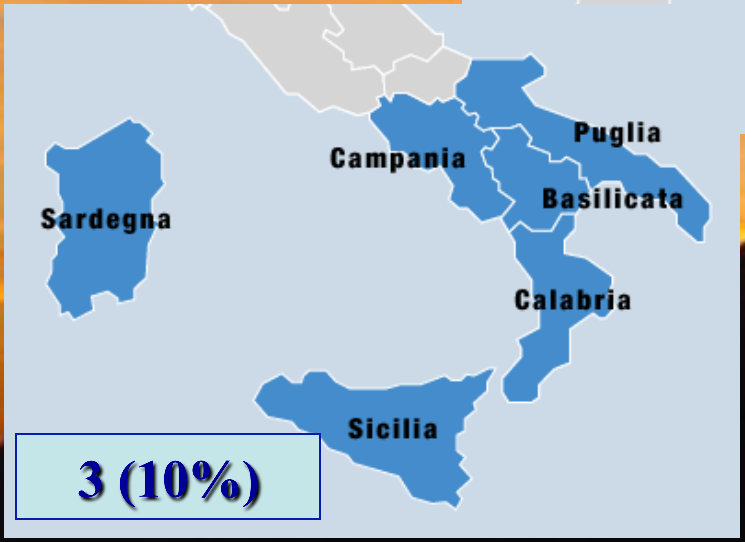
XVIII Congresso Nazionale AIRO
Milano 2008

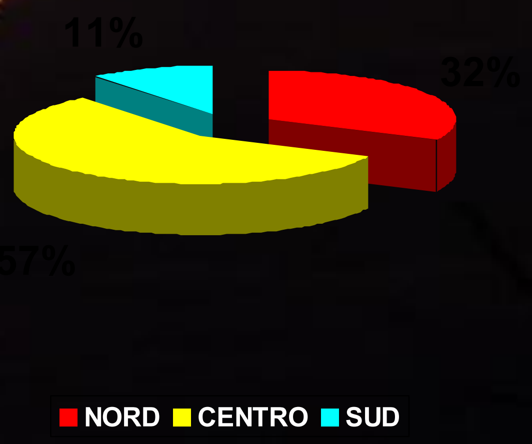
47 contributi

TECNICHE AD ALTO GRADIENTE DI DOSE
28 (59,6%)

TECNICHE AD ALTO GRADIENTE DI DOSE
28 (59,6%)

