



Current Practices of Medical Physics External Beam Plan Checking

*A report on the results of a survey conducted by the
Medical Physics Community of Practice (CoP) Chart Checking Practices Working Group*

May 2016

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Executive Summary

Introduction

- The Chart Checking Practices Group of the CCO Medical Physics Community of Practice conducted a survey of the physics treatment plan checking practices at the beginning of 2015. They asked each medical physics department from all the Ontario cancer centres to complete the survey in a group setting and submit a single response from that centre. As part of the survey the physicists were asked to self-report the variability in practice within their centre.

Workload & Workflow

- The median number of plans checked per day per physicist is 6 (Q.5). All centres reported that “field based” plans take less than 30 min each to check (Q. 8). At all centres, if a physicist is heavily involved in generating a treatment plan, another physicist performs the check (Q. 11).
- At 4 of the 15 centres, some palliative plans are not checked by a physicist (Q. 7)
- Less than half of all centres use automated checks, however, most centres with the Pinnacle TPS use some automated tests (Q. 19).
- At most centres the Physicists check the plan after the oncologist signoff (Q. 10).
- Physics involvement in contouring or imaging was reported from 9 of the 15 centres (Q. 9).

MU / Dose Verification

- Some centres indicated that they perform more than one type of patient specific QA. The comments suggested that these centres had a primary QA method and a backup method (Q 34). Some centres also indicated they had a backup or alternate method for secondary MU/dose calculations (Q 35).

Items Checked

- There was more inter-centre variability in contour checks than in other aspects of checking (Q 17).
- It is possible that for some plans at some centres, the GTV to CTV expansion and/or the Optimization structures are not checked by anyone (Q 17).
- It is possible that for some plans at some centres, DVH binning and/or Fluence maps are not checked by anyone (Q. 19).
- Less than half of centres reported that physicists checked immobilization devices, but all centres reported other groups checking this. Few centres reported that physicists checked IGRT parameters. This was mostly done by other groups and some centres reported that IGRT parameters followed standard protocols and were independent of the plan (Q. 22).

Intra-Centre Variability of Physics Checks

- At 10 of the 15 centres the physicists were consistent in their practice for over 75% of the checking items that were in the survey. The degree of uniformity does not appear to correlate with the use of an official checklist.

Troubleshooting and Consultation

- Lack of conformality was the most common reason for defining a plan as sub-optimal (Q. 24).
- Four centres indicated urgency/timing affected whether sub optimal plans were accepted as is (Q. 24).

Documentation

- Official checklists are used at 7 of the 15 centres, with 3 other centres indicating that they use unofficial checklists (Q. 28).
- For sub-optimal plans, only 5 of the 15 centres indicated some documentation if the plan was modified and only 3 of the 15 centres indicated some documentation if the plan was not modified (Q. 27).

Background

The physics treatment plan (or chart) check has been shown to be a critical factor in ensuring safe high-quality radiation therapy¹. However, there is very little publicly available documentation on plan checking. Anecdotal evidence suggests that the practice of plan checking is highly variable even among physicists within the same centre. The Medical Physics Community of Practice Chart Checking Practices Working Group (CCPWG) conducted a survey of the medical physics departments at all cancer centres in Ontario in order to determine the current practices relating to physics treatment plan checking.

Survey Method

The survey, prepared by the CCPWG, consisted of 36 questions addressing medical physics checks of MV photon external beam radiotherapy plans generated in a treatment planning system excluding non-standard treatment equipment such as Gamma Knife, CyberKnife and Tomotherapy. It was distributed to the medical physics department at all cancer centres in Ontario on Jan. 27, 2015. Each department was asked to complete the survey in a group setting with all the checking physicists (or as many as possible) present and submit a single response.

The survey concluded on March 27, 2015 (2 months from the initial distribution), with a completed response from all 15 medical physics departments. Although attendance was not recorded, all centres appear to have had most of the physicists attend the survey sessions and a few centres were able to have all of their physicists at their survey sessions. The time required by each department to complete the survey was estimated to be between 2 and 3 hours and most departments completed the survey over multiple sessions.

Each question included a comment section where the group could expand on their answers and describe any assumptions made in responding to the questions. The participants were encouraged to record the key points of any group discussions which occurred in the process of completing the survey. Initial feedback suggests that the dialogue which was generated was beneficial to the participating physicists.

The survey was designed to identify which elements of a patient's plan are being checked by the physicist and what level of documentation is being performed with the checking. The survey also included questions designed to give some information about how the physics plan check fits into the larger treatment planning process, the plan checking workload, and to highlight some of the tools being used as part of the plan checking process.

Questions addressing which elements of a patient's plan are being checked by the physicists were designed to capture the variability in practice within each centre. These questions asked the groups to indicate if: "All", "Most", "Some", or "None" of the physicists in the group performed that particular check.

Variability in individual practice was not intended to be captured. For example, the option "Some" was not intended to indicate that an element was checked by "All Physicists" "Some of the time", although it appears to have been interpreted this way in a few cases. The survey also did not attempt to assess how thoroughly each element was checked. The respondents were instructed that if an item was considered when checking a plan (no matter how superficial) it was deemed to be a check.

1. Ford, E. C. *et al.* Quality control quantification (QCQ): A tool to measure the value of quality control checks in radiation oncology. *Int. J. Radiat. Oncol. Biol. Phys.* **84**, e263–e269 (2012).

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Some questions asked if a particular check is "automated" which referred to the use of a piece of software to perform the check and output the results as a substitute for or in addition to a manual check.

Results

Enclosed is a summary to the survey responses from the 15 centres. The goal of this report is to present the survey results in an unbiased manner without any attempt at drawing conclusions. It is recommended that each institution review the report to form their own conclusions. This information may be used to provide more insight and guidance to the community.

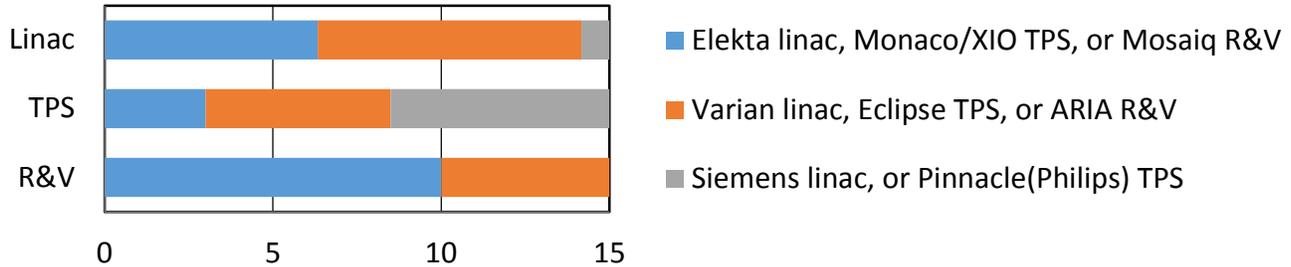
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Site Information

Question 1. What vendors of linacs are used in your centre?

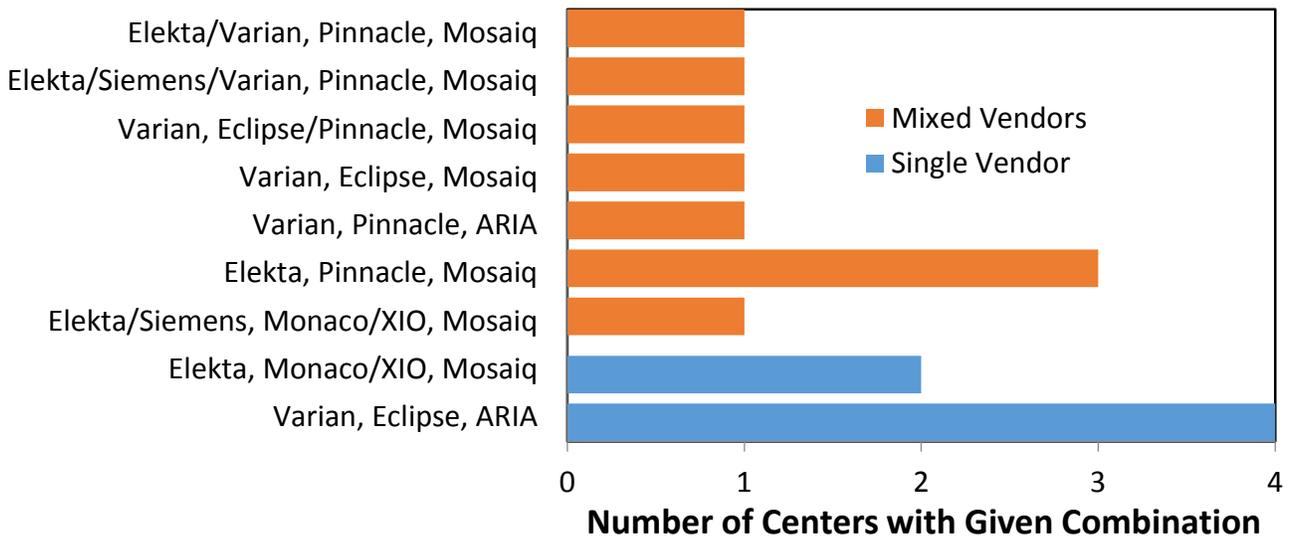
Question 2. For MV external beam planning, what is your primary clinical TPS?

Question 3. What is your R&V system?



Notes:

- Responses to questions 1,2 & 3 were combined by centre and are reported together
- For centres that reported multiple linac, or TPS types, each type was counted as 1/2, or in one case 1/3 so that the totals still added up to 15 centres. (Monaco and XIO treated as the same type)
- The different combinations of linac, TPS and R&V reported are summarized below
- Centres that reported multiple linac, or TPS vendors were treated as distinct groups in the graph below



Summary of responses:

- 6 centres were single Vendor
- 6 centres combined Pinnacle with Mosaiq
- All centres with Monaco or XIO used Mosaiq
- No centre with Elekta or Siemens linacs used ARIA

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Workload

- Question 4.** What percentage of staff physicists in your department (excluding the head) routinely check treatment plans?
- Question 5.** What is the range (within the group) of the number of treatment plans checked in a day, per person, at your centre? Note: each plan in a treatment course counts separately.
- Question 6.** How many physicists (FTE) are checking plans in a given day?

# Plan Checking Physicists per Day	Percentage Physicists involved
1	108
3	100
2.5	100
2	100
1.5	100
1.25	100
1	100
1	100
1	100
1	100
1	100
2	95
2	92
2	80
4	60

Notes:

- One centre reported 108% for question 4, but noted in comments that this accounted for the department head participating in plan checking at a 50% capacity
- There was some variation in the interpretation of question 5.

