National Audit in the UK

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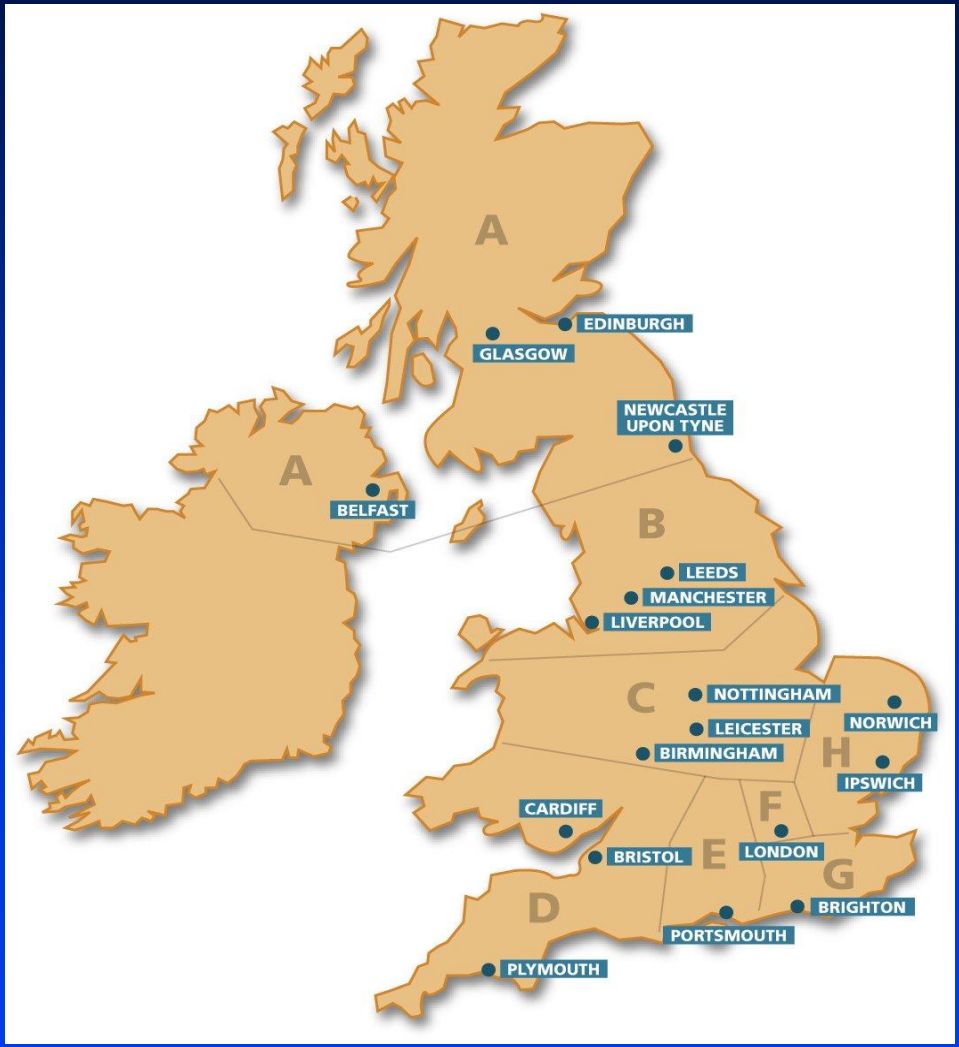
National Interdepartmental
Audit Group

UK Audit Groups



Group A Scottish + Northern

Group B Trans Pennine

Group C Midlands

Group D South West

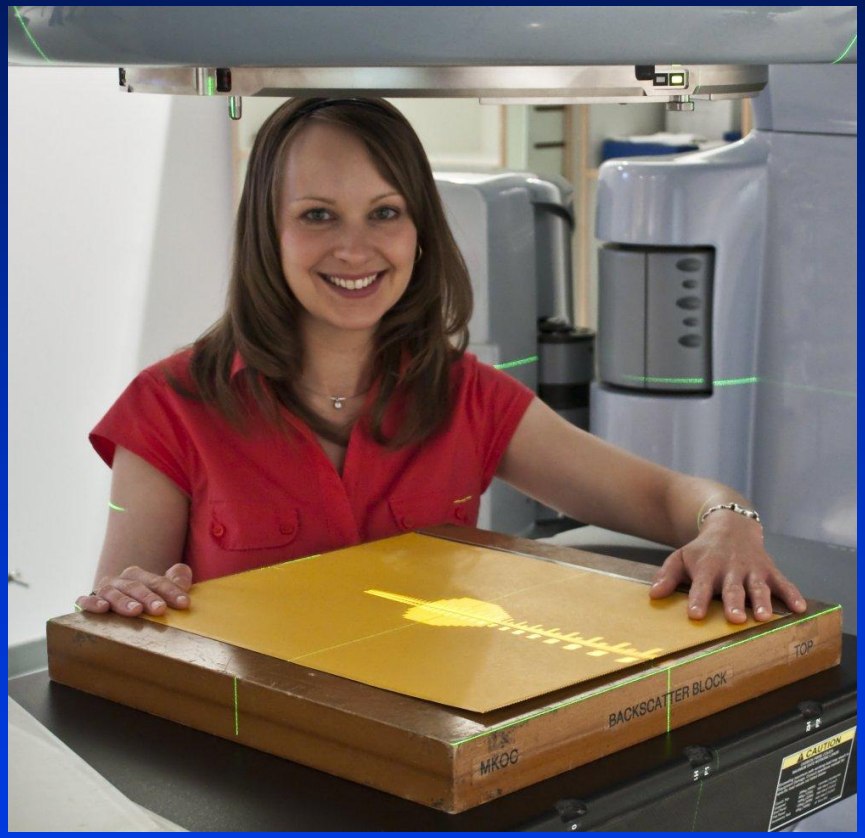
Group E South East Central

Group F N. E. Thames

Group G S. E. Thames

Group H Anglia

Scope Article 2009



Dramatic technological developments in radiotherapy are challenging audit to keep pace and deliver its aims of maintaining safe radiotherapy delivery in the UK.