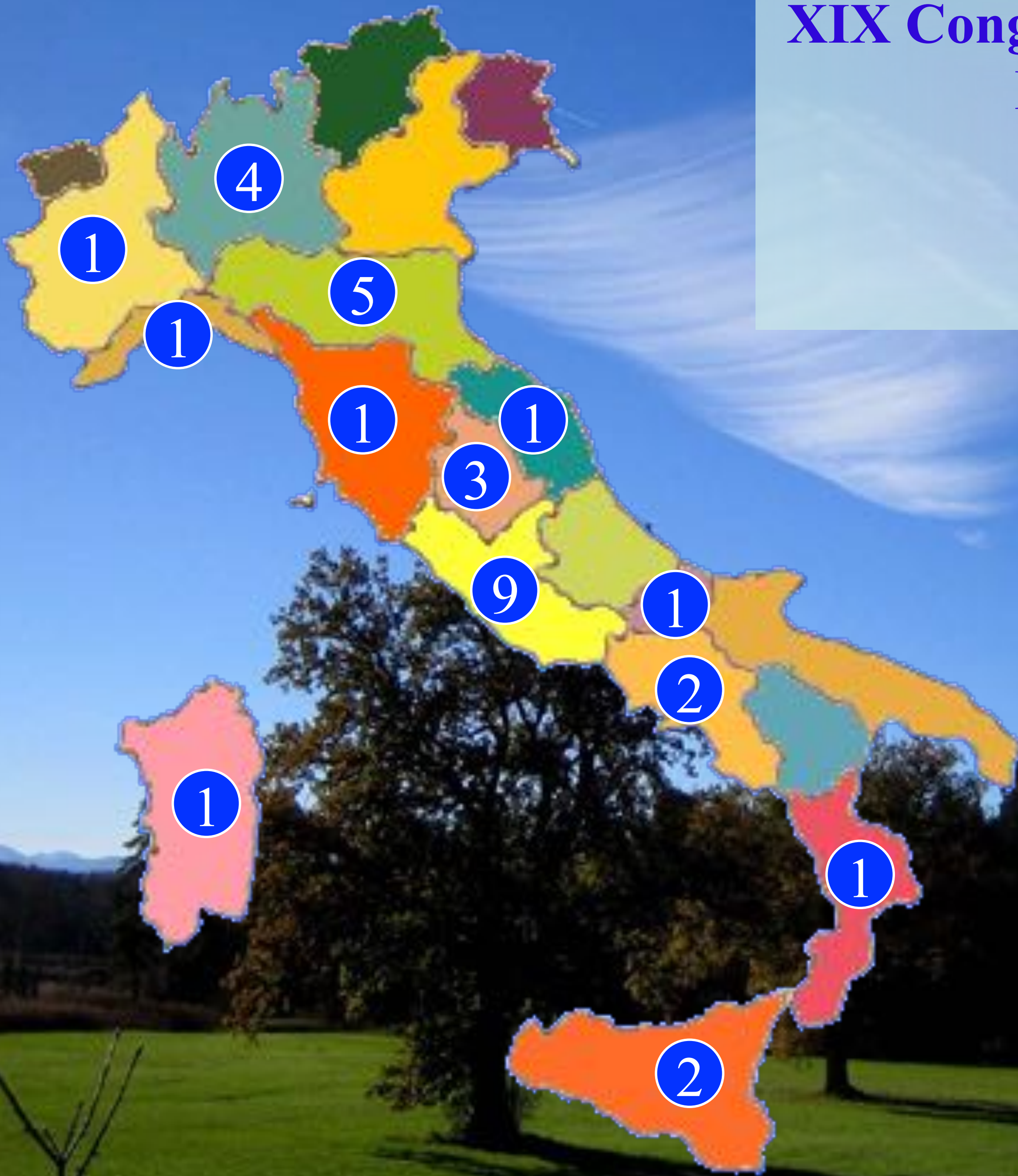






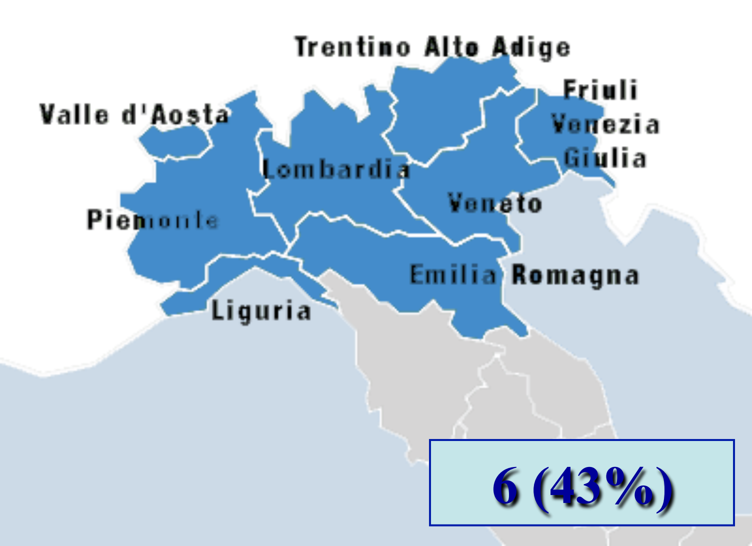
XIX Congresso Nazionale AIRO
Bologna 2009

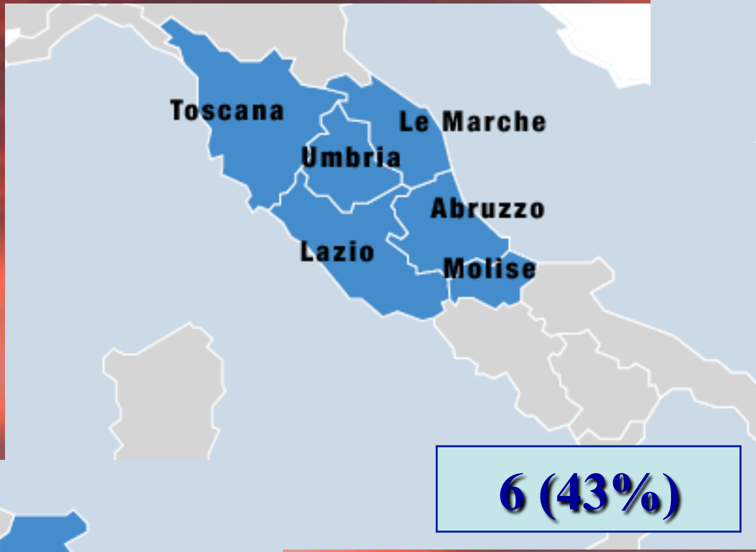
32 contributi

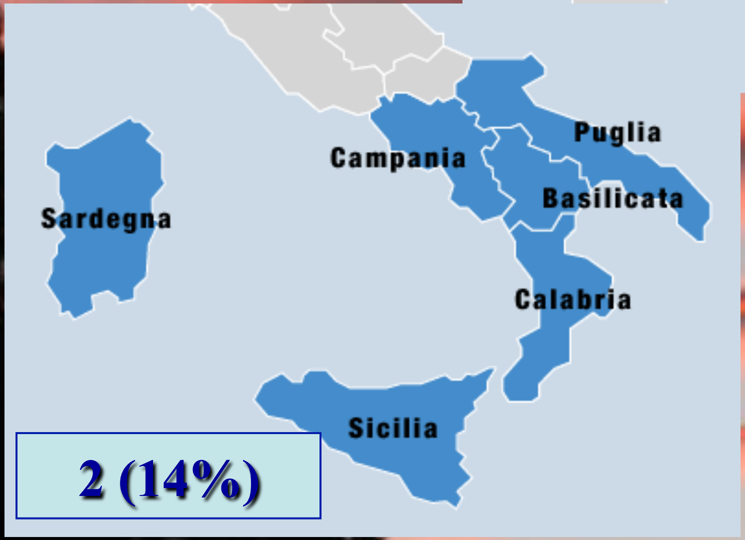


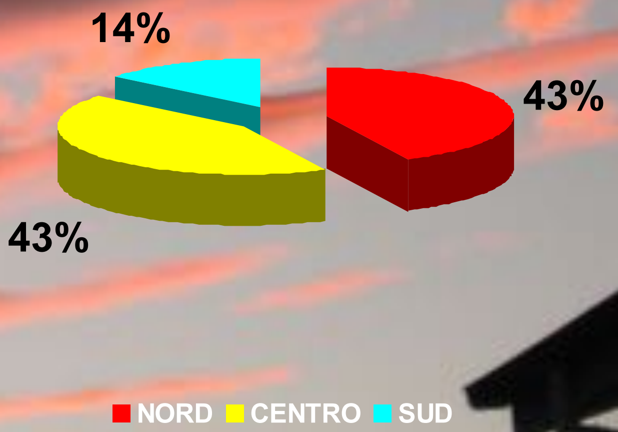
TECNICHE AD ALTO GRADIENTE DI DOSE
14 (43,8%)

