# IMRT credentialing and Gamma analysis survey

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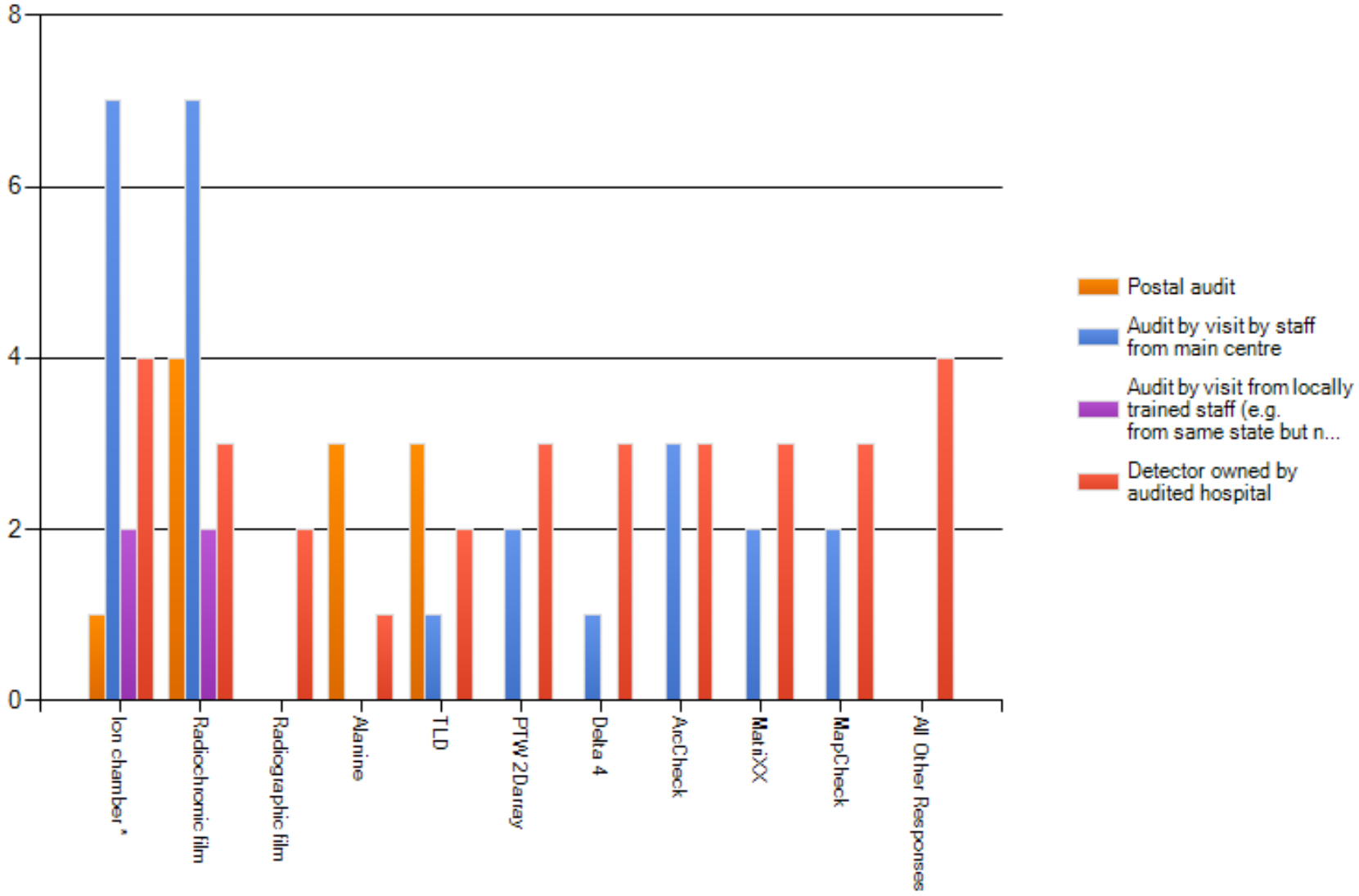
# Responses

- 9 answers
  - EORTC
  - TROG (x2)
  - RPC
  - RTOG
  - ACDS
  - QARC
  - RTTQA (x2)
- 57% on behalf of group / 43% personal opinion