A difficult challenge but an awesome motivation

New York Times Jan 23 2010

The New York Times

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Radiation Offers New Cures, and Ways to Do Harm

Published: January 23, 2010

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Because New York State is a leader in monitoring radiotherapy and collecting data about errors, The Times decided to examine patterns of accidents there and spent months obtaining and analyzing records. Even though many accident details are confidential under state law, the records described 621 mistakes from 2001 to 2008. While most were minor, causing no immediate injury, they nonetheless illuminate underlying problems.

Enlarge This Image

Scott Jerome-Parks, with his wife, Carmen, was 43 when he died in 2007 from a radiation overdose. More Photos »

The Radiation Boom

When Treatment Goes Awry

This is the first in a series of articles that will examine issues arising from the increasing use of medical radiation and the new technologies that deliver it.

The Times found that on 133 occasions, devices used to shape or modulate radiation beams — contributing factors in the injuries to Mr. Jerome-Parks and Ms. Jn-Charles — were left out, wrongly positioned or otherwise misused.

On 284 occasions, radiation missed all or part of its intended target or treated the wrong body part entirely. In one case, radioactive seeds intended for a man's cancerous prostate were instead implanted in the base of his penis. Another patient with stomach cancer was treated for prostate cancer. Fifty patients received radiation intended for someone else, including one brain cancer patient who received radiation intended for breast cancer.

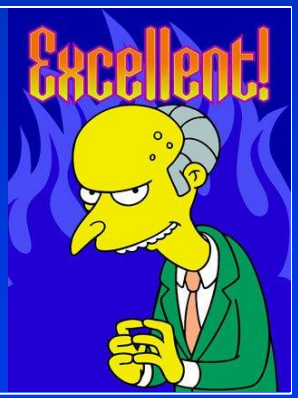
New York health officials became so alarmed about mistakes and the underreporting of accidents that they issued a special alert in December 2004, asking hospitals to be more vigilant.

NY Times Quotes

A single error that becomes embedded in a treatment plan can be repeated in multiple radiation sessions. Many of these mistakes could have been caught had basic checking protocols been followed

"If you radiate a person wrong, there's no repeat — you can't say, 'Let's forget about that one and do it correct next time"

In radiotherapy, avoiding an outside, independent review is a calculated gamble. Part of the problem is that hospitals may skimp on quality assurance because, depending on the state, it is voluntary.