Summary of responses:

Physicists involved

- Most centres have 1 – 2 FTE physicists checking plans per day.
- At 11 centres all physicists check treatment plans.
- At 4 centres some physicists do not check plans (60-95%).
- At 2 centres the Chief Physicist participates in plan checking

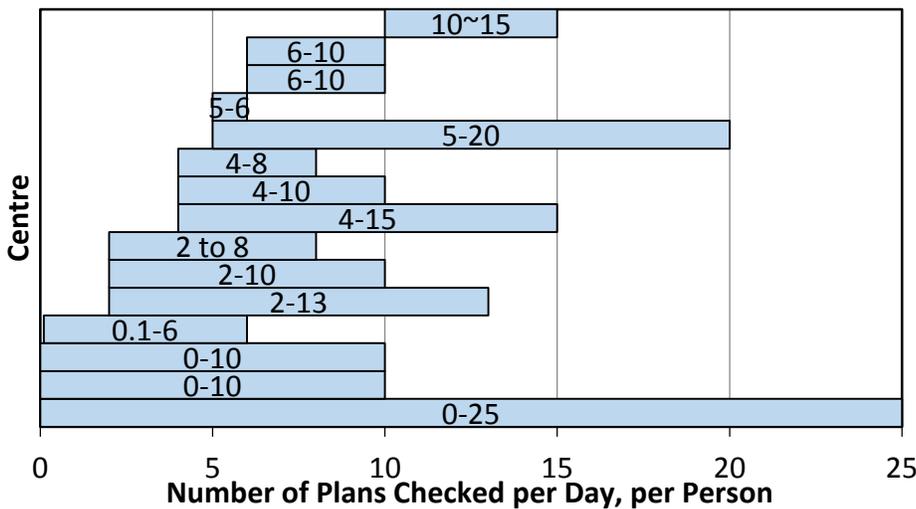
Summary of question comments:

Scheduling Practices

- The allotted time slots scheduled for plan checking ranged from ½ day to 2 weeks
- Schedule extra physicists for Fridays
- Additional physicists are required to help out as needed

Assignment methods

- Physicists assigned are responsible to check all plans ready in that time period
- Physicists are allocated to various site groups
- Physicists are matched with certain dosimetrists
- Physicists not assigned on a checking schedule may be required to check specific types of plans such as for new technique they have implemented



Notes:

- The 0.1 minimum from one centre refers to a physicist not scheduled for checking who still checks plans, at an estimated rate of 1 plan per 2 weeks

Summary of responses:

- Median Plans checked is 6 (median of the range median)
- Average plans checked is 7.5 (average of the range median)

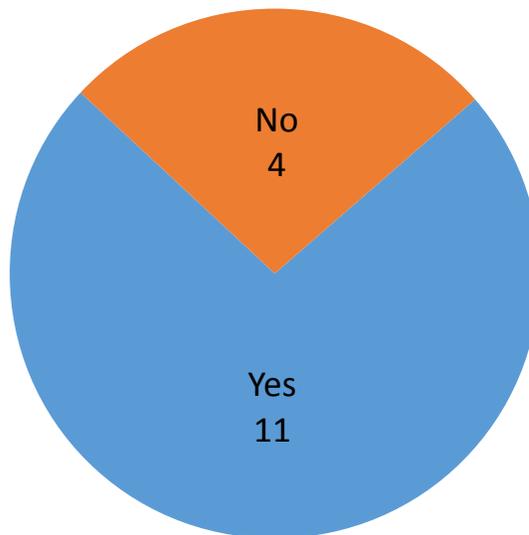
Question 7. Are all external beam photon treatment plans (generated in a TPS) checked by a physicist?

Summary of responses:

- All 4 centres which were counted as “No” indicated that it was a portion of their palliative plans which did not receive a Physics check.

Selected question comments:

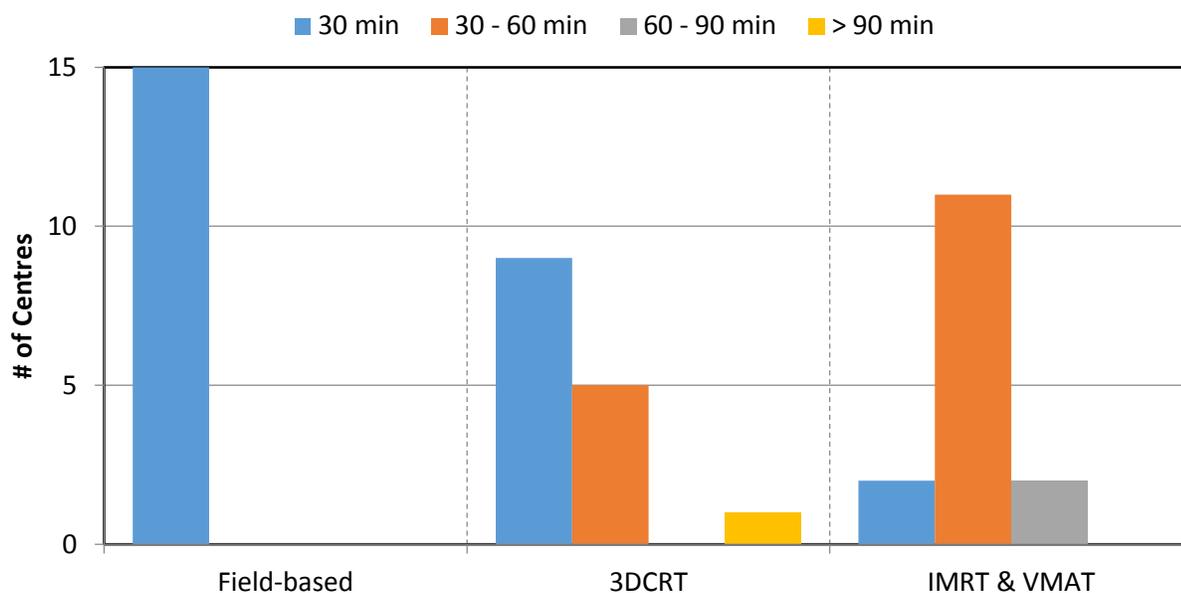
- “Not emergency cord compressions”
- “Handcalc equivalent plans checked by dosimetrist”
- “All plans with dose calculated in the TPS are checked by Physics (i.e. anything with a dose distribution).”



- “Some palliative plans are not checked by a physicist if independent MU check and hotspots meet local accepted values. MU calculations are independently checked by unit physicist at the treatment unit.”
- “Our palliative process involves therapists using Eclipse to generate geometry only with export to RadCalc for MU. These cases have not been counted here.”
- “One centre indicated “Yes” but in the comments indicated that palliative plans, geometrically configured in the TPS but not calculated, were not checked by a physicist.”

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Question 8. Estimate the average time to check plans of the following types (average over all plans and physicists). This time does not include QA measurements.



Notes:

- IMRT/VMAT includes forward planning
- One centre excluded SBRT from 3DCRT times, another centre included it, but commented that non-SBRT would take 20 min, while SBRT can take up to 2 hours

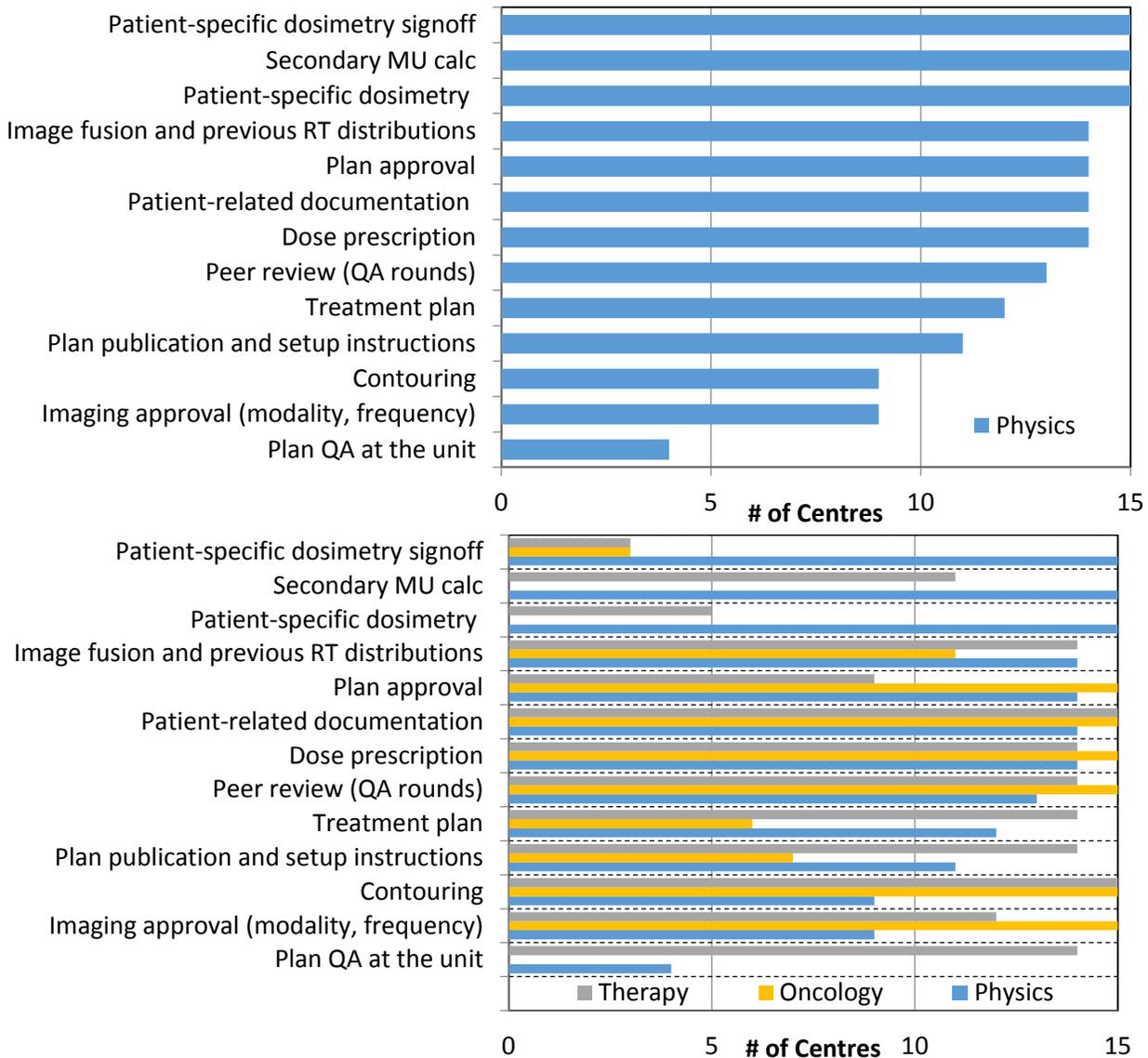
Selected question comments:

- "Assumes, no re-plans or issues"
- "For 2-phase field-based plans, time shown above is per phase."
- "These are an average of reported values amongst our 3 physicists"
- "For IMRT, prostates are <30 min, but breast, GI, lung are more (no H&N or CNS at our centre)"
- "IMRT/VMAT: Checking time depends heavily on the disease site/technique."
- "There is large variation in the IMRT/VMAT time check based on site/contours/protocols/gated/fusion/..."
- "Forward planned segments take much longer than inverse. Would be better to separate these categories"

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Workflow

Question 9. Indicate which of these resources participates in any of the given activities listed in the table below (creates, modifies, approves or checks).



Notes:

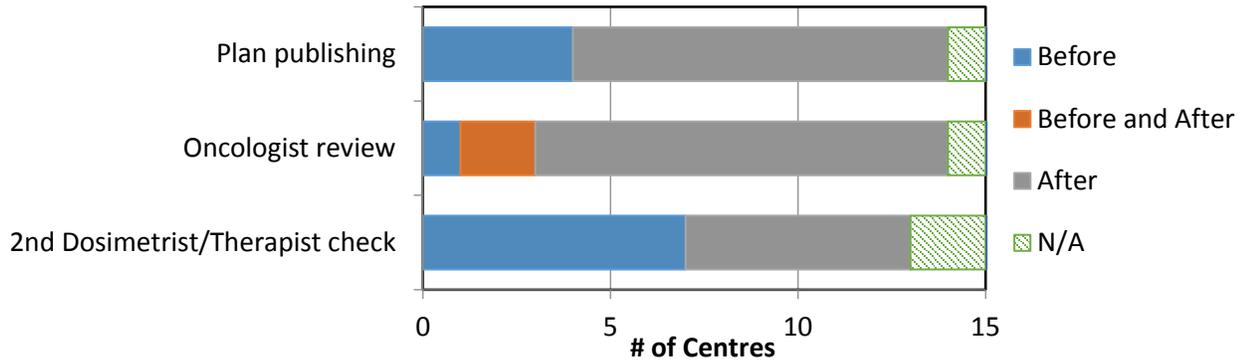
- First graph shows the physics participation sorted by # of Centres. Second graph keeps same order but adds Therapy and Oncology
- The comments suggest some confusion about the activities and there was variation in the interpretations

Summary of responses:

- 3 centres have oncologists involved in patient-specific dosimetry signoff
- 5 centres reported having therapists involved in patient-specific dosimetry
- 12 centres have physics involvement in contouring or imaging
- 4 centres have physicists involved in plan QA at the unit

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Question 10. Indicate when the physics chart check occurs relative to the activities listed in the table below.