5

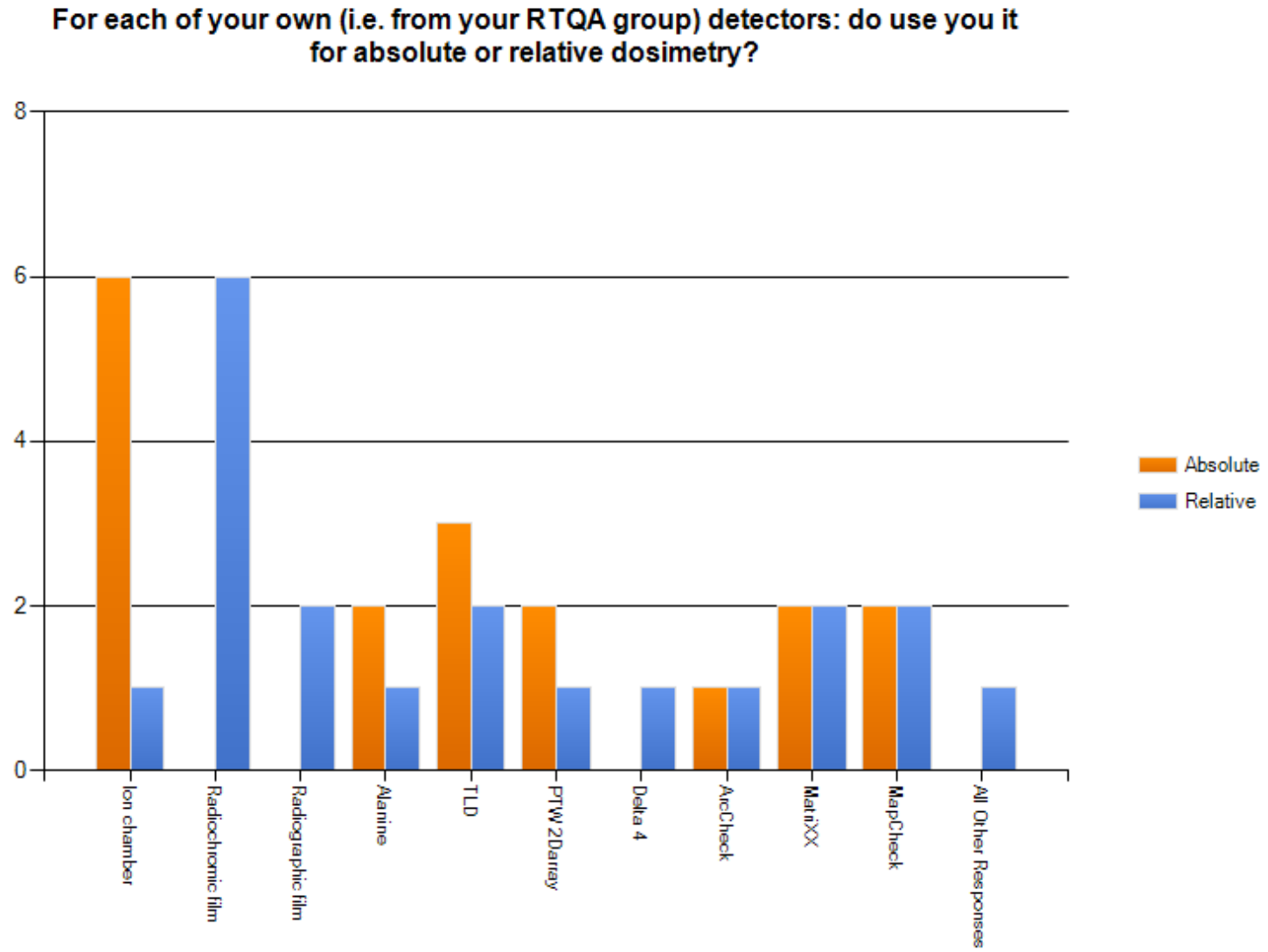
**For IMRT dose distribution analysis please list all detectors used and their primary use (eg do you use detector arrays in some circumstances and film in others)**



# 5. For IMRT dose distribution analysis please list all detectors used and their primary use (eg do you use detector arrays in some circumstances and film in others)

- PTW SemiFlex (0.125cc) used for our trial audits Farmer chamber from local hospital used for postal audits, to verify plan delivery prior to alanine measurements ArcCheck to be used for future trial visits, but not yet commissioned Assume details for NRRA audits (Octavius) completed by someone else
- Postal audit using farmer chamber owned by audited hospital, radiographic film and alanine as indicated above is currently under development but not yet in use. Also use of ArcCheck for audit visits will commence shortly.
- IBA cc13
- OSL used by our national auditing group. Note audits are ad hoc and have been designed around a particular trial though the plan is to move to generic credentialing to be conducted by our newly created national audit group (ACDS). Progress in this direction is dependent on on-going funding so ad hoc audits likely to continue for a while. Hence, detectors used will depend on availability by the (voluntary) audit group.
- Farmer type.
- Exradin A16

6.


For each of your own (i.e. from your RTQA group) detectors: do use you it for absolute or relative dosimetry?
8
6
4
2
0
Ion chamber
Radiochromic film
Radiographic film
Alanine
TLD
PTW 2Darray
Delta 4
ArcCheck
MatriXX
MapCheck
All Other Responses
Absolute
Relative

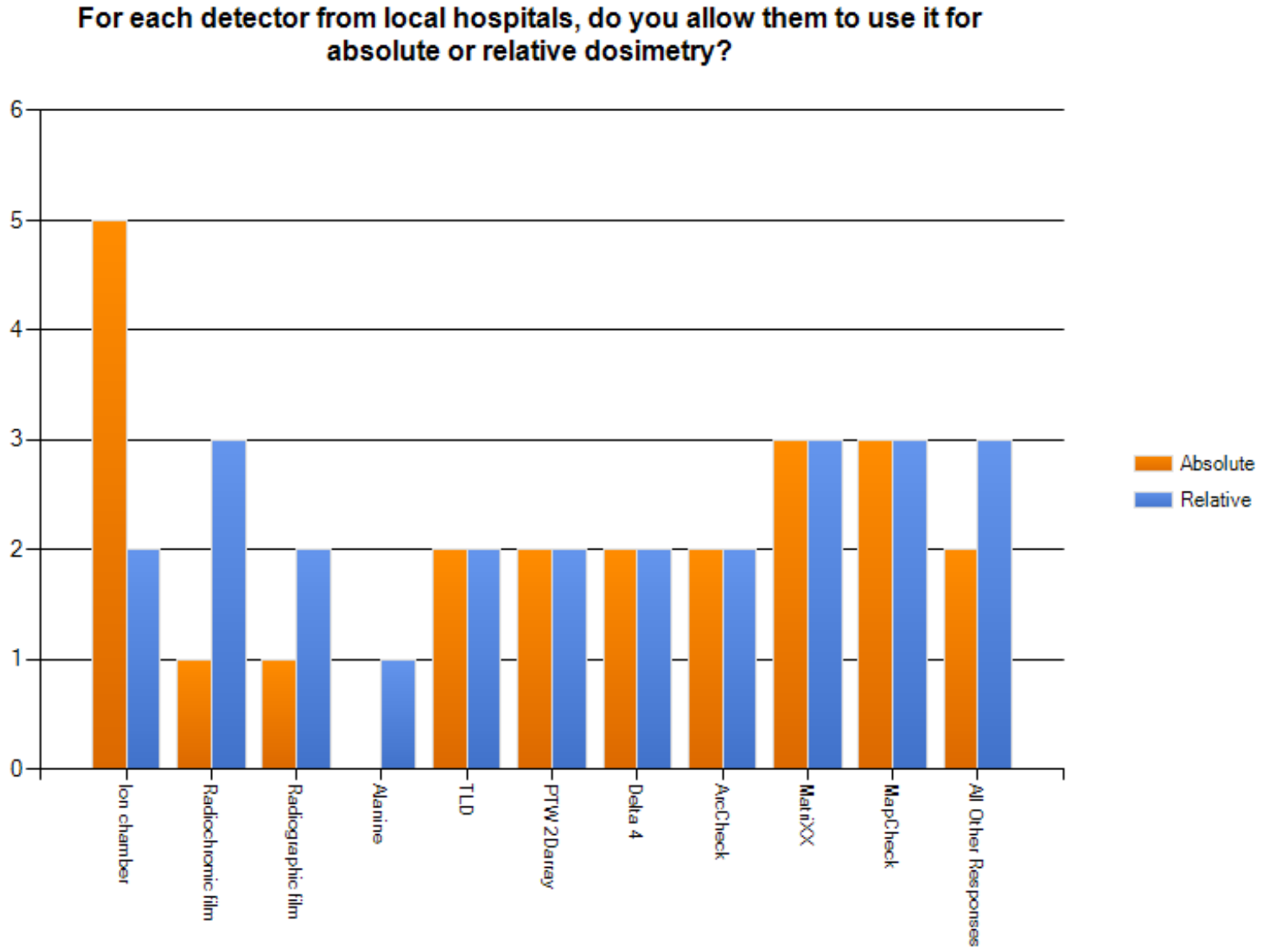
## 6. For each of your own (i.e. from your RTQA group) detectors: do use you it for absolute or relative dosimetry?