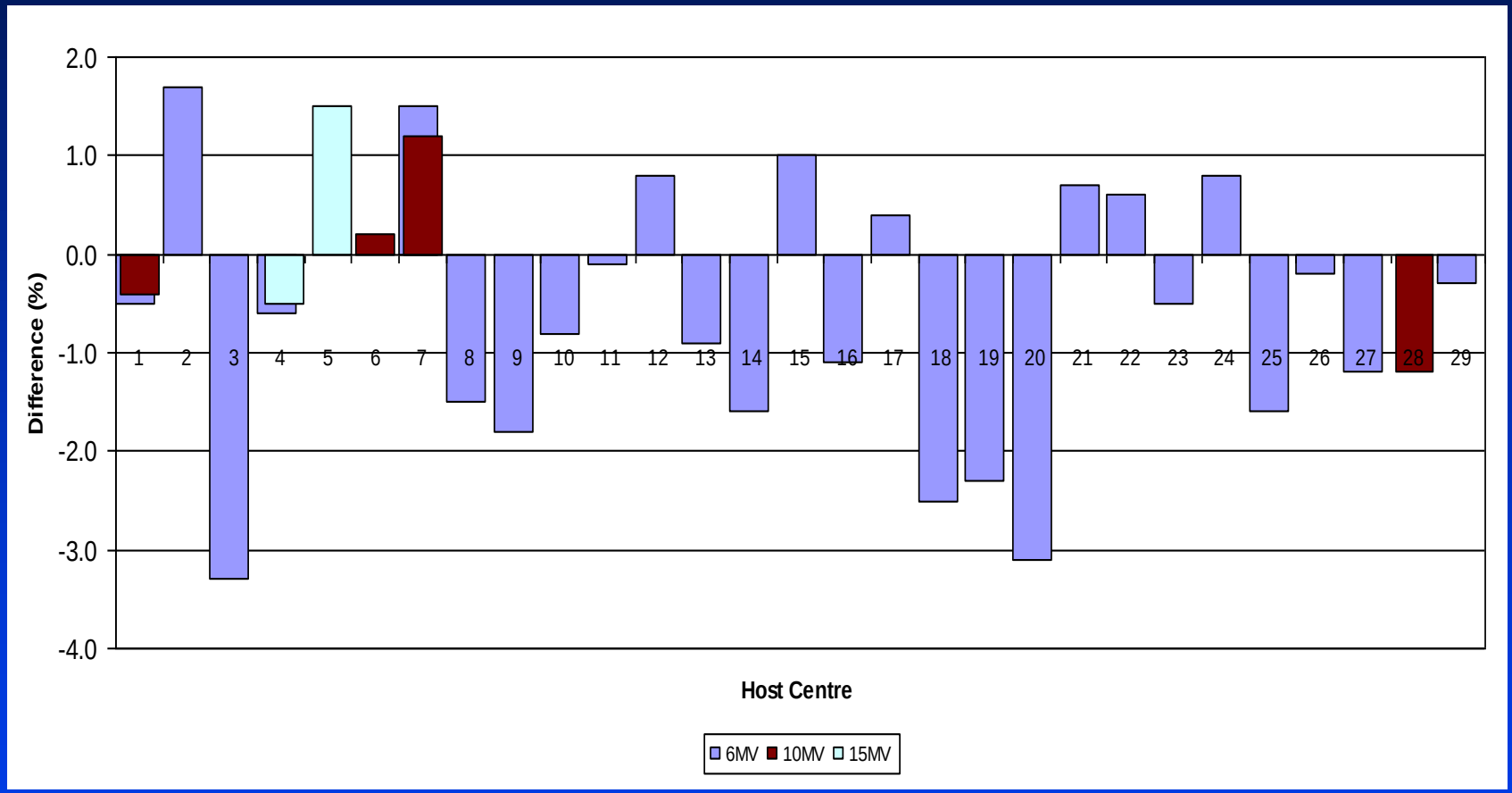
Audit

- Regulation of radiotherapy provision in the US is not comprehensive
- National audit is already working within the UK
- Each department should participate in audit regularly
- Incident reports often highlight no culture of audit

MV Photon Audit 2008

- Dosimetry standard documented and comparable
- Clinically relevant situation
- Wedge beam planned and calculated dose of 2 Gy delivered
- Actual dose measured