TECNICHE AD ALTO GRADIENTE DI DOSE 14 (43,8%)







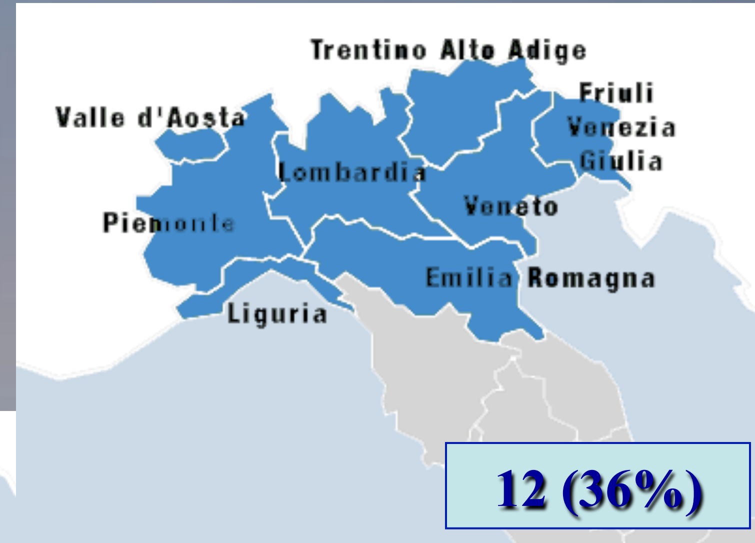


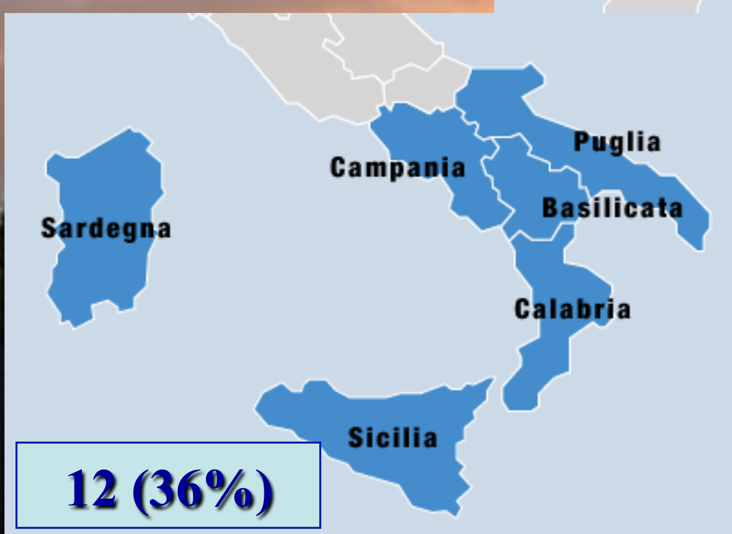
XX Congresso Nazionale AIRO
Napoli 2010

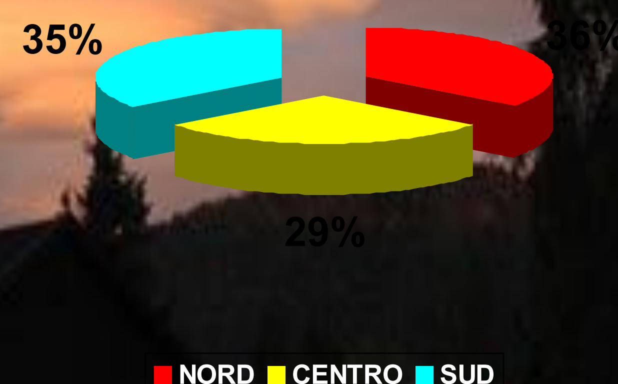
45 contributi

TECNICHE AD ALTO GRADIENTE DI DOSE
34 (75,6%)

TECNICHE AD ALTO GRADIENTE DI DOSE
34 (75,6%)