- Our group is considering EPID but a long way off development yet.
- I'm being picky, but none of these can perform absolute dosimetry
- no own detectors

# 7. For your absolute measurements, how often do you calibrate your detector and by what method?

- SemiFlex ion chamber initially calibrated at NPL. Calibrated against secondary standard every year
- For farmer chamber, annual cross-calibration against NPL secondary standard. For TLD and alanine, detectors are calibrated with each use with a subset irradiated under standard conditions.
- PTW 2Darray and ArcCheck are also calibrated with each use according to manufacturer instructions.
- Ion chamber: every 3 yrs at SSDL MatriXX: on site at each visit
- 2 years through national standards lab
- Every two years our reference chamber is sent to a PSDL which does an in-water Co-60 TRS-398 calibration.
- Prior to each analysis

8.


For each detector from local hospitals, do you allow them to use it for absolute or relative dosimetry?
6
5
4
3
2
1
0
Ion chamber
Radiochromic film
Radiographic film
Alanine
TLD
PTW 2Darray
Delta 4
ArcCheck
MatriXX
MapCheck
All Other Responses
Absolute
Relative

# 8. For each detector from local hospitals, do you allow them to use it for absolute or relative dosimetry?

- (for postal audit only - used as initial check that setup etc. correct prior to alanine measurements)
- Local hospital measurements compared against visiting measurements
- Assume you are referring to patient specific QA.
- I'm being picky (again), but none of these can perform absolute dosimetry
- We do not control how the local site uses their dosimeters
- for imrt, not ref dosimetry

9. For local hospital absolute measurements, how often do you require them to calibrate their detectors and by what method?

- Expect detector to be calibrated anually (as per IPEM81) - UK NPL standard
- According to local practice - no strict requirements
- National guidelines: every 3 yrs by intercomparison at PSDL or SSDL
- Sites are required to confirm they follow national recommendations which requires calibration at standards lab every 2 years
- I.C. TRS-398, every two years.
- every 2 years at a minimum
- No requirements, but should comply to (inter)national dose protocols and we ask which they apply

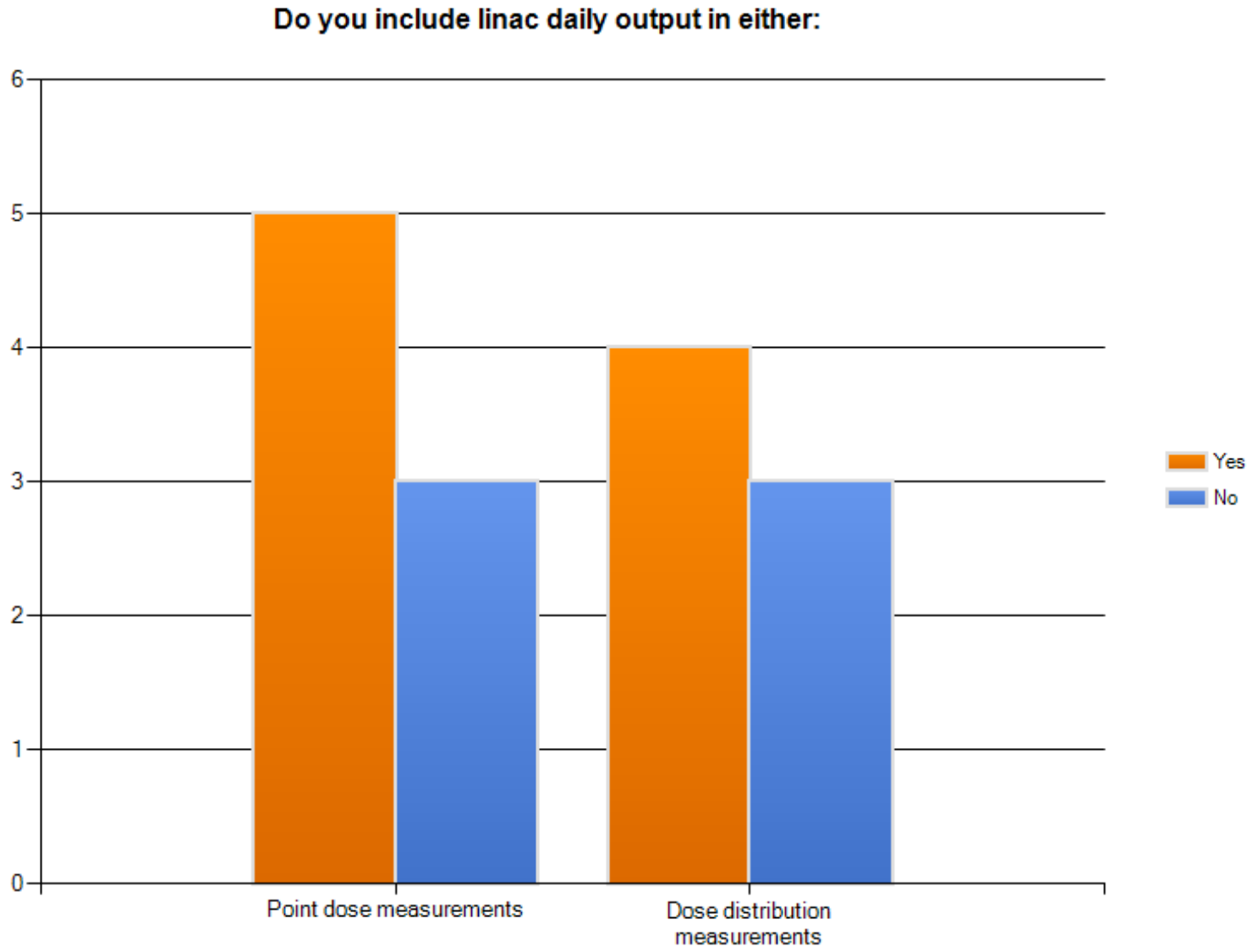
# 10. Which do you consider to be acceptable forms of absolute dosimetry? Tick all that apply