Planned Wedge Field by Department



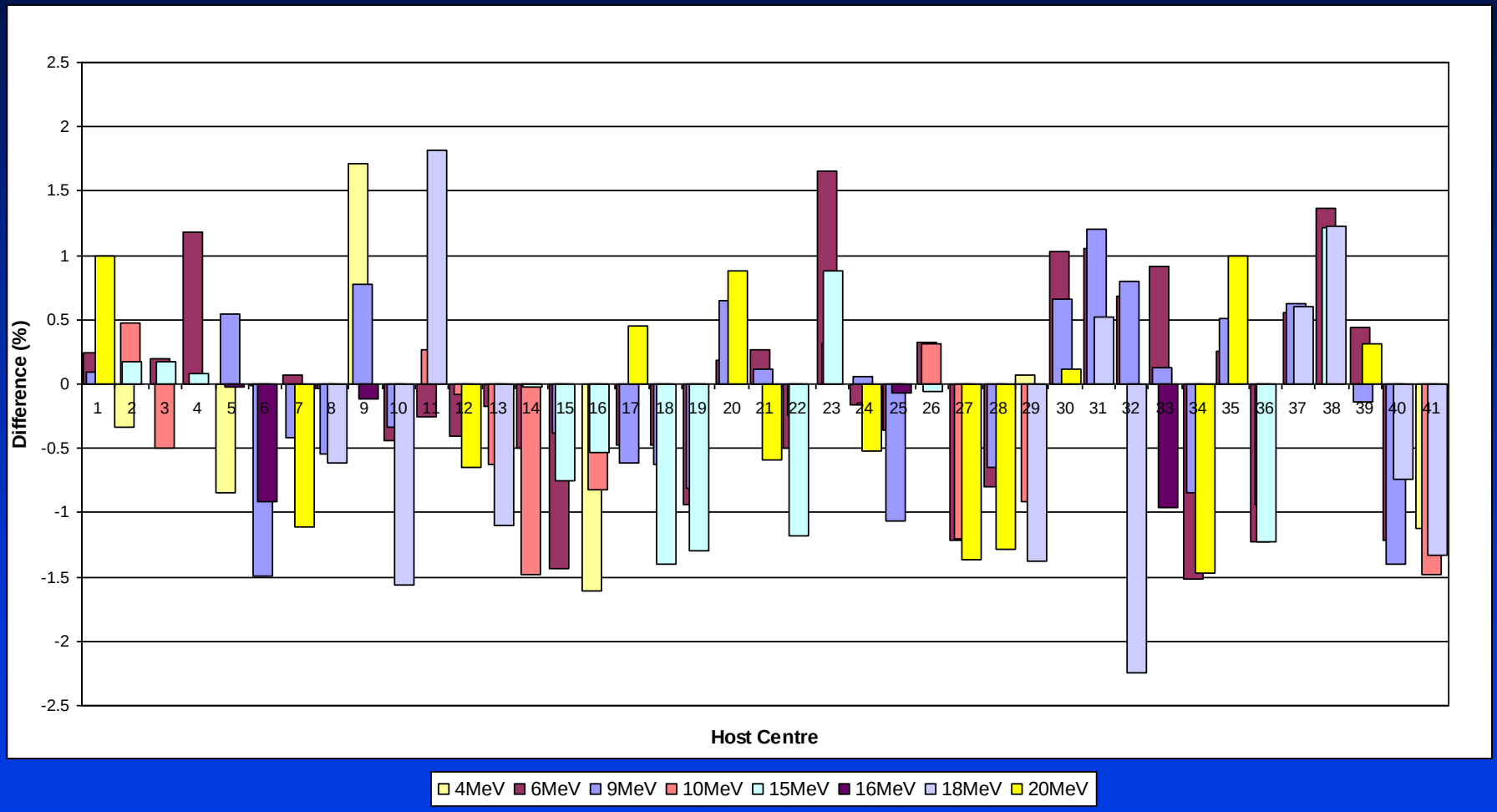
Electron Audit 2009

- Audit was performed using the IPEM 2003 Code of Practice.
- A spreadsheet was devised to enable all the measurements to be tabulated and a results page produced.
- The parameters were measured for three different energy beams – lowest and highest available and either 9 or 10 MeV

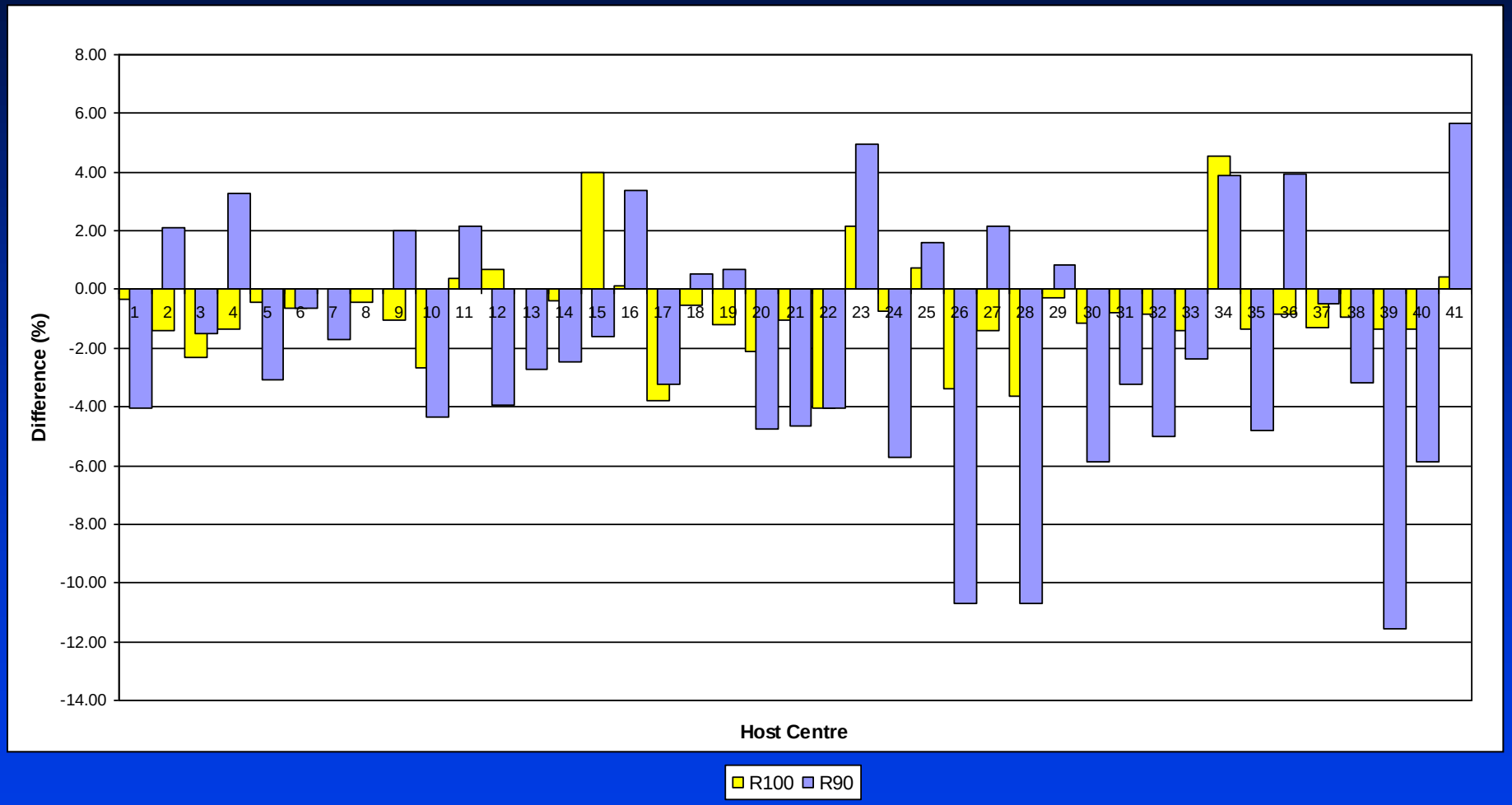
Parameters Measured

- Beam energy defined as R_{50}
- Output at reference point z_{ref}
- Measured dose for a planned treatment with standoff and bolus using a rectangle measuring 7 by 5 cm