Summary of question comments:

- Several centres indicated that the timing of the physics plan check is not always consistent. Factors affecting the timing were:
 - Who generated the plan
 - Disease site
 - Availability (Oncologist and Physicist reviews are concurrent)
- One centre utilizes a 2 stage Physics Review, part before and part after Oncology Review

Question 11. If a physicist is heavily involved in generating a treatment plan, does another physicist perform the check?

Summary of responses:

- All centres answered “yes”.
- One centre commented that their answer was “almost always yes unless there was a time constraint.”

Question 12. Multi-disciplinary peer-review?

12a Are treatment plans presented at a formal (scheduled) multi-disciplinary peer-review?

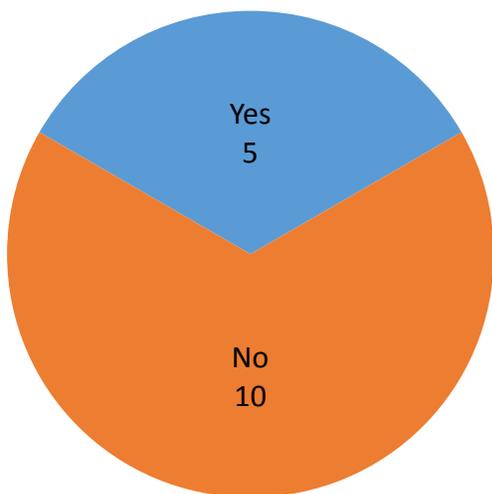
Summary of responses:

- All centres answered “yes”.

Selected question comments:

- “We strive to have all dose distribution plans audited before 25% of the total dose is delivered.”
- “all plans are peer-reviewed by the Site group(consisting of Oncologists, Physicists and Planners).”
- “Plans are reviewed at time of site rounds, however if plan is not ready, then contours are only reviewed.”

12b Are all plans presented at the peer-review?

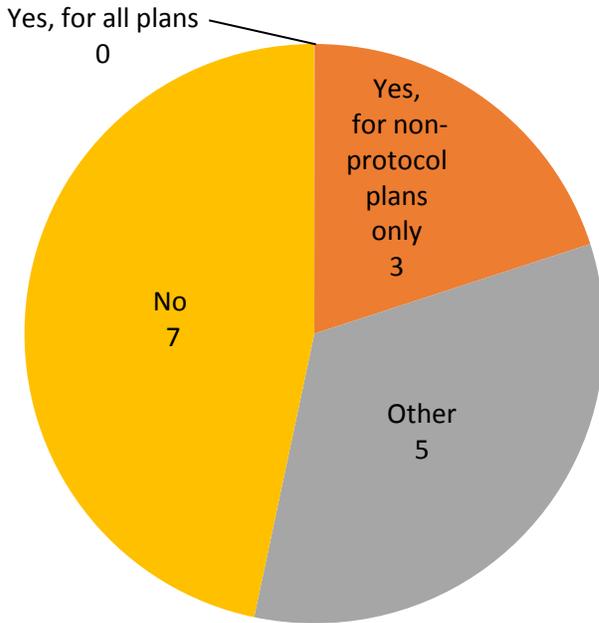


Summary of question comments:

- There was a large variation in the selection factors from the “No” centres.
- The most common criteria was all curative and some palliative
- Disease site was also a common factor affecting peer review
- One centre only selected difficult plans and ones for educational purpose.
- There was some confusion over the difference between Peer Review and Multidisciplinary Rounds.

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Question 13. Do you have a formal multi-disciplinary pre-planning consultation?



Notes:

- No centre selected the option “Yes, for all plans”

Summary of question comments:

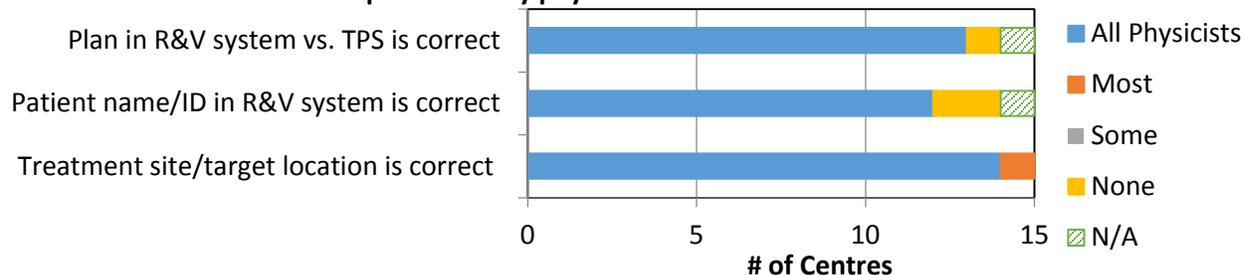
- For “Other” responses, most centres commented the pre-planning consultation was site specific.
- One centre commented the consultation was only for patients with previous treatment with potential beam overlap.
- Some centres have informal pre-planning consultations.

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Verification of Physician Intent

Question 14. Plan/Patient/Site Check

14a Which of these checks is performed by physics?



Summary of responses:

- 4 centres have automated checking process for the correct plan and patient name/ID.

14b Are these (same) checks performed by other groups?

Summary of responses:

- Yes for all centres.

Question 15. For the physics check, what is the treatment site/target location (e.g., laterality, disease) planned in the TPS checked against?

Summary of responses:

- With only one exception, all centres reported “All” their physicists checked against an electronic patient chart. The other centre reported “All” their physicists checked against a paper chart.

Summary of question comments :

- A few centres commented on using planning nomenclatures as secondary check.

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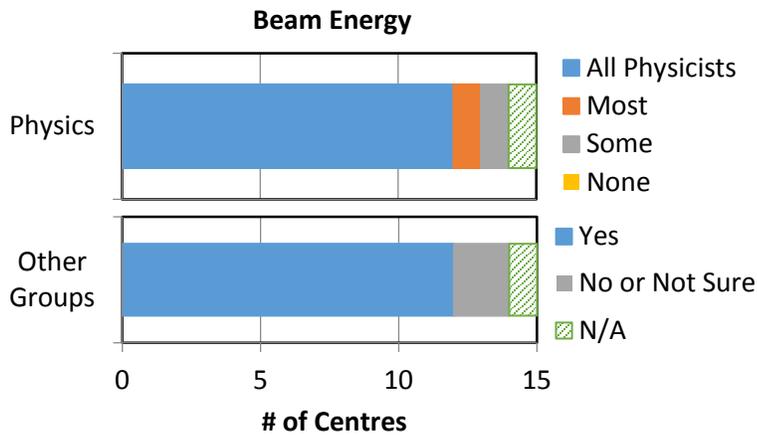
Question 16. Prescription Check

16a Which of these checks regarding the prescription in the TPS is performed by physics?

16b Are these (same) checks regarding the prescription in the TPS performed by other groups?

Notes:

- The graph below indicates checks for energy; “Total Dose” and “Fractionation” are not shown since they are checked by Physics and by “Other Groups” at all centres



Summary of responses:

- All centres reported “All” their physicists and other groups performed checks on “Total Dose” and “Fractionation”
- Two centres have automated checks for all three items

Summary of question comments:

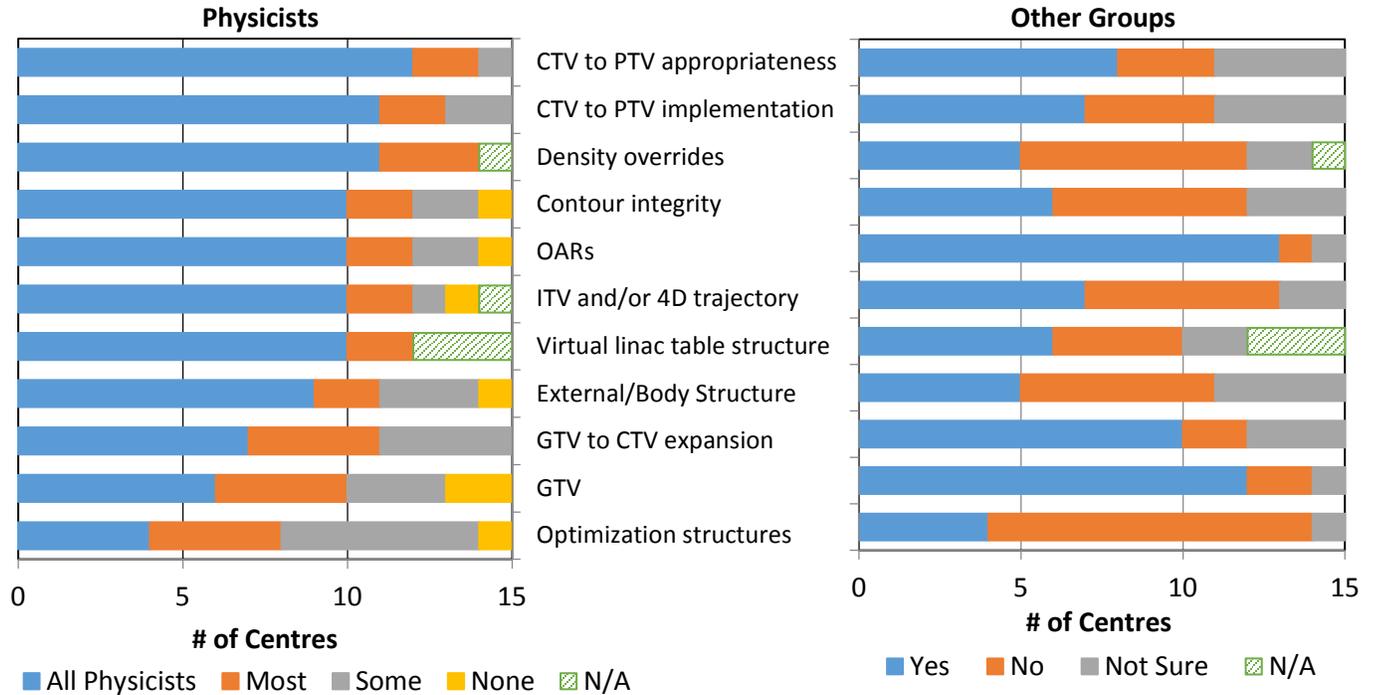
- A few centres do not include energy in their prescriptions

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Question 17. Contour checks

17a Which of these checks regarding structures/contours is performed by physics?

17b Are these (same) checks regarding structures/contours performed by other groups?