| | Response percent | Response count |
|---|---|---|
| **Converting a reading from a measurement device to Gy using only factors provided by a PSDL or Secondary standard Dosimetry Lab (SSDL) and temperature and pressure?** | **71.4%** | **5** |
| **Normalising the measurements to a standard measurement (eg 10*10 field) performed during the same measurements with the same device** | **71.4%** | **5** |
| **Normalising the dose as in b), but by measuring the 10*10 field in another phantom with an ion chamber.** | 57.1% | 4 |
| **Normalising the measurement to the calculated dose in the same geometry at a certain point (e.g. max dose or isoc, or even a trial-and-error best fit)** | | |

# 10. Which do you consider to be acceptable forms of absolute dosimetry? Tick all that apply

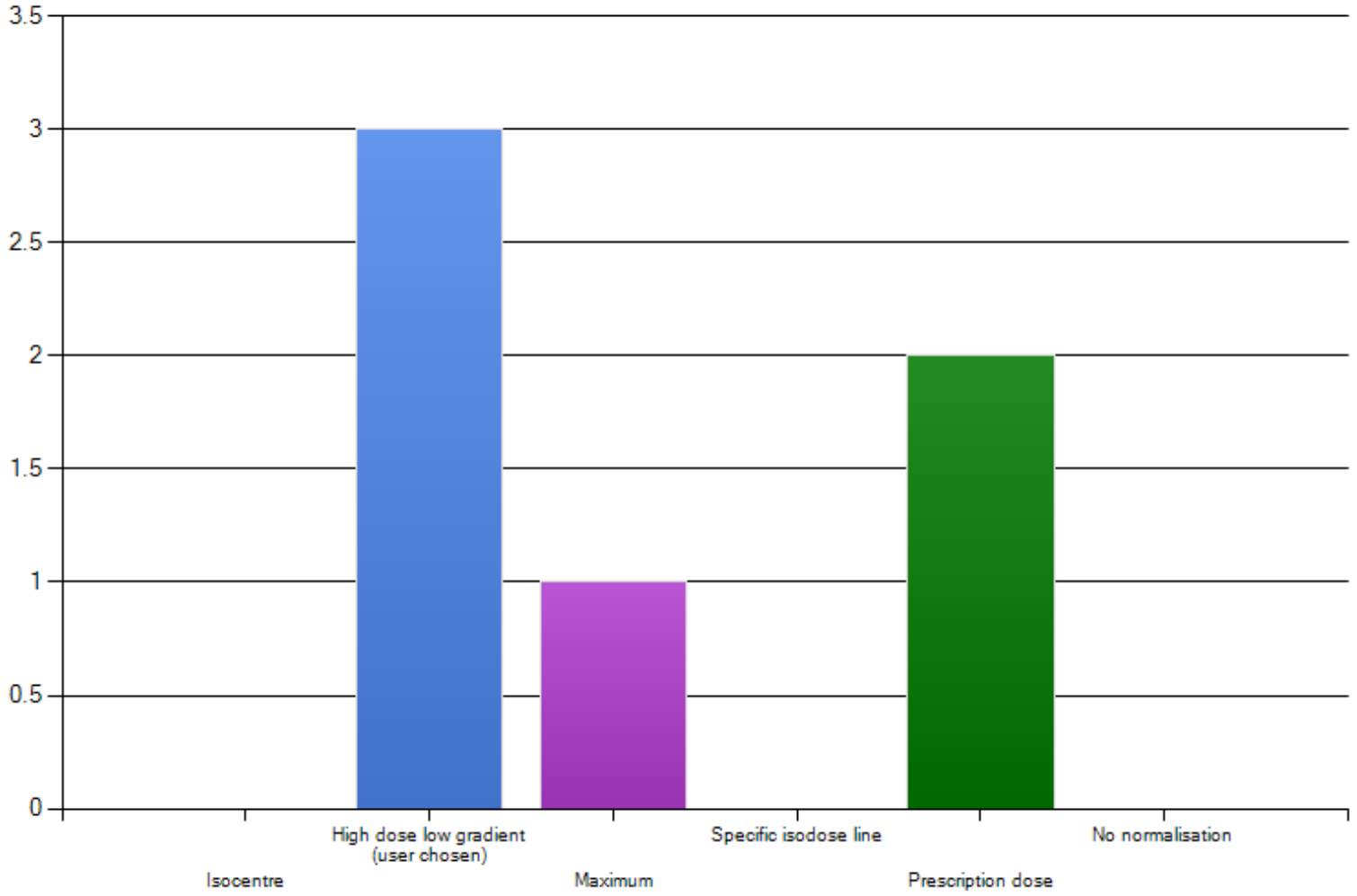
- In practice we don't specify how, or how often centres calibrate their QA check devices. If they don't get a pass on their QA report it is up to the centre to resolve the issue.
- I'm being picky, but none of these are absolute dosimetry
- Either follow calibration protocol or reference to an ion chamber measurement in water using a calibration protocol
- last option absolutely NOT allowed

11.


Do you include linac daily output in either:
6
5
4
3
2
1
0
Point dose measurements
Dose distribution measurements
Yes
No

12.