Output z_{ref} by Department



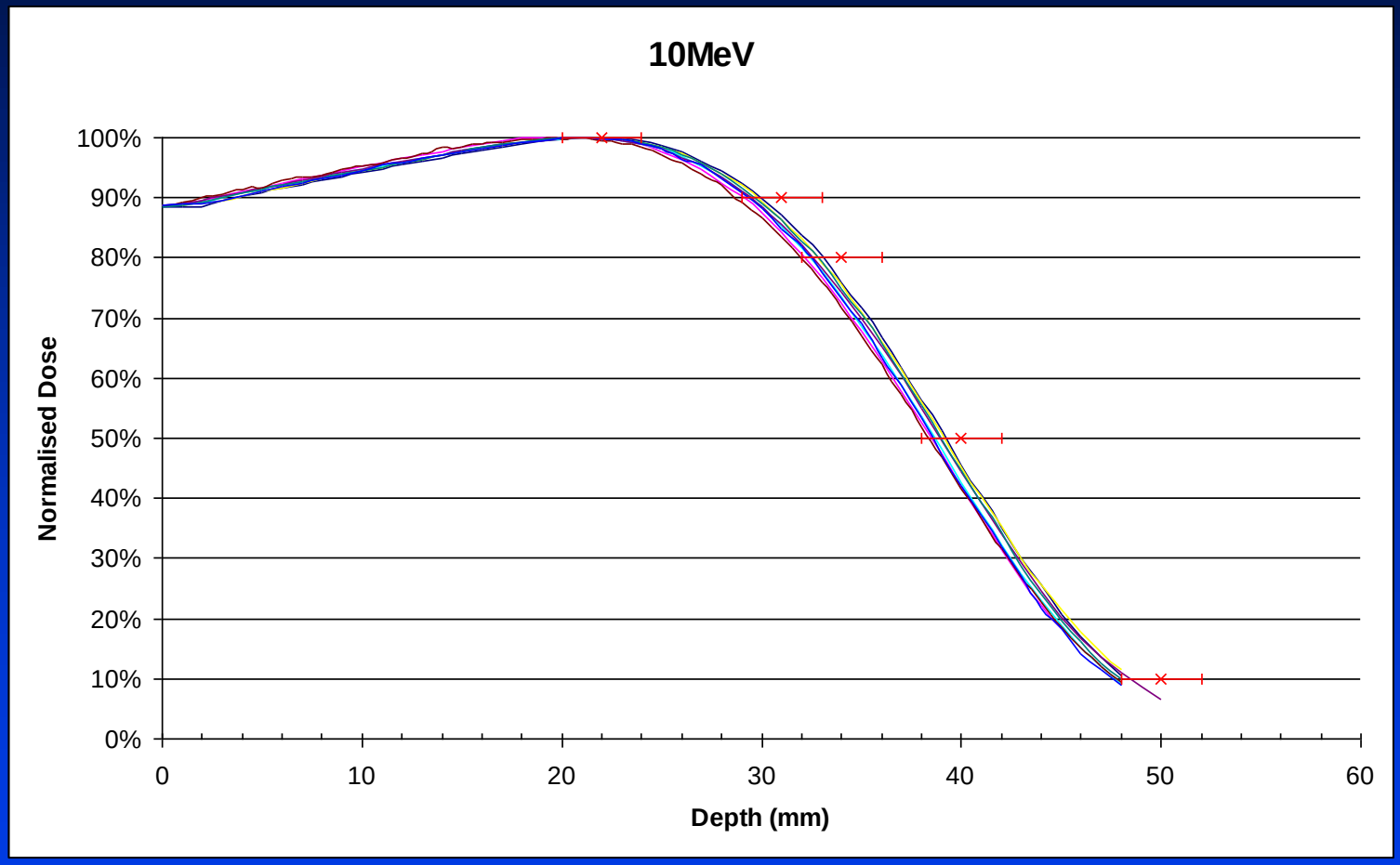
Planned Cutout Field by Department



Department 1

- All linacs matched 50% electron ionisation depth to within 1mm
- One set of reference values used clinically
- At 10 MeV measured dose was 1.79 Gy

Department 1



Departments 2+3

Dept 2

Two contributory factors

- clinical issued depth dose data was average of two different machines
- bolus material “SuperFlab” not water equivalent

Allowing for these factors reduced dose error to 4.8%

Dept 3

- bolus sheet used was incorrect thickness
- will now introduce QA of bolus sheets

IMRT Audit 2010

- Independent of linac, TPS and treatment delivery method
- Suitable for a plan from any clinical site
  - e.g. head and neck, prostate, breast
- Quick and simple
  - existing patient plans
  - commonly available equipment
- Audit both IMRT modelling and beam delivery
  - absolute dose (alanine)
  - spatial dose distribution (film)
- One method for measurement and analysis