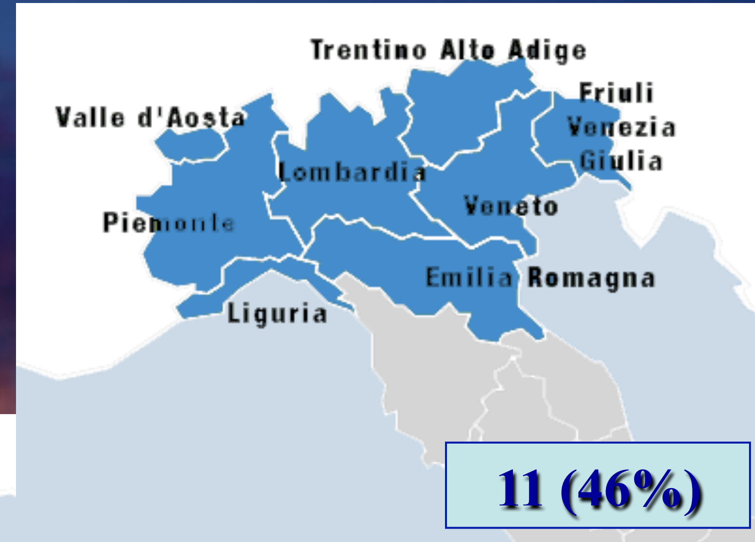


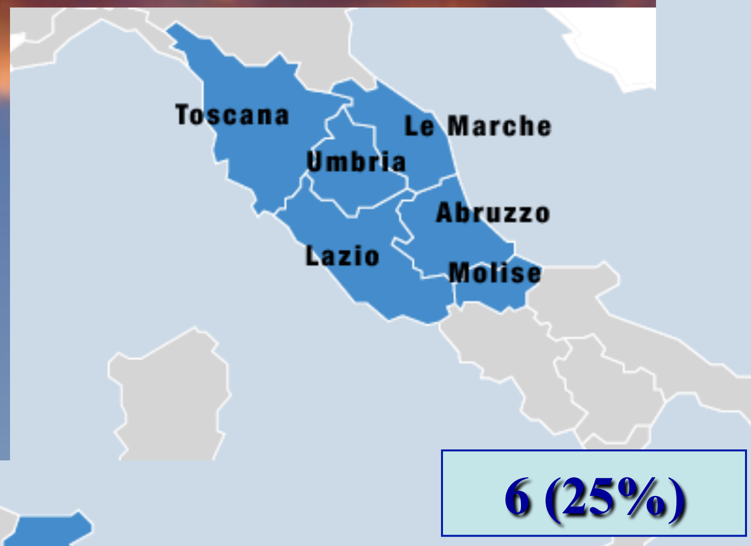
XXI Congresso Nazionale AIRO
Genova 2011

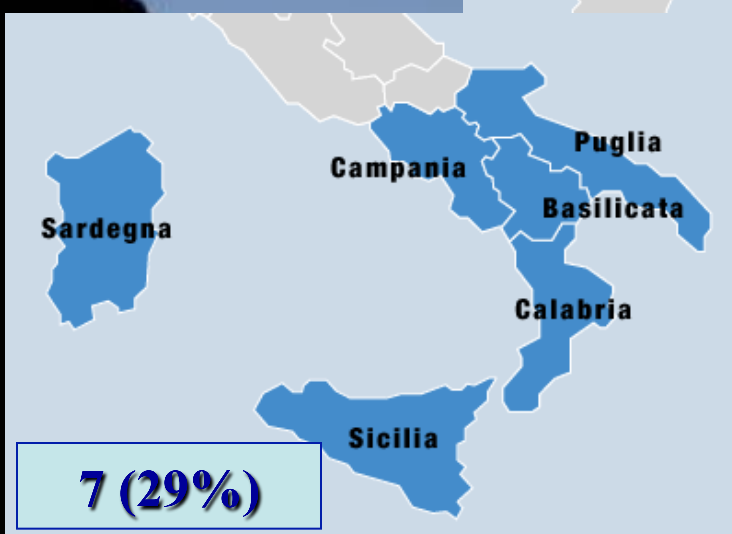
35 contributi

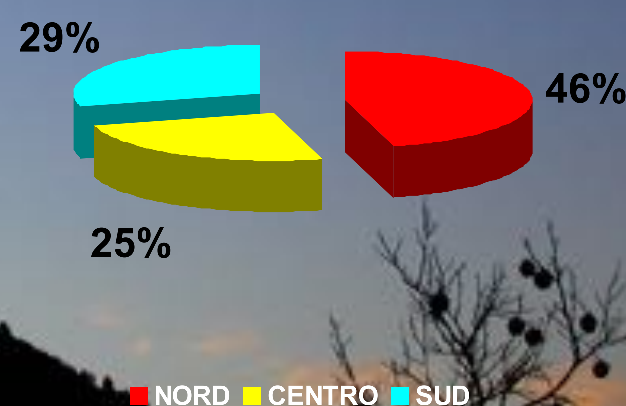
TECNICHE AD ALTO GRADIENTE DI DOSE
24 (68,6%)

TECNICHE AD ALTO GRADIENTE DI DOSE
24 (68,6%)