**For relative dose distribution measurements (including gamma analysis) how do you normalise the dose?**



# 12. For relative dose distribution measurements (including gamma analysis) how do you normalise the dose?

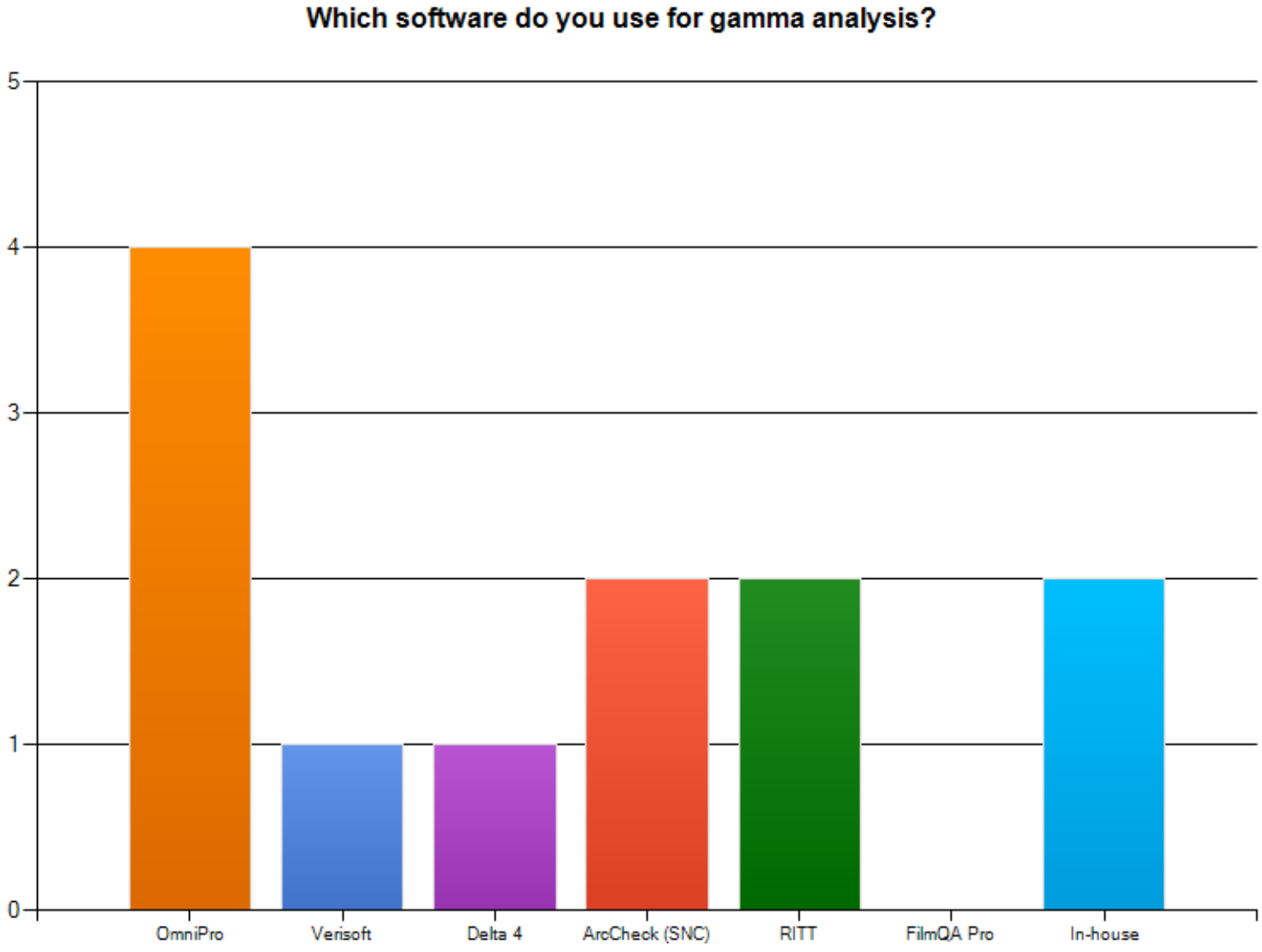
- Postal audits: Alanine absolute dose point measurement will be made at a defined point in the film plane, so normalised to that point and it will therefore be possible to convert film to absolute dose if necessary
- Centre can choose but they must specify this in the facility questionnaire. Centres typically do what works best for their QA device/ analysis software and I think asking them to change to meet trial group requirements may be difficult (risk of error)
- To Centre of field (not IMRT, wedges and open beams)
- We normalize to the TLD absolute dose measurement adjacent to the film
- we believe the gamma % should be the pres dose. this is something we could standardise

# 13. Do you use gamma index calculations and if so are they global or local gamma calculations?

- Do not use 1
- Global 6
- Local 0

- Use OmniPro I'mRT. From its description of gamma analysis I've assumed this is global dose (i.e. % dose difference is to the normalisation point)
- Not at IMRT yet. We use both global and local comparisons for out-of-field measurements, local for in-field (< 80% field size).
- also something to standardise?

14.


Which software do you use for gamma analysis?
5
4
3
2
1
0
OmniPro
Verisoft
Delta 4
ArcCheck (SNC)
RITT
FilmQA Pro
In-house