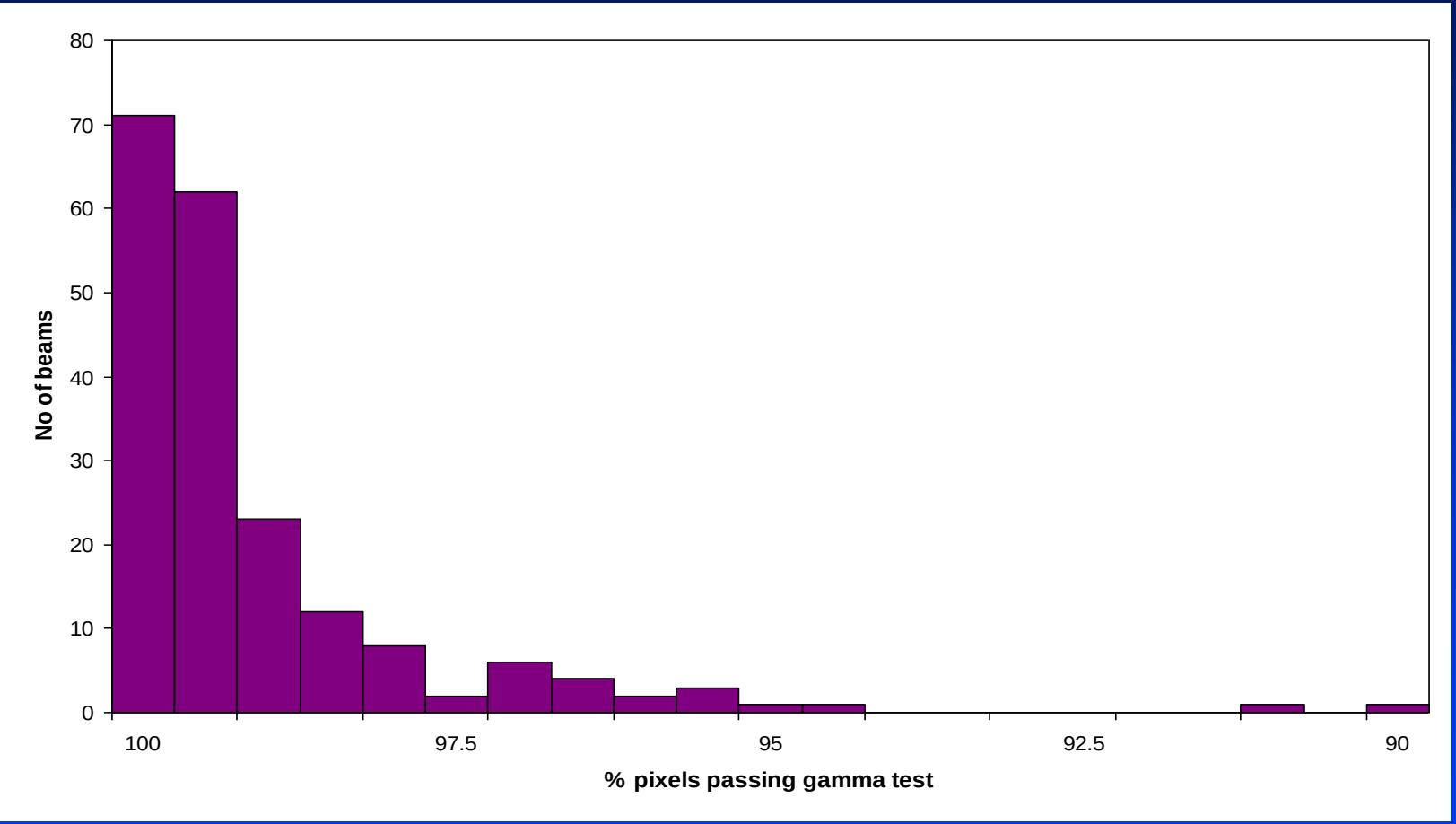
Method

- Plan IMRT plan on TPS
- Calculate dose grid for each beam at gantry 0°
- Irradiate supplied EDR film at 95 cm FSD
  5 cm deep in a phantom
- Measure dose with ion chamber and alanine
- Return films and alanine with DICOM dose grids