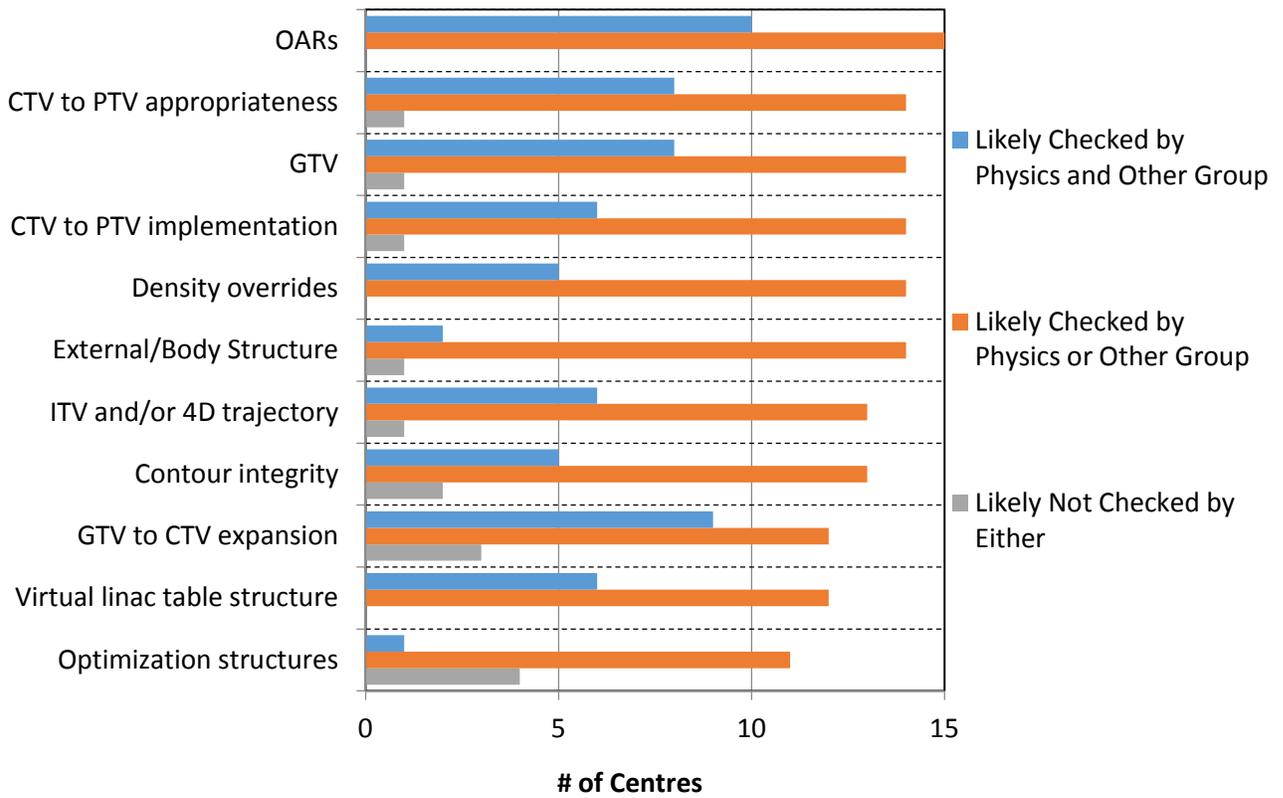
Selected question comments:

- “Physicians take responsibility for entirety of plan including contours, but not sure about consistency of checking by individuals”
- “No explicit contour integrity check.”
- “Physics checks the GTV where applicable and within their limit of expertise.”
- “A quick review of GTV is performed in Multidisciplinary case review.”
- “We only check opt. structures for hybrid breast IMRT”

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The categories in the next graph were generated from the Question 17 responses using the following equations:

"Likely Checked by Physics and Other Group"	Defined By:	(Physics "All"+"Most") AND (Other "Yes")
"Likely Checked by Physics or Other Group"	Defined By:	(Physics "All"+"Most") OR (Other "Yes")
"Likely Not Checked by Either"	Defined By:	(Physics "Some" + "None") AND (Other "No"+"Not Sure")



Observations:

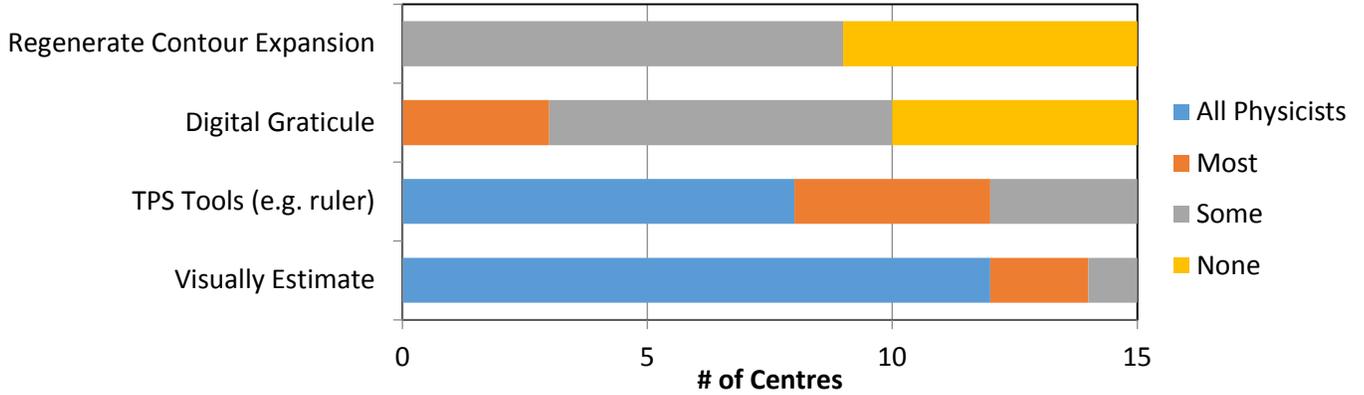
- Items likely not being checked at least once at some centres are:
 - Optimization structures (4 centres),
 - GTV to CTV expansion (3 centres),
 - Contour integrity (2 centres)

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Plan Evaluation

Question 18. Margin expansion

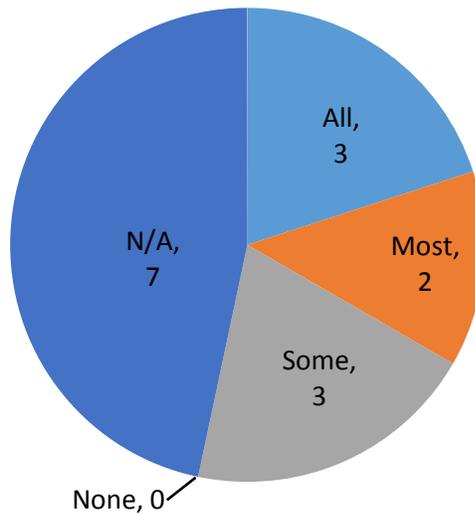
18a If margin expansions are checked by physics in the TPS, how is the check performed?



Summary of responses:

- Most centres performed a visual estimate along with some form of measurement
- 3 centres reported “All Physicists” checked margin expansions using “Visually Estimate” and “Some” or “None” for the other methods.
- 8 centres reported “All Physicists” checked margin expansions using “TPS Tools” plus “Most” or “Some” for the other measurement methods.

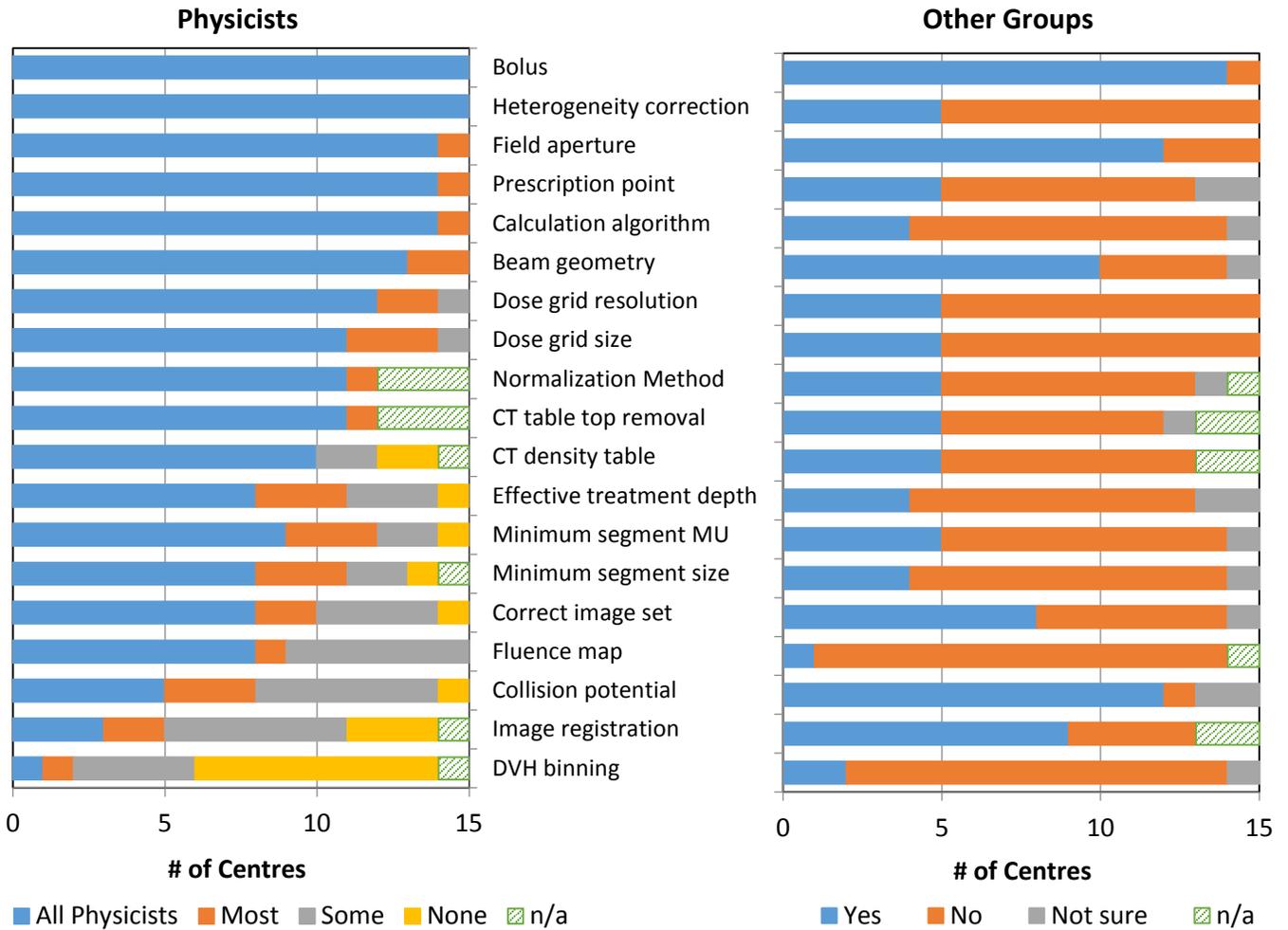
18b If expansions are set using TPS scripts, does physics still check them?



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Question 19. Plan Settings

- 19a. Which of these checks is performed by physics?
- 19b. Are these (same) checks performed by other groups?



Notes:

- Field aperture and Fluence map refer to visual inspections of these elements.
- Prescription point refers to the location of the prescription or normalization point(s).
- Beam geometry refers to number of beams and beam angles.