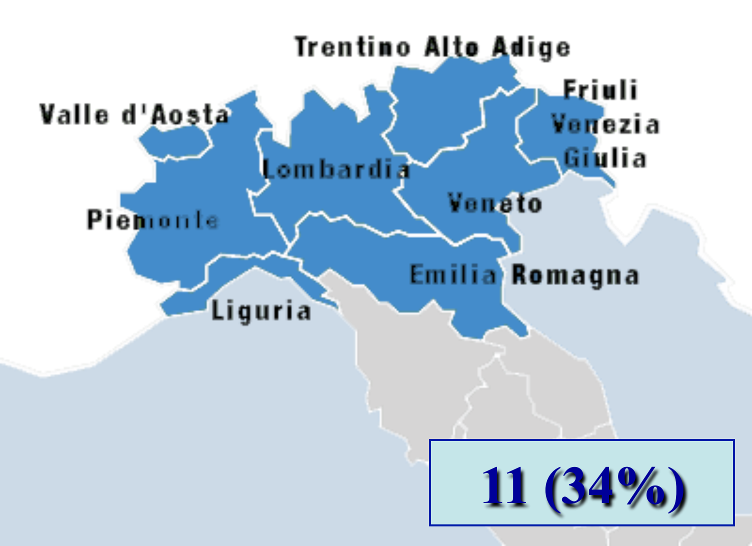


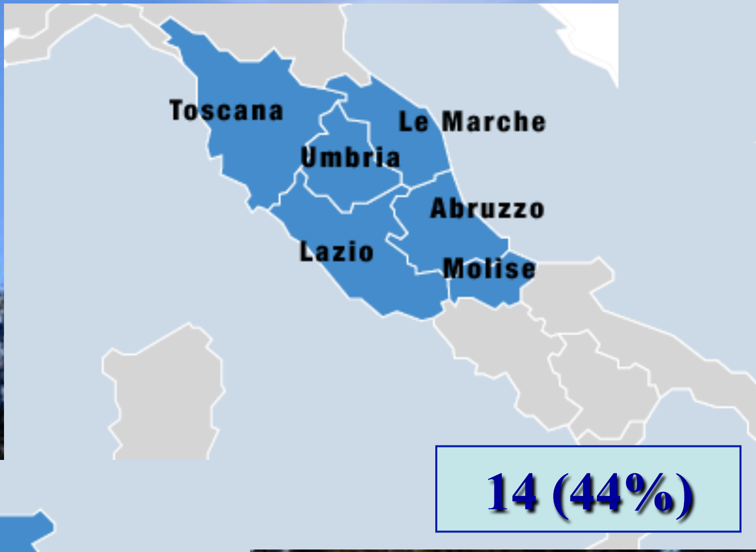
XXII Congresso Nazionale AIRO
Roma 2012

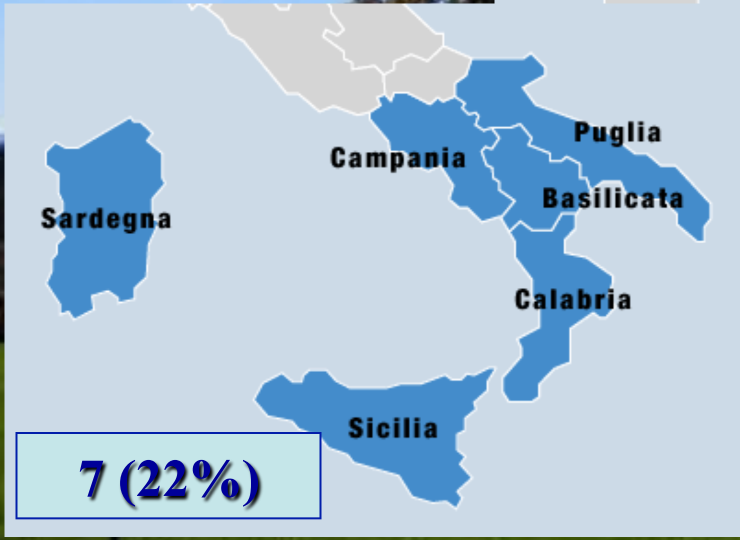
53 contributi

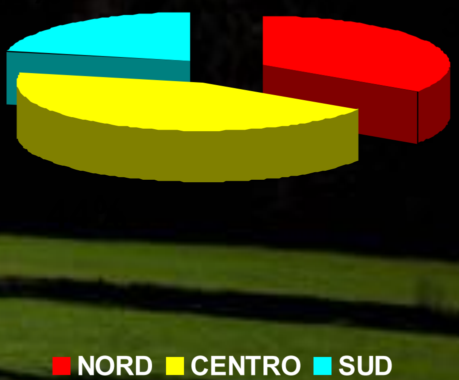
TECNICHE AD ALTO GRADIENTE DI DOSE
32 (60,4%)