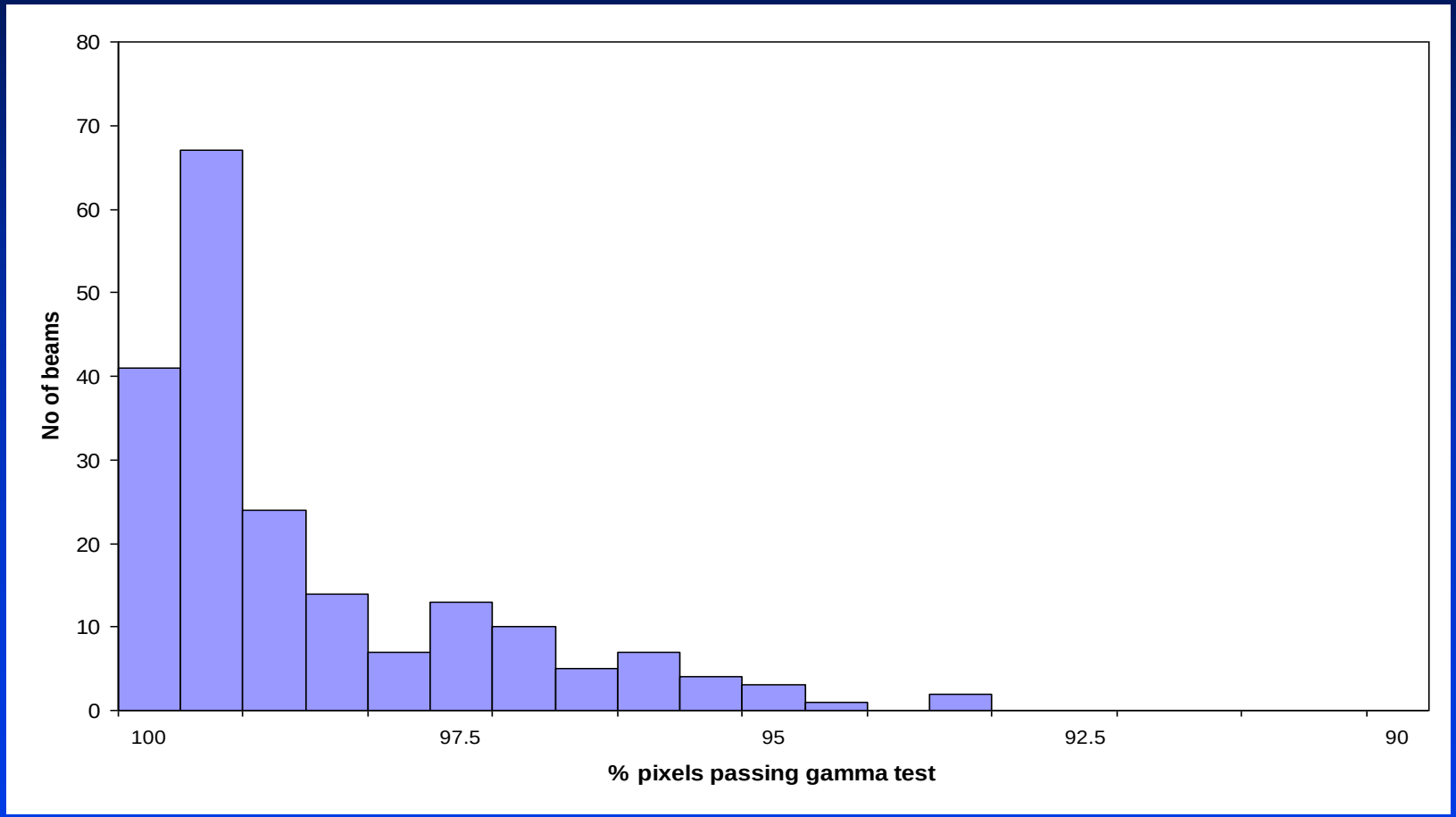
Tolerances

- 5% for alanine measurements
- 95% pixels passing gamma evaluation
  - within 20% isodose
  - 3%/3mm for prostate/breast
  - 4%/4mm for head and neck and complex sites