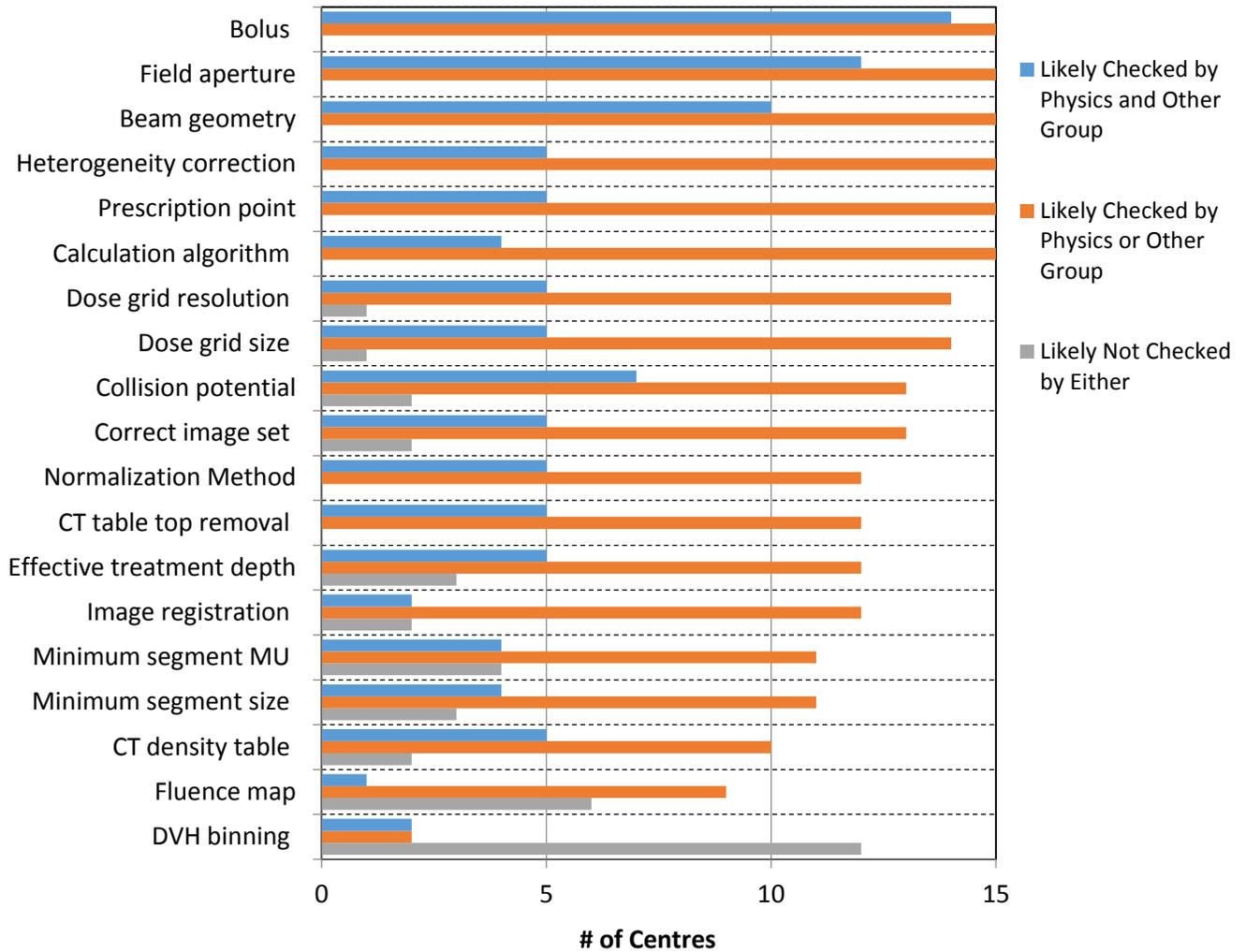
Selected question comments:

- “There is only one CT density table input in the TPS so no need to check”
- “Field segment size and abutment is checked, but not field aperture.”
- “Image registration is checked by oncologists in only certain site groups.”
- “Rooms-eye-view screen shots mandatory for plans with couch kicks. For these cases, trial setups are also conducted.”

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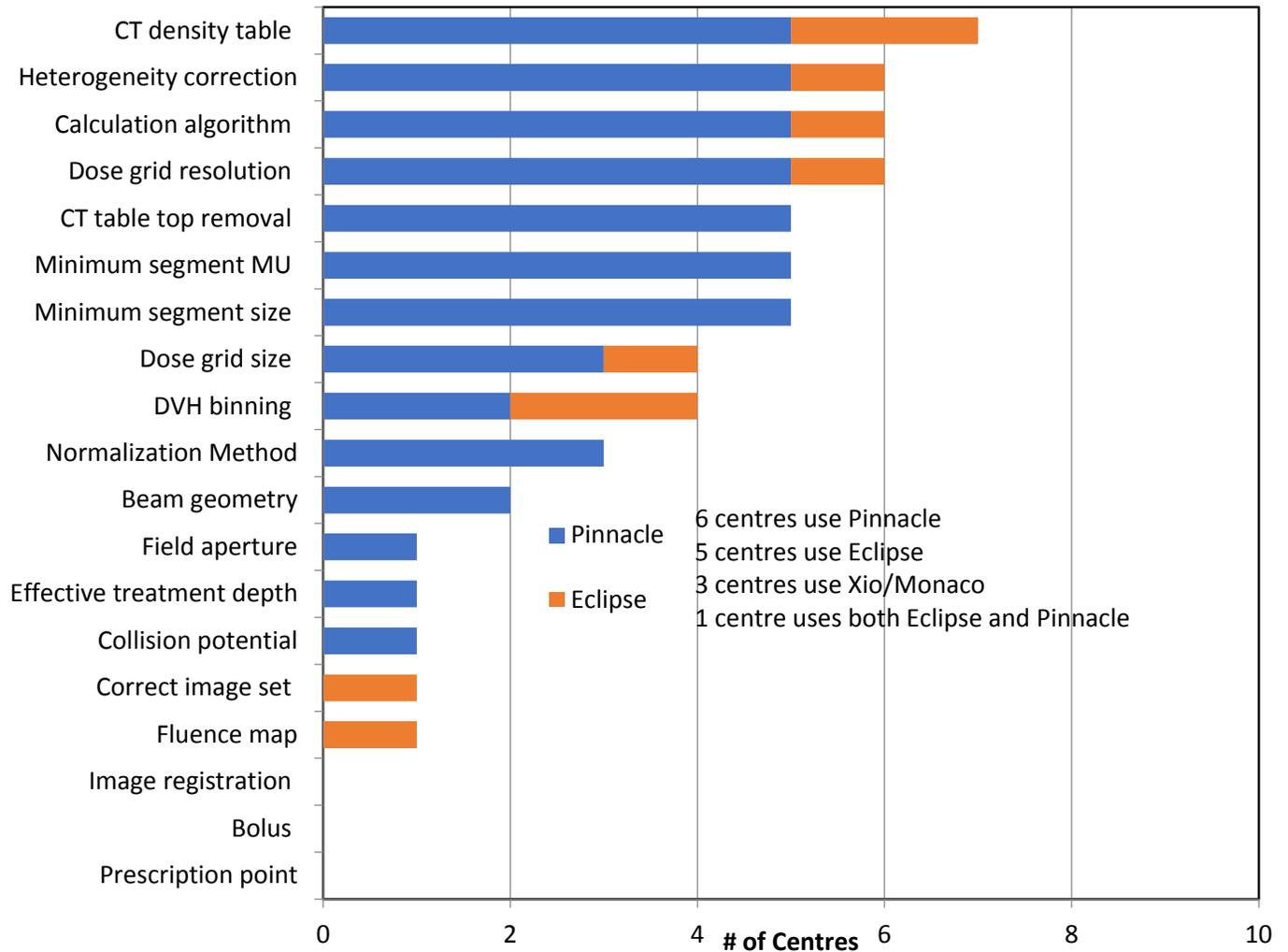
The categories in the next graph were generated from the question 19 responses using the following equations:

"Likely Checked by Physics and Other Group"	Defined By:	(Physics "All"+"Most") AND (Other "Yes")
"Likely Checked by Physics or Other Group"	Defined By:	(Physics "All"+"Most") OR (Other "Yes")
"Likely Not Checked by Either"	Defined By:	(Physics "Some" + "None") AND (Other "No"+"Not Sure")



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Question 19 also asked whether each check was "automated", which referred to the use of a piece of software to perform the check and output the results as a substitute for or in addition to a manual check.

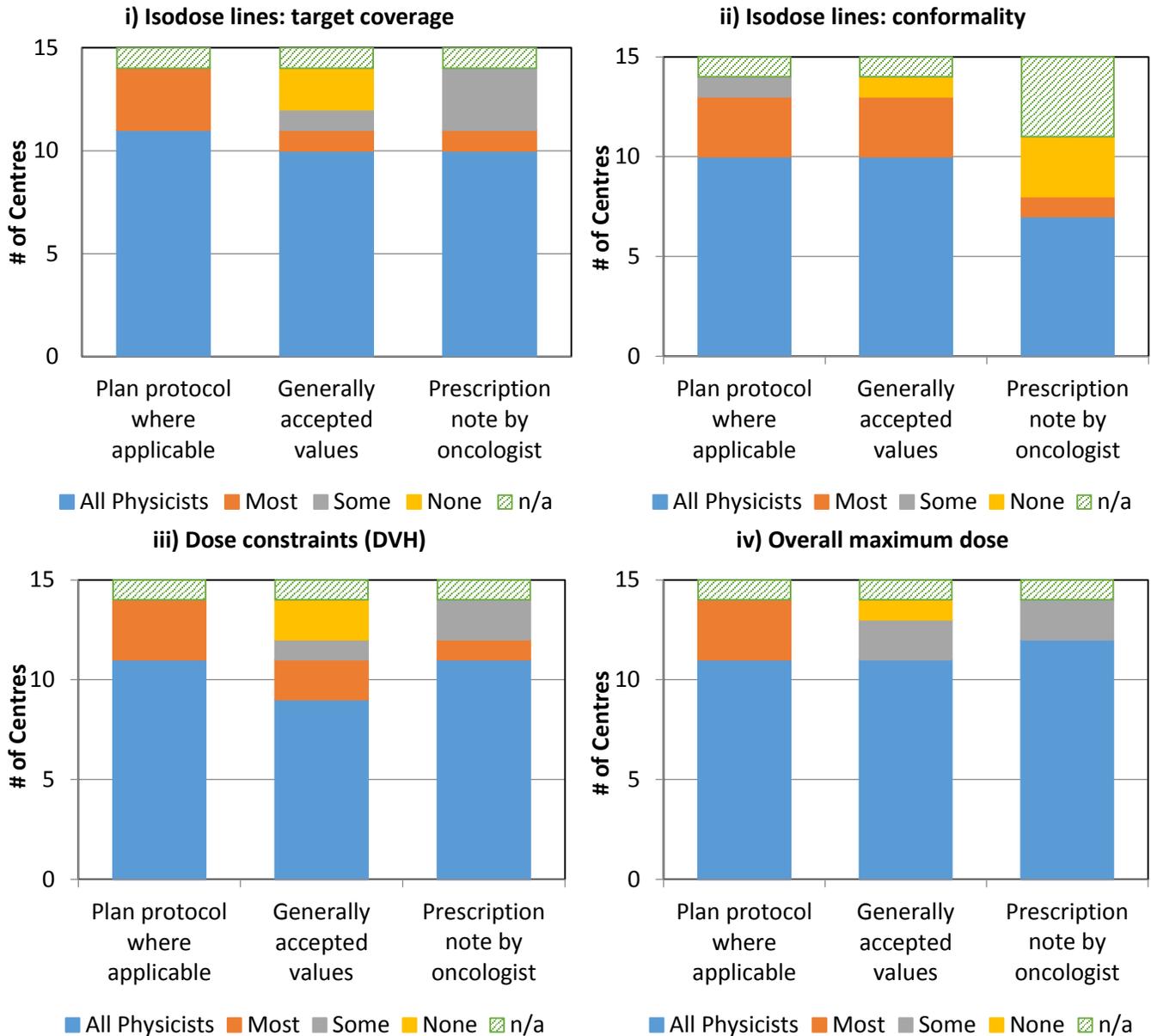


Summary of responses:

- Less than half of all centres use automated tests
- Most Pinnacle centres have some automated tests
- Xio/Monaco users have no automated tests

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Question 20. For contour-based plans, indicate what the following items are checked against by physics:



Summary of responses:

- All centres do some form of verification for DVH Constraints and Maximum Dose
- At 1 centre “Some” do not verify coverage or conformality
- 5 centres have automated checks for target coverage, DVH, and overall max dose.
- 2 centres have automated checks for conformality.