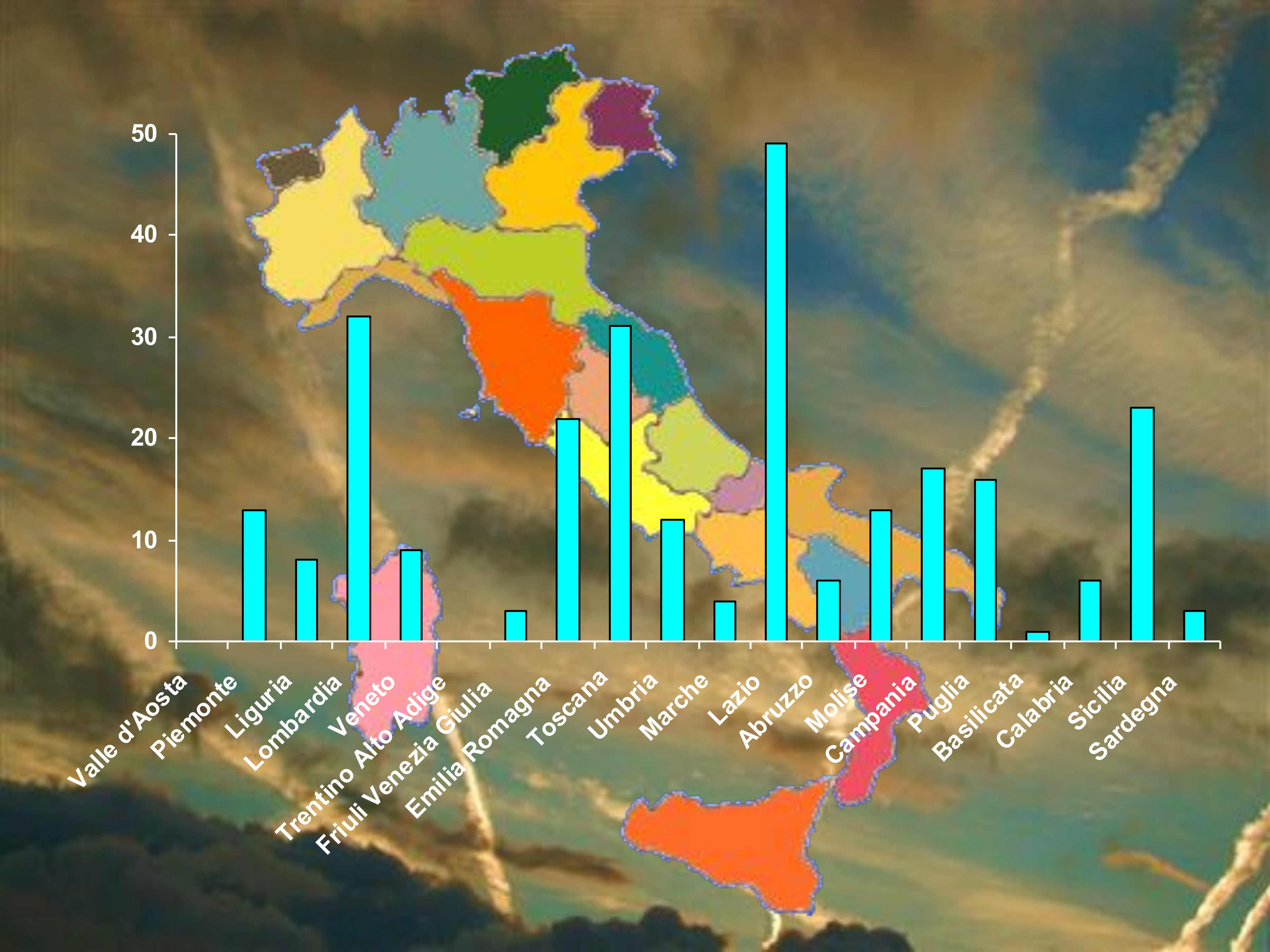
TECNICHE AD ALTO GRADIENTE DI DOSE
32 (60,4%)