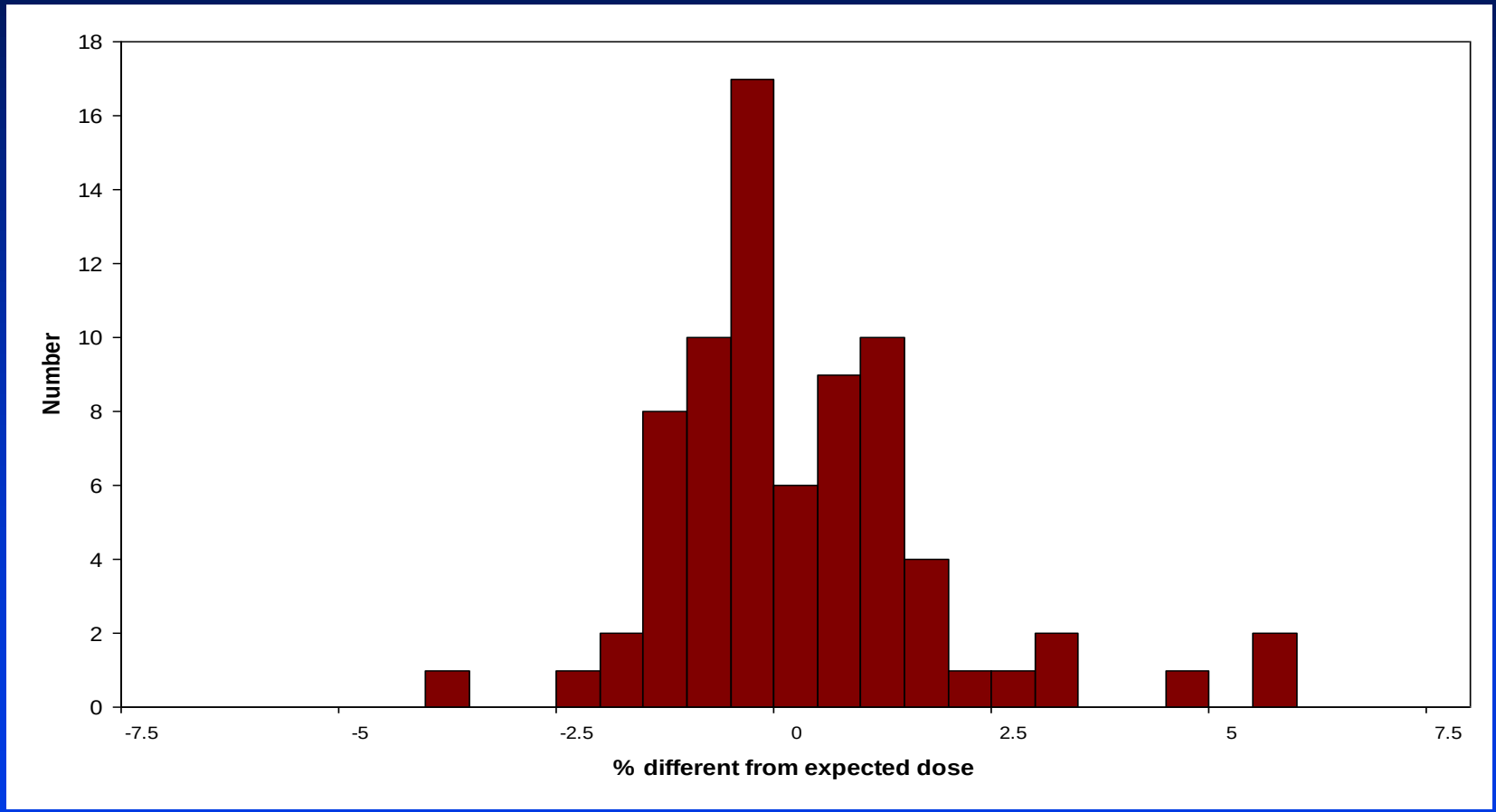
Prostate and simple sites



Head and neck and complex sites



Alanine


18
16
14
12
10
8
6
4
2
0
Number
-7.5
-5
-2.5
0
2.5
5
7.5
% different from expected dose

IMRT Today

- IMRT now routine in most departments
- Expected that at least 24% radical plans are IMRT or VMAT
- Continuing audit in individual groups

Audit within Group

Visiting Centre	Host Centre	IMRT plan	Conformal Plan
Department A	Department B	Planned: 2.007Gy Measured: 2.025Gy % difference: 0.9%	
Department B	Department C	Planned: 2.008Gy Measured: 2.045Gy % difference: 1.9%	Planned: 2.007Gy Measured: 2.036Gy % difference: 1.4%
Department C	Department D	Planned: 2.000Gy Measured: 2.043Gy % difference: 2.1%	Planned: 2.014Gy Measured: 2.049Gy % difference: 1.8%
Department D	Department E	Planned: 2.068Gy Measured: 2.140Gy % difference: 3.4%	Planned: 4.000Gy Measured: 4.037Gy % difference: 0.9%
Department E	Department H	Planned: 1.992Gy Measured: 2.054Gy % difference: 3.1%	Planned: 3.999Gy Measured: 4.124Gy % difference: 3.1%
Department F	Department G	Planned: 2.001Gy Measured: 2.029Gy % difference: 1.4%	Planned: 1.999Gy Measured: 2.022Gy % difference: 1.2%
Department G	Department J	Planned: 2.010Gy Measured: 2.021Gy % difference: 0.6%	Planned: 2.000Gy Measured: 2.028Gy % difference: 1.4%
Department H	Department F	Planned: 2.000Gy Measured: 2.029Gy % difference: 1.4%	Planned: 2.002Gy Measured: 2.028Gy % difference: 1.3%
Department J	Department K	Planned: 2.000Gy Measured: 1.985Gy % difference: 0.8%	Planned: 2.000Gy Measured: 1.995Gy % difference: 0.3%
Department K	Department A	Planned: 2.000Gy Measured: 2.014Gy % difference: 0.7%	Planned: 1.999Gy Measured: 2.020Gy % difference: 1.0%

Audit Issues

- Low kV
- Total Skin Electron Treatment
- National rotational audit

Low kV Audit

- Audit of 50kV unit
- HVL in agreement
- Output difference of 3.8% between host and visitor
- Outside tolerance
- Both departments investigated

Low kV Audit

- Performed strontium checks on chambers
- Host centre showed 3.5% decrease in response since previous check
- Chamber sent to NPL for recalibration
- Good agreement found

Total Skin Electron Audit

Host centre setting up new technique

Agreement between host and visitor on

- beam energy
- output with ionisation chamber
- beam uniformity

Total Skin Electron Audit

- Measurements taken on Rando phantom in treatment position
- Host used TLD
- Visitor used electron diodes
- Difference of 15% found
- Calibrating diodes on phantom surface results in a reading 9% too high

Rotational Audit

- Standard output measured – difference 1.6%
- Pressure reading difference 1%
- Barometer calibrated in house
- Method of calibration reviewed

Lessons from Audit

- Audit is alive and well in UK
- If errors are found then don’t assume the auditors are right!
- Full investigation to find cause of discrepancy

Epinal France Incident

- Incident in May 2004
- Made public late 2006
- Court case Jan 2013

Impact of accident

- Error carried on for 15 months (May 2004 – Aug 2005)
- At least 23 patients received overdose (20% or more than intended dose)
- Between September 2005 and September 2006, four patients died and ten show severe radiation complications
- By end 2012 at least 12 patients had died as a consequence of overdose

Court Case Jan 2013

Two doctors and a physicist were charged with

- manslaughter
- failure to help people in danger
- destroying evidence

Physicist

- Guilty of manslaughter
- Destroying evidence
- Sentence three years in prison (18 months suspended)
- Fined €10,000 (£8,600) in damages
- Banned from practising radiotherapy physics for five years

Physicist

- Admitted to "inadmissible negligence" in
  - installation of the new software
  - training of planning staff using it
- Showed a desire to hide the truth and attempt to play down, even disguise his mistakes

Clinical Oncology

Report on incident - recommended

- Peer review
- Mandatory reporting system
- Quality system
- Nationwide audit
- Adequate physics support
  (especially for satellite centres)

Conclusion

- Key goals for the benefit of patients
  - Research
  - Development
  - Modernisation
  - Application of state-of-the art techniques
- Committed to audit
- Positive about
  - protecting
  - providing best care