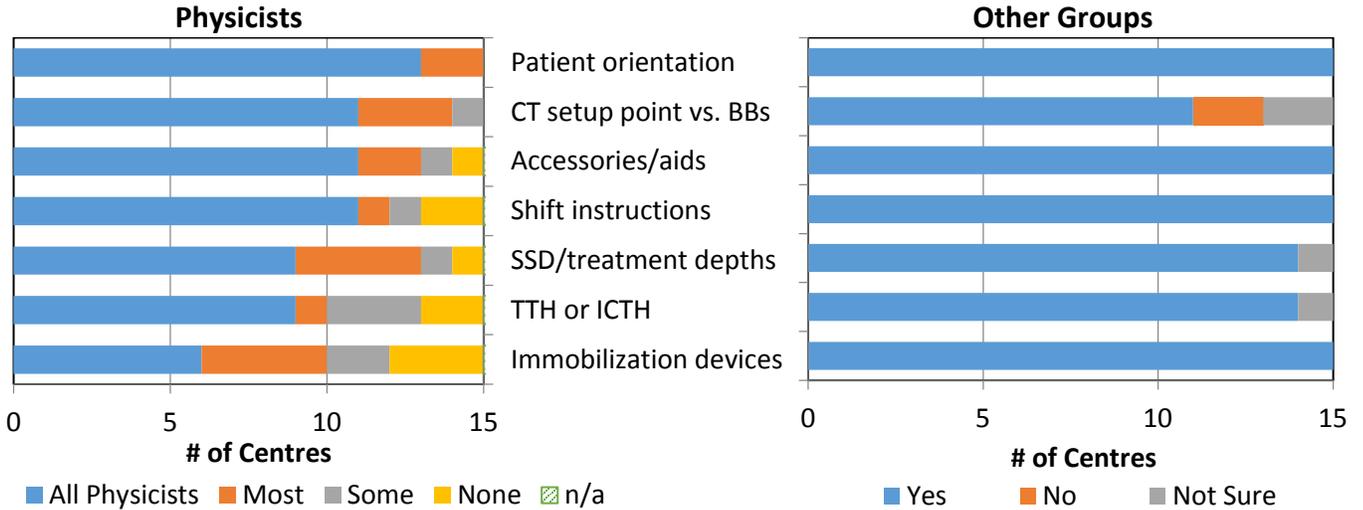
Selected question comments:

- “Automation, done when technically possible within the constraints of the TPS (Eclipse)”
- “Automated check is only available on some sites/protocols.”

Setup Instructions and IGRT

Question 21. Patient setup instructions (for treatment)

21a. Which of these checks regarding patient setup instructions (for treatment) is performed by physics?
 21b. Are these (same) checks regarding patient setup instructions (for treatment) performed by other groups?

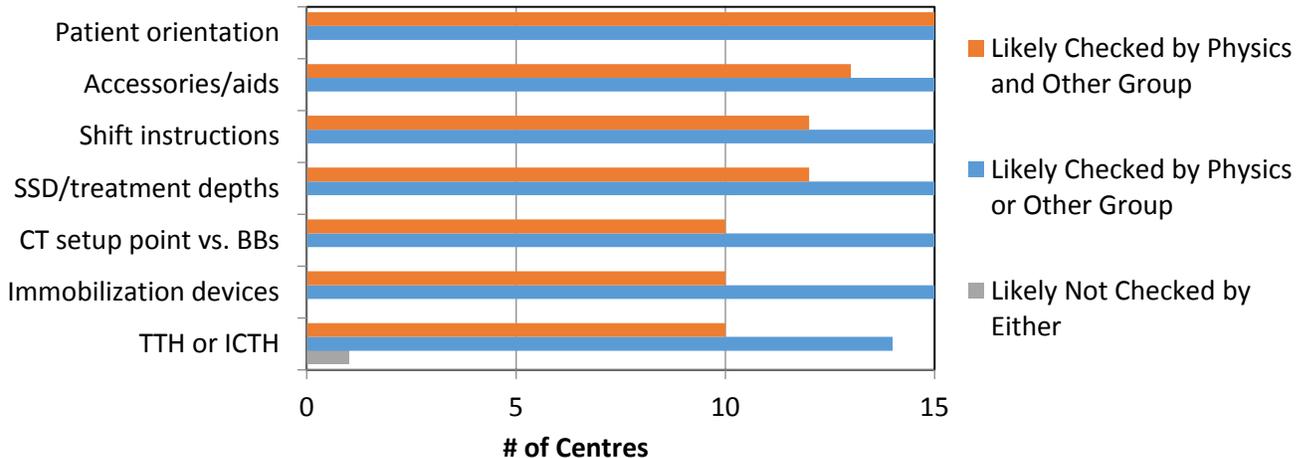


The categories in the next graph were generated from the question 21 responses using the following equations:

"Likely Checked by Physics and Other Group" Defined By: (Physics "All"+"Most") **AND** (Other "Yes")

"Likely Checked by Physics or Other Group" Defined By: (Physics "All"+"Most") **OR** (Other "Yes")

"Likely Not Checked by Either" Defined By: (Physics "Some" + "None") **AND** (Other "No"+"Not Sure")



Observations:

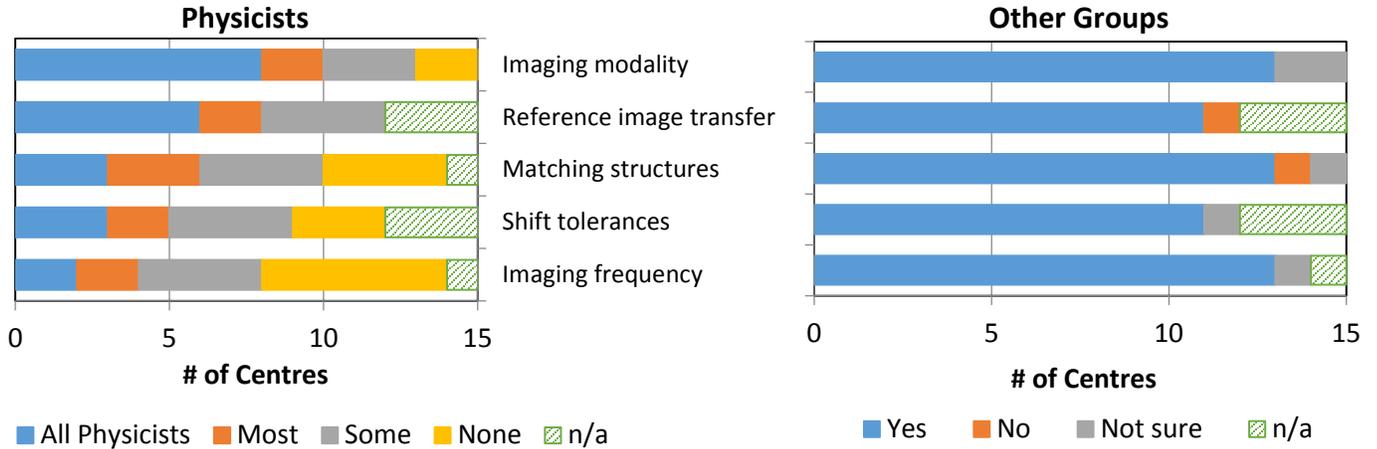
- 1 centre reported that neither physics or other groups checked TTH/ICTH

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 22. IGRT

22a Which of these checks regarding IGRT is performed by physics?

22b Are these (same) checks regarding IGRT performed by other groups?

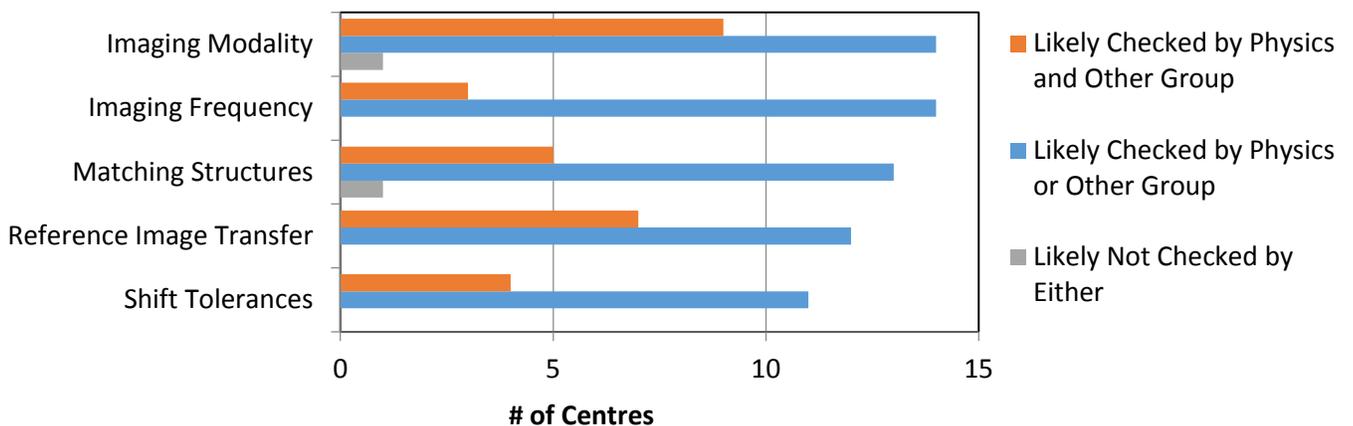


The categories in the next graph were generated from the question 22 responses using the following equations:

"Likely Checked by Physics and Other Group" Defined By: (Physics "All"+"Most") **AND** (Other "Yes")

"Likely Checked by Physics or Other Group" Defined By: (Physics "All"+"Most") **OR** (Other "Yes")

"Likely Not Checked by Either" Defined By: (Physics "Some" + "None") **AND** (Other "No"+"Not Sure")



Summary of question comments:

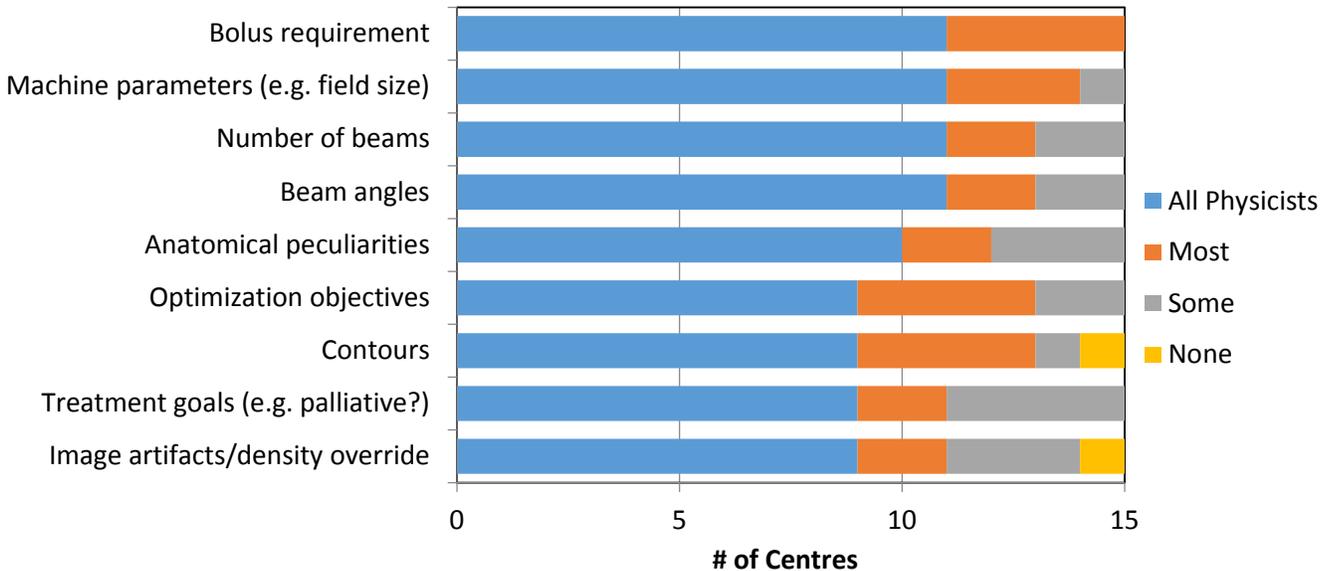
- Five centres indicated that shift tolerances reside in site protocols and are not linked to individual plans
- One centre stated that all patients are getting imaging daily as the standard of care.

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Troubleshooting and Consultation

The next five questions are on "troubleshooting and consultation" and improving treatment plans. The distinction is made between plans that do NOT fulfill the plan or DVH criteria stated in some protocol (therefore basically unacceptable plans) and plans that DO fulfill these criteria (therefore acceptable), but still deemed "sub-optimal". The intent of the questions is to find out what chart-checking physicists do to improve these plans, and if they make a distinction between the former and the latter plans in doing so.

Question 23. If plan/DVH criteria are not met, which of the following do you check for appropriateness?



Notes:

- An "Other" category option, with text to add two additional items, was also available

Summary of responses:

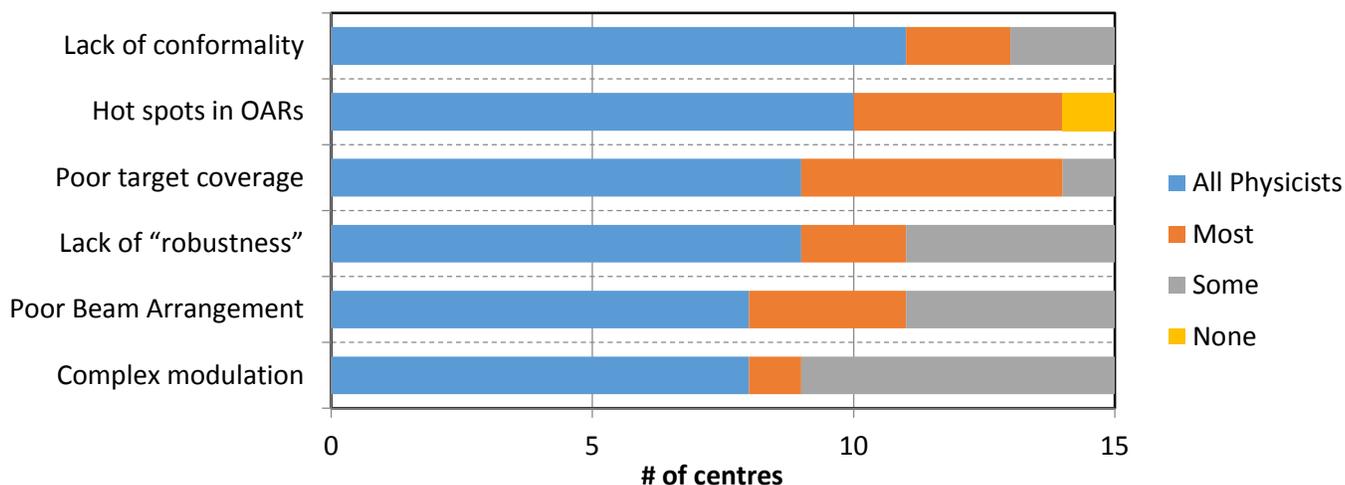
- Items that were indicated as checked under the "Other" category were:
 - Beam energy
 - ICRU point placement
 - Plan normalization
 - Margins
 - RO notes/physician intent
 - Treatment goals are not well understood (compromise of PTV coverage for OAR sparing?)
 - Sub-optimal patient position
 - Machine parameters: limitations of MLC leaf widths may trigger a change to a different beam model (type of linac).

Summary of question comments:

- "Some people said they checked most of these items for appropriateness before they checked the plan/DVH criteria."
- "Bolus requirement: is typically discussed prior to planning."
- "Image artifacts may be checked as part of troubleshooting but it is not something commonly done."
- "Anatomical peculiarities include: 1)No neck, 2)air in rectum, 3)patient size related issues for imaging and planning."

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 24. How do you define a sub-optimal plan which otherwise meets the prescription planning goals/criteria?



Notes:

- Lack of "robustness" refers to the issues with tight margins, intra-fraction motion, and reproducibility
- Poor Beam Arrangement refers to poor choice of beam angles too many fields or too few fields
- An "Other" category option was also available.

Summary of responses:

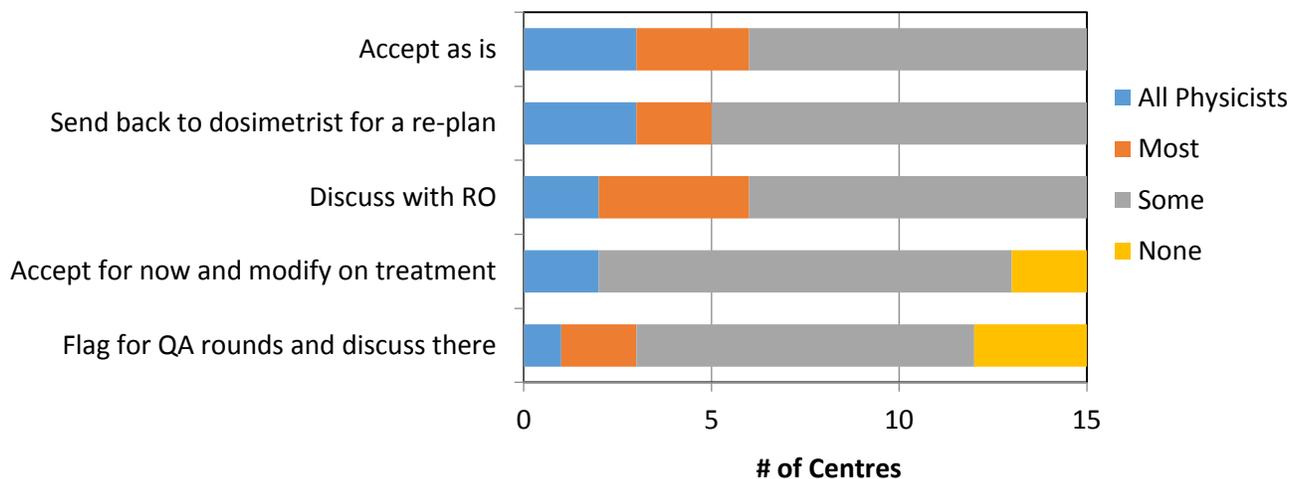
- Items that were indicated as checked under the "Other" category were:
 - Regions of high dose near OAR
 - Unnecessary complexity
 - Not following protocol
 - Less than typical OAR sparing
 - Illogical or contradictory optimization parameters

Selected question comments:

- "Most of the above issues are site specific."
- "Time pressures sometimes require that we accept a sub-optimal plan."
- "Hot spot is assumed to be a region of 105% dose."
- "Hot spots in OARS that are within the PTV would be considered acceptable but outside of the treatment volume was considered to be lack of conformality."

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 25. What is done with a sub-optimal plan which otherwise meets the prescription planning goals/criteria?



Summary of responses:

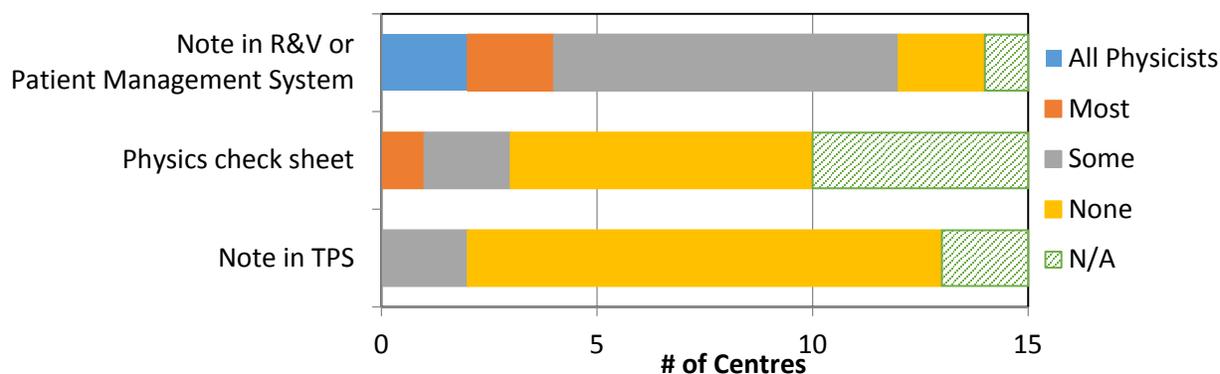
- 3 centres indicated that all physicists “accept as is” sub-optimal plans
- All centres reported that at least some physicists “accept as is” sub-optimal plans
- Items that were indicated as checked under the “Other” category were:
 - Discuss with Dosimetrists (3 centres)
 - Physics Modifies or Replans (3 centres)
 - Comments/Education (1 centre)

Summary of question comments:

- Four centres indicated that urgency/timing affected their choice of action.
- One indicated that the decision “depended on magnitude of how sub-optimal the plan is.”
- Another indicated that “how well the planning goals and criteria were defined” affected the decision.
- One centre stated that their choice of action was “very circumstantial”, but did not elaborate.
- One centre stated that “highly modulated plans are sent for automatic QA measurement”.
- For modifying on treatment two comments were received:
 - “Many sub-optimal plans are allowed to treat for 1-2 fractions and are re-planned later.”
 - “The only example we could think of is adding a bit of bolus.”

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

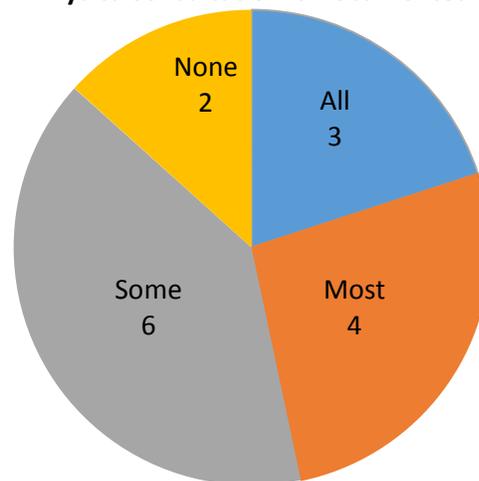
Question 26. When physics is consulted during plan generation due to a plan not meeting the clinical objectives or otherwise sub-optimal, where is this documented?