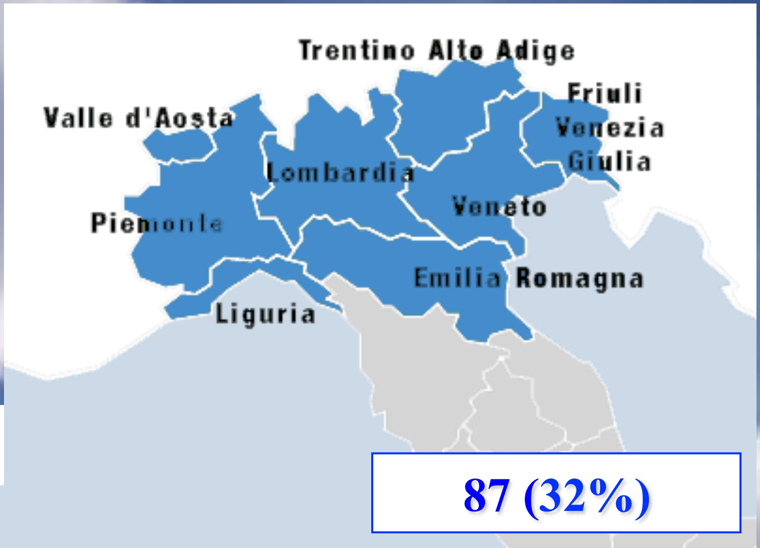


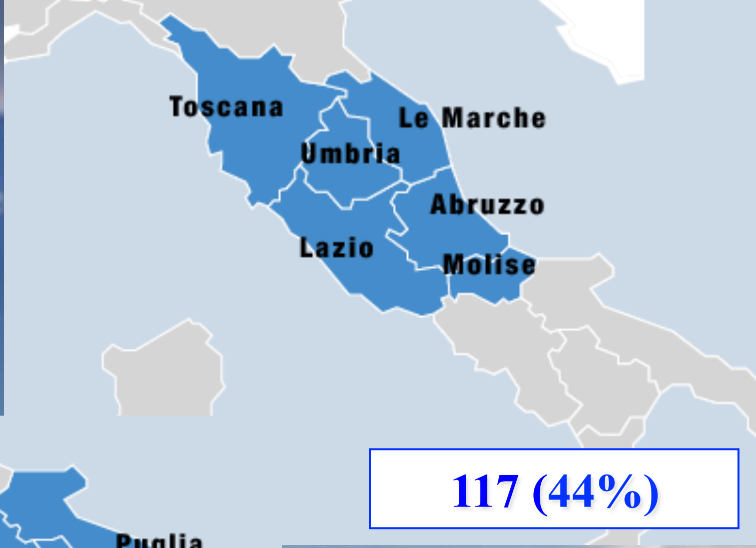


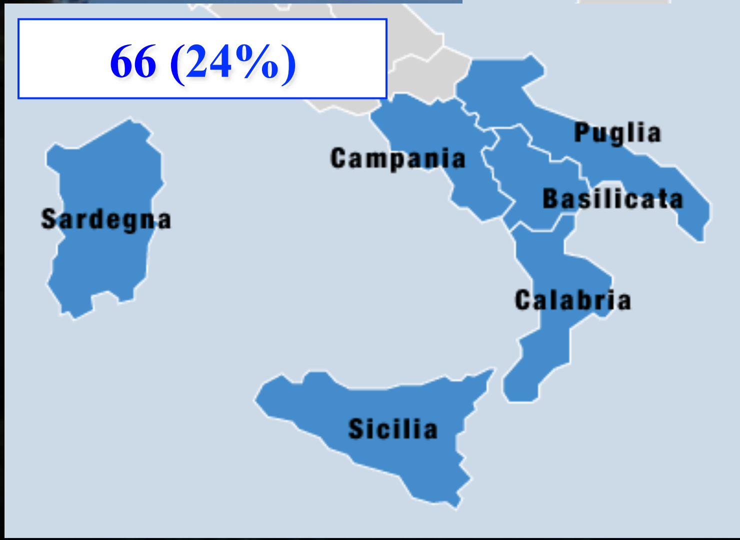


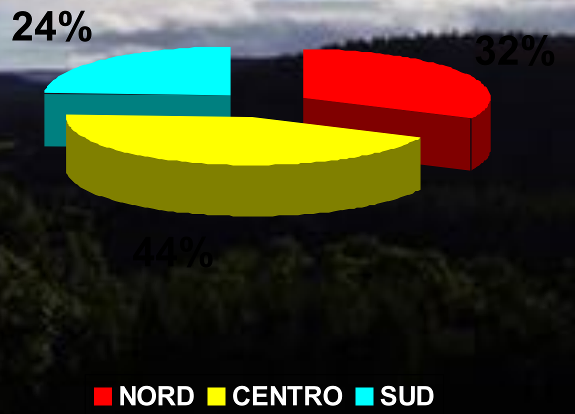
50
40
30
20
10
0
Valle d'Aosta
Piemonte
Liguria
Lombardia
Veneto
Trentino Alto Adige
Friuli Venezia Giulia
Emilia Romagna
Toscana
Umbria
Marche
Lazio
Abruzzo
Molise
Campania
Puglia
Basilicata
Calabria
Sicilia
Sardegna