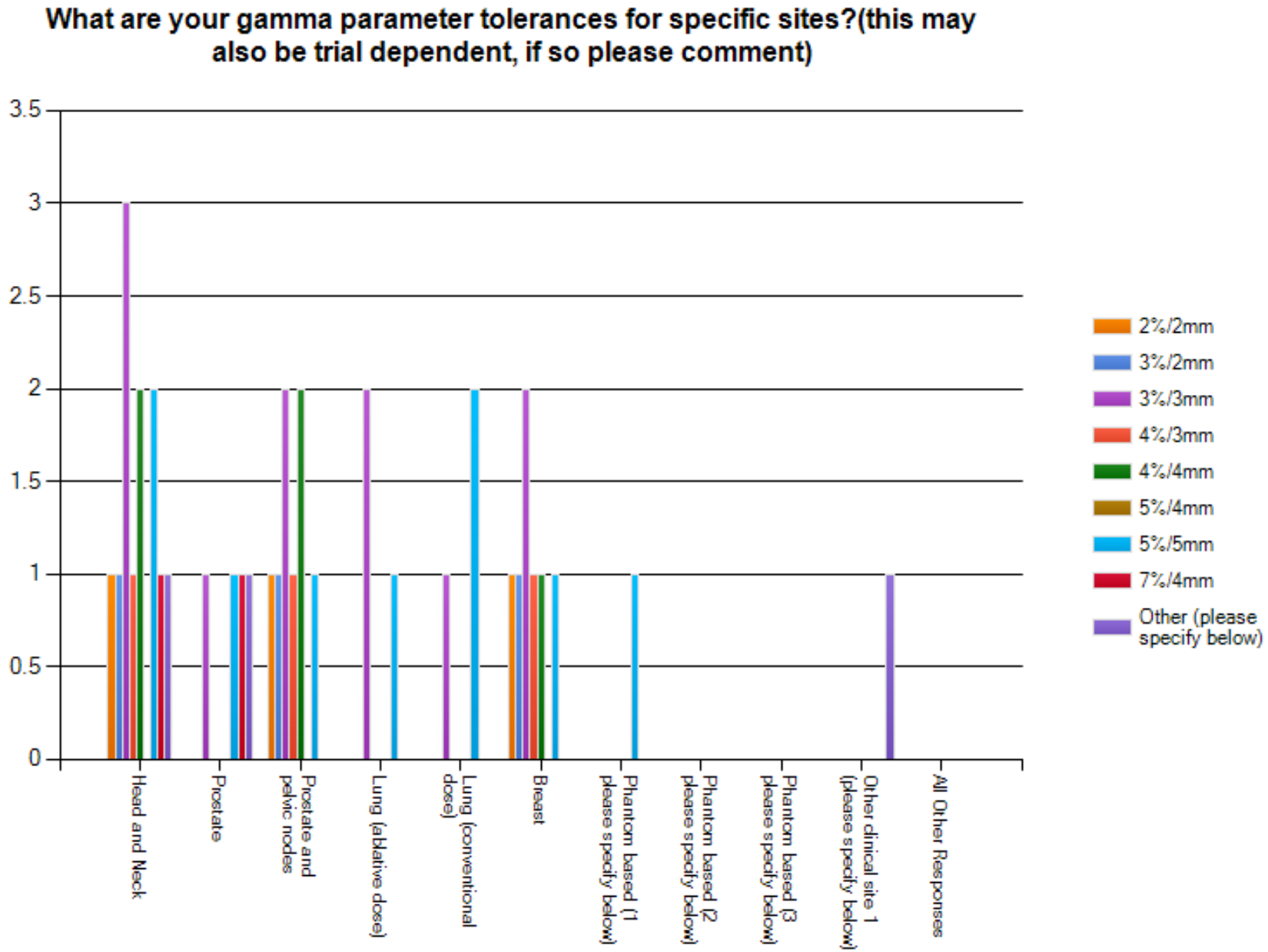
# 14. Which software do you use for gamma analysis?

- We measure standard output first and correct for it in absolute point dose measurements. Dose distribution measurements (film) are relative so does not apply
- Daily output is included for PTW 2Darray and ArcCheck, however not for film.
- Hospital can use both, but correction for daily is advisable we think

# 15. Do you limit the area you include in the analysis?(e.g. 6cm x 10cm film size or a specific isodose)

- 100% yes
- 10% dose threshold. Higher dose if there are significant artefact or other issues
- 20% threshold for composite distributions, 10% for individual fields
- Rectangle bounding target including penumbra to 10% threshold
- Usually >10 or 20%
- each anthropomorphic phantom has a unique ROI that we use.
- think best to limit to percentage of pres dose, but some detectors will have limited size and we maybe do not want to exclude them

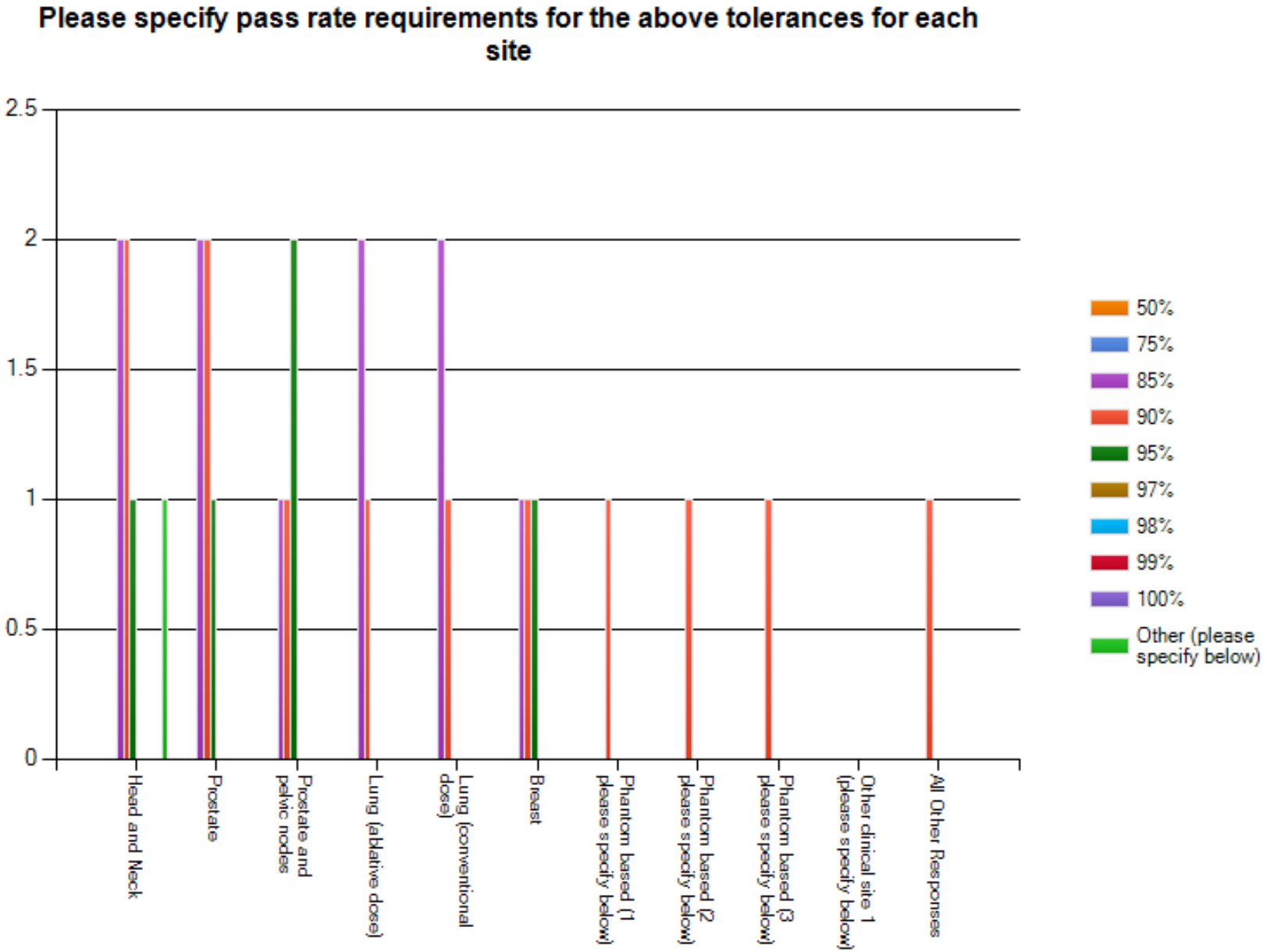
16.