270 Contributi
Congressi Nazionali AIRO
2006-2012

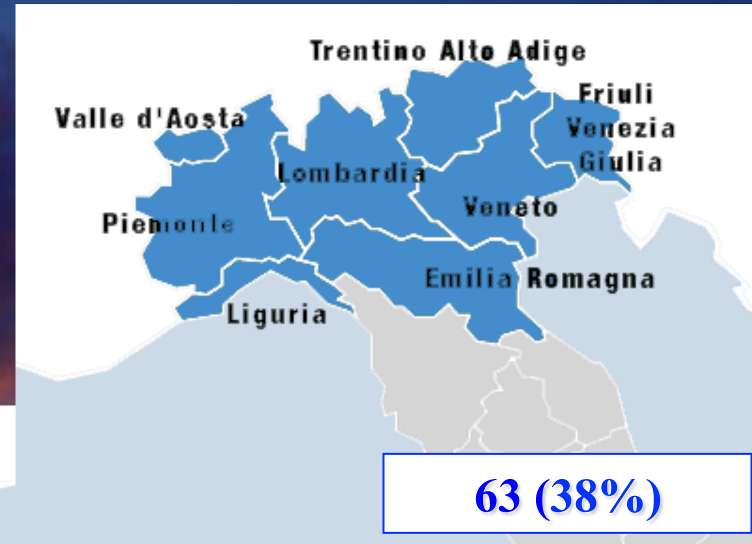


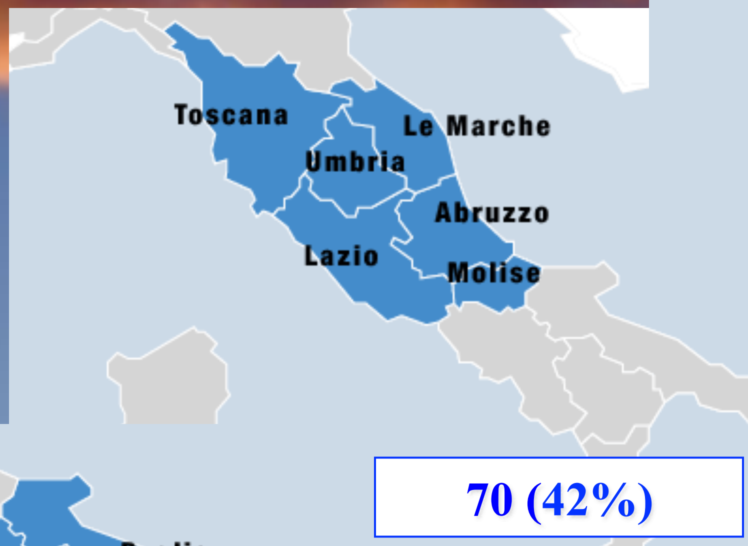


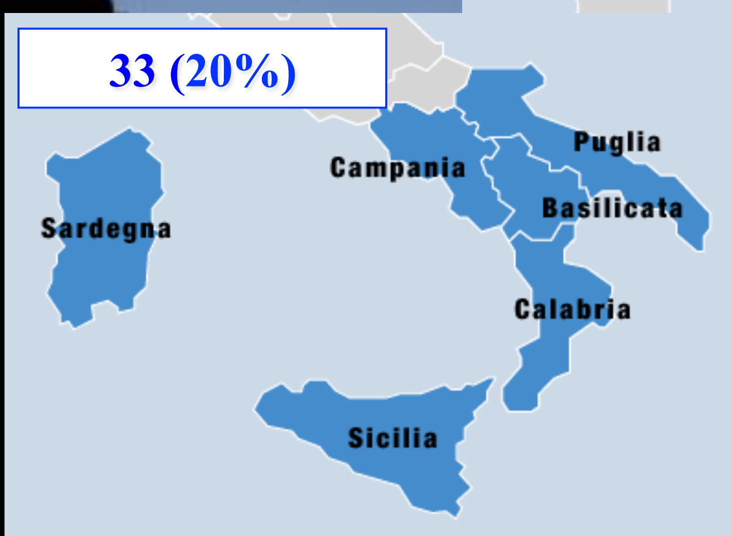


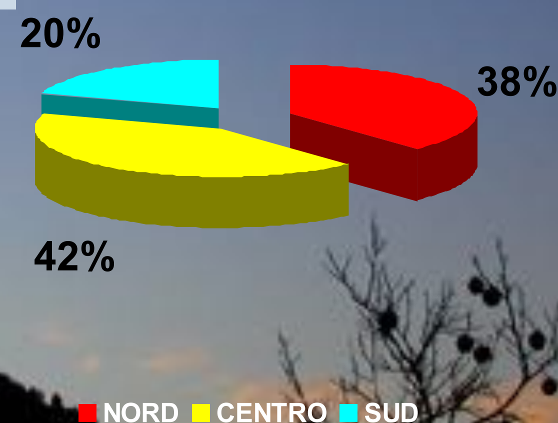


Congressi Nazionali AIRO 2006-2012
166 Contributi
TECNICHE AD ALTO GRADIENTE DI DOSE





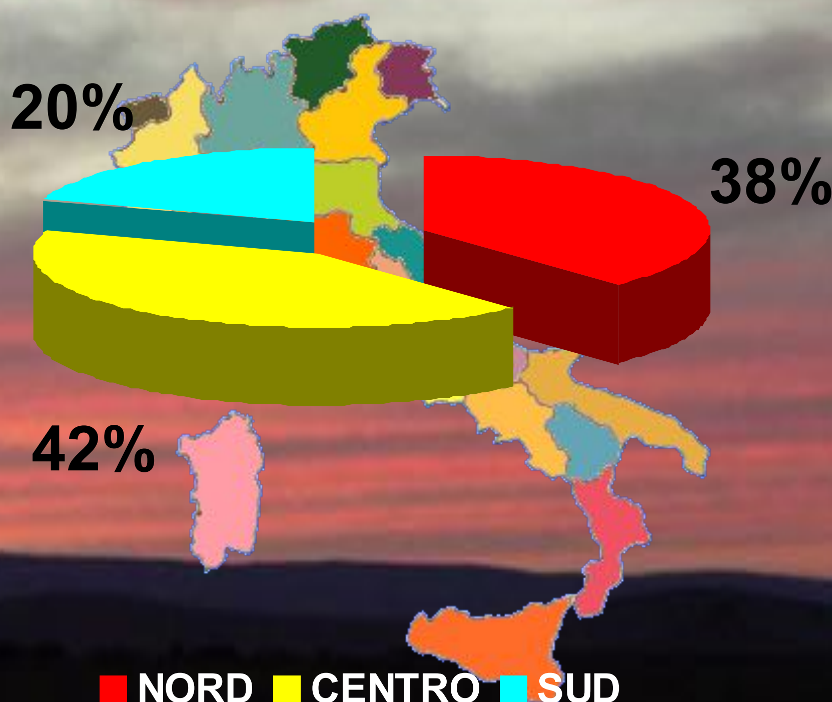




Popolazione	Centri	LinAc	High Technology
45,8%	45%	48,5%	65%

Popolazione	Centri	LinAc	High Technology
22,5%	28%	26,5%	20%

Popolazione	Centri	LinAc	High Technology
31,7%	27%	25%	15%



CONCLUSIONI

- **BUON LIVELLO DI INNOVAZIONE TECNOLOGICA, SEPPUR CON DISOMOGENEA DISTRIBUZIONE SUL TERRITORIO NAZIONALE**

- **BUON LIVELLO DI PRODUZIONE SCIENTIFICA, MA ANCOR PIÙ EVIDENTE DISOMOGENEITÀ TERRITORIALE**

PAESE A DIVERSE VELOCITÀ...

Johann Wolfgang von Goethe
(1749-1842)

"Es ist nicht genug zu wissen; man muß auch anwenden; es ist nicht genug zu wollen: man muß auch tun"

"La conoscenza non è sufficiente, dobbiamo applicarla. La volontà non è abbastanza, dobbiamo agire"

PER ANDARE OLTRE LE DIFFICOLTÀ

GRAZIE PER L'ATTENZIONE