What are your gamma parameter tolerances for specific sites?(this may also be trial dependent, if so please comment)
3.5
3
2.5
2
1.5
1
0.5
0
Head and Neck
Prostate
Prostate and pelvic nodes
Lung (ablative dose)
Lung (conventional dose)
Breast
Phantom based (1 please specify below)
Phantom based (2 please specify below)
Phantom based (3 please specify below)
Other clinical site 1 (please specify below)
All Other Responses
2%/2mm
3%/2mm
3%/3mm
4%/3mm
4%/4mm
5%/4mm
5%/5mm
7%/4mm
Other (please specify below)

# 16. What are your gamma parameter tolerances for specific sites? (this may also be trial dependent, if so please comment)

- Also report 3%/3mm and 5%/5mm results. Lower (2%/2mm) reported if useful
- Pass rates for each of the above sets of parameters are usually reported. If less than 95% of pixels fail at the 3%/3mm level then further investigation is undertaken.
- Anal canal: 5%/3mm, 95% pass with MatriXX, 90% pass with EBT2 radiochromic film (single exposure) Head+neck: 5%/3mm, 90% pass with EBT2 radiochromic film (three exposures) Prostate: 5%/3mm, with EBT radiochromic film 95% pass through isocentre; 90% pass on off-axis plane
- Our PROFIT (pelvis) audit used 5%/3mm and used the mapcheck device in 2 coronal planes with a 95%/ 90% of points pass rate (isocentre and 2cm post to iso planes respectively). ICARIS (H&N) used 5%/3mm 10% threshold using EBT2 film, 90% of points to have gamma less than or equal to 1. Specific trials could insist on higher spec. In practice, we expect in-house QA to have 3%/3mm or better, spec for most trials.
- is also trial dependent!

17


Please specify pass rate requirements for the above tolerances for each site
2.5
2
1.5
1
0.5
0
Head and Neck
Prostate
Prostate and pelvic nodes
Lung (ablative dose)
Lung (conventional dose)
Breast
Phantom based (1 please specify below)
Phantom based (2 please specify below)
Phantom based (3 please specify below)
Other clinical site 1 (please specify below)
All Other Responses
50%
75%
85%
90%
95%
97%
98%
99%
100%
Other (please specify below)

# 17. Please specify pass rate requirements for the above tolerances for each site

- Head and neck: tolerance not used, just comment on results and whether they look reasonable PPN: Taken from data in IPEM report 96
- Please see comments to qu 16
- see previous comments
- Anal canal: 5%/3mm, 95% pass with MatriXX, 90% pass with EBT2 radiochromic film (single exposure) Head+neck: 5%/3mm, 90% pass with EBT2 radiochromic film (three exposures) Prostate: 5%/3mm, with EBT radiochromic film 95% pass through isocentre; 90% pass on off-axis plane
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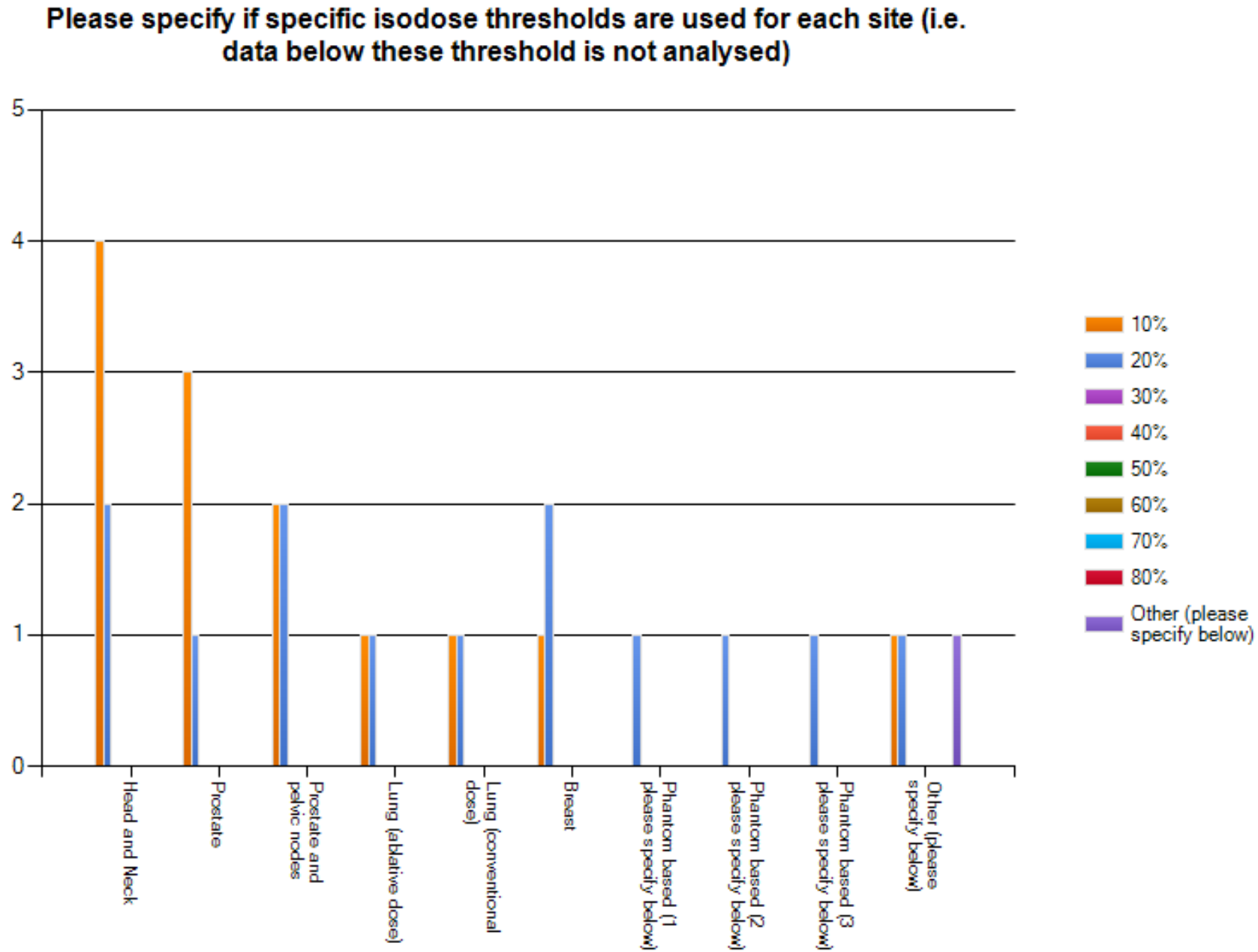
18.


Please specify if specific isodose thresholds are used for each site (i.e. data below these threshold is not analysed)
5
4
3
2
1
0
Head and Neck
Prostate
Prostate and pelvic nodes
Lung (ablative dose)
Lung (conventional dose)
Breast
Phantom based (1 please specify below)
Phantom based (2 please specify below)
Phantom based (3 please specify below)
Other (please specify below)
10%
20%
30%
40%
50%
60%
70%
80%
Other (please specify below)

18. Please specify if specific isodose thresholds are used for each site (i.e. data below these threshold is not analysed)

- 10% ideally used, possibly higher if there are problems with the film (artifacts, calibration)
- Anal canal: 10% threshold
- not used
- standardise?

# 19. What do you think should be included in a dosimetry report ?

| | | |
|---|---|---|
| **Named personnel** | **100.0%** | **6** |
| **Signature of responsible physicist** | 83.3% | 5 |
| **Phantom used** | **100.0%** | **6** |
| **Detector used** | **100.0%** | **6** |
| **Analysis software used** | 83.3% | 5 |
| **Reference dose details (e.g output under reference conditions)** | 66.7% | 4 |
| **Details of traceability of dosimetry to national (primary) standard** | 50.0% | 3 |
| **Details of plan measured** | 50.0% | 3 |
| **Details of points measured (e.g. low/high dose or low/high gradient)** | 66.7% | 4 |
| **Details of position of points measured (e.g. in Primary PTV / spinal cord)** | 83.3% | 5 |
| **Gamma details (see next question)** | **100.0%** | **6** |

19. What do you think should be included in a dosimetry report ?

- Pass/fail thresholds and references as to from where these were derived
- Dosimetry traceability is included in audit protocol. Details of plan is recorded on visit spreadsheet

20. Which details of gamma analysis should be included in a report? (e.g. dose difference, DTA, threshold, normalisation point.....)

| | | |
|---|---|---|
| **Global or local calculation** | **100.0%** | **6** |
| **Dose difference tolerance** | 83.3% | 5 |
| **Distance to agreement tolerance** | 83.3% | 5 |
| **Normalisation point** | 50.0% | 3 |
| **Threshold used** | 83.3% | 5 |
| **Calulation grid size** | 33.3% | 2 |
| **Definition of whether measured or calculated is the reference** | 33.3% | 2 |

20. Which details of gamma analysis should be included in a report? (e.g. dose difference, DTA, threshold, normalisation point.....)

- Calc grid size should be noted on visit spreadsheet. Norm point and defn of reference will be recorded on analysis of results.
- Dose and distance desirable but we are often constrained by the analysis software in use

# 21. In terms of dosimetry audits, what, in your opinion, should be standardised between the GHG groups?

- Ideally which set of dose points should be measured for which anatomical site (minimum set of acceptable criteria). Also as much as possible should be standardised to make it easier to accept other groups audits as accreditation for trials
- Traceability of absolute dose measurements and gamma parameters for specific sites
- Baseline: monitoring of reference dose output for all beams. Other protocol specific tests as specified in the protocol.
- All items ticked in 19 and 20.
- Gamma analysis seems to be widely used so we are probably stuck with this. Frequency of audits? (ie how long an audit is valid for).Requirement to demonstrate level I audit has been carried out by internationally approved audit group.
- The use of an absolute dosimetry measurement traceable to a national standard to normalize the dose distributions

# Summary

A lot of variety

Probably lots of different reasons for this due to organisation of groups, geographical restrictions, national protocols (e.g. frequency of calibration) etc

Always going to use different software (probably not a good thing if we all used the same anyway!)

# Summary

Areas of commonality

Lots of film and ion chamber use

Use of gamma (but variety within)

Some of the information included in reports

# Future?

Ensure clarity in reports due to variation in practice, include cost commonly agreed data

Example of a report from each group

(clinical example + template with crib notes?) ??

Best initial approach not to make changes (risk of error) but key aim of clarity and understanding?

Agree on things to aim to standardise in the future? E.g. inclusion of linac output?

Work together to define the standards? i.e. reviews of previous studies to justify values, share data, comparative studies?