Notes:

- The bar graph above shows the responses for the three possible locations of documentation given in the question.
- The pie chart is based on the responses to the option “It is Not Documented”, but for clarity the negative has been removed from the question and the answers are inverted.
- Two centres responded N/A to “It is Not Documented” (both Question 26 and 27). These were converted to “All Physicists” document consultations, since this was clear from their responses to the other options.

Physics Consultation is Documented



Summary of responses:

- The question provided the option to include additional locations for documentation in addition to the three given. No additional locations were mentioned.
- “Note in R&V or Patient Management System” was the most common location for documenting the consultation. However only 4 of the 15 centres indicated “All” or “Most” for this option.
- More than half the centres indicated “Some” or “None” for “It is Documented”.

Selected question comments:

- “We do not routinely document each physics consultation. However, if a consulting physicist has been involved significantly in the re-planning, that physicist will not be the checking physicist. This is communicated via email or phone but not otherwise documented.”
- “Does email count?”

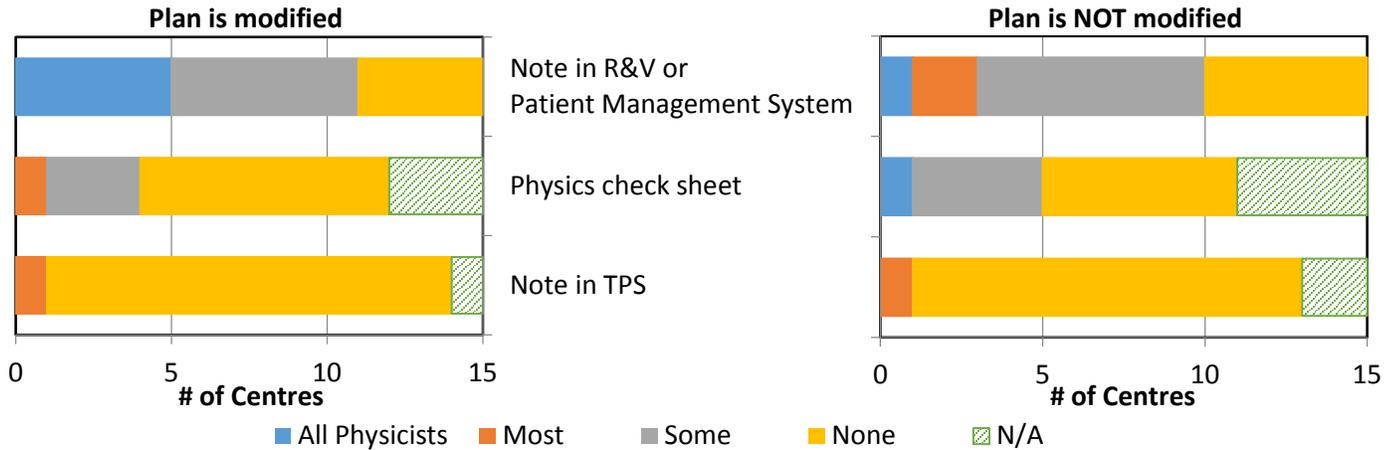
CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 27. Physics troubleshooting documentation

When physics troubleshoots issues/concerns with a plan (i.e., at their own initiative) that is discovered during the physics check and:

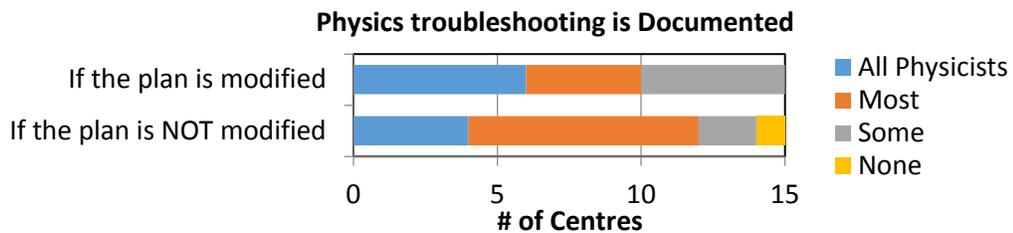
27a the plan is modified, where is this documented?

27b the plan is NOT modified, where is this documented?



Notes:

- The bar graphs above shows the responses for the three possible locations of documentation given in the questions.
- The bar graph below is generated from the responses to “It is Not Documented”, except that for clarity the negative has been removed from the question and the answers are inverted.
- Two centres responded N/A to “It is Not Documented”. These were converted to “All Physicists” document troubleshooting. This was clear from their responses to the other options.



Summary of responses:

- One center mentioned in-house software for publishing treatment plans (Web Publishing)
- Three centres referred to e-mail when the plan is modified, and one centre referred to e-mail when the plan was not modified.
- Three centres referred to records maintained by individual physicists when the plan was not modified.
- “Note in R&V or Patient Management System” was the most common location for documenting plan troubleshooting regardless of whether the plan was modified or not.
- Documentation was more likely to occur if the plan was modified

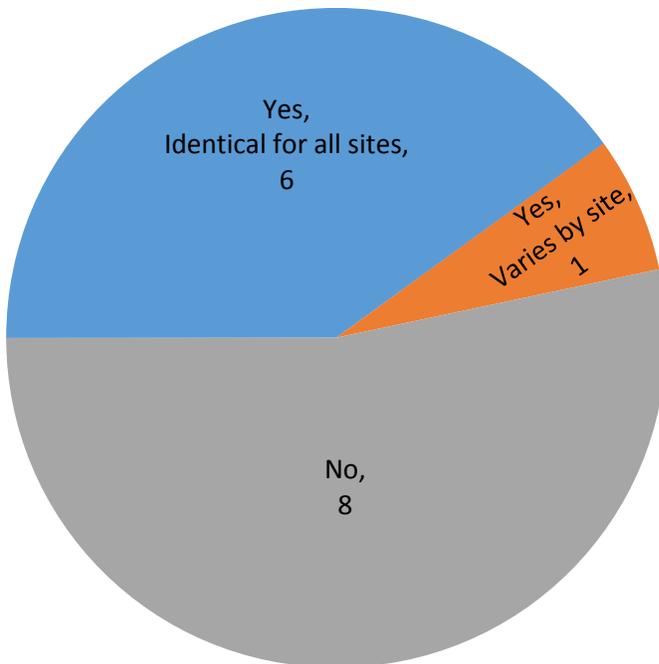
Selected question comment:

- “For minor modification not requiring a full replan, this is documented in ARIA. For full replans back to dosimetry, we have a replan "encounter" or process.”

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Documentation

Question 28. Do you use a standardized chart check list as part of the official documentation for all plan checks?

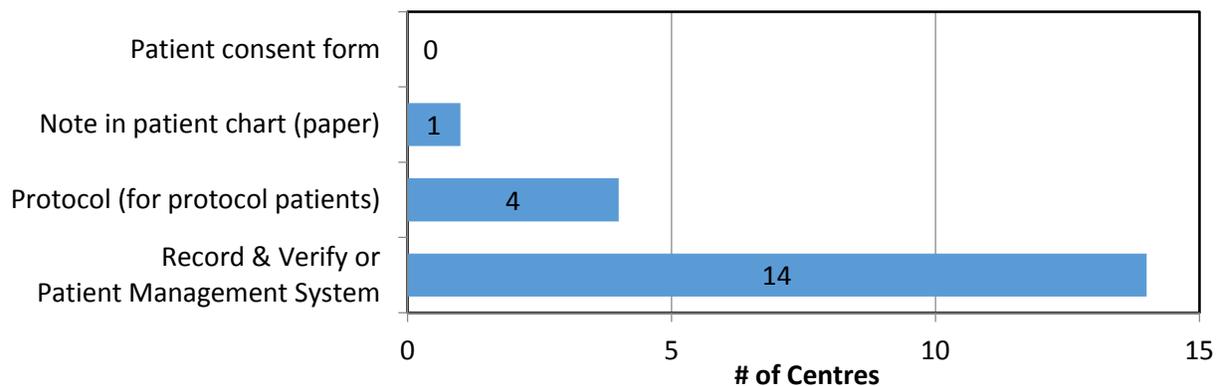


Summary of question comments:

- 3 of the 8 centres that responded 'No' have unofficial checklists.
- 1 of the 6 centres that responded 'Yes, Identical for all sites' reported that they have different checklists for 3D conformal and for IMRT/VMAT.

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 29. Where does the radiation oncologist's official prescription reside?



Summary of responses:

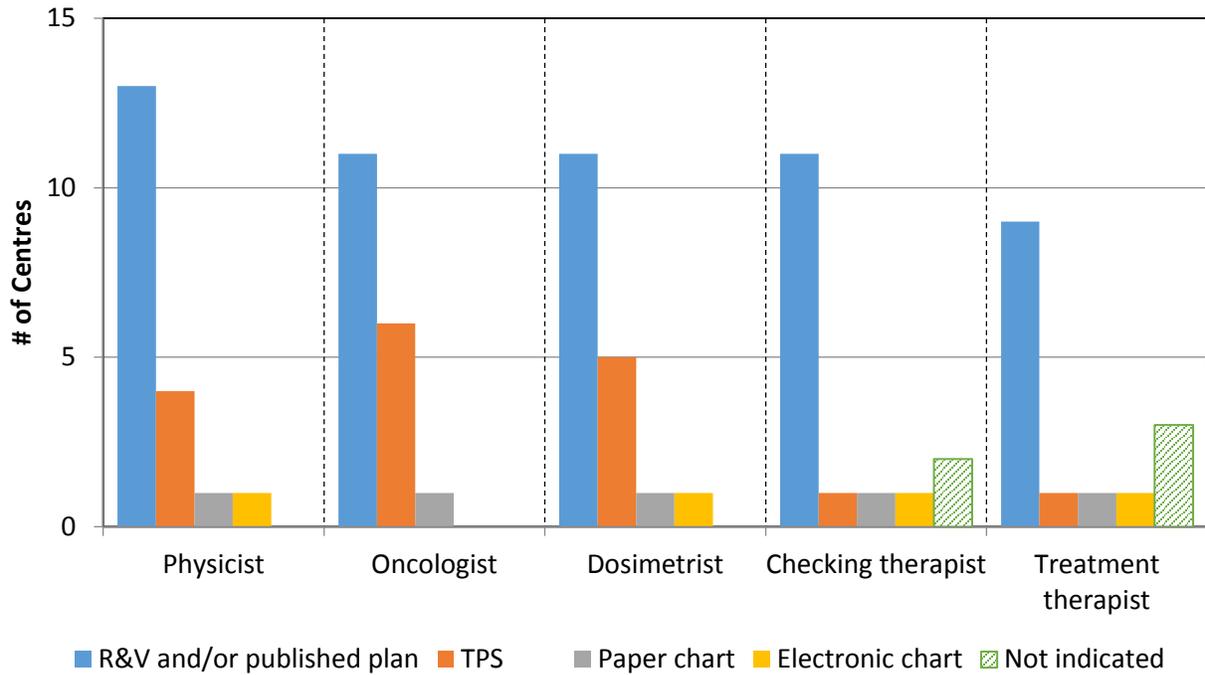
- 4 of the 14 centers that responded with: "R&V or patient management system" also indicated: "Protocol (for protocol patients)"
- No centre indicated "Patient consent form".

Selected question comment:

- "The patient management system (Eclipse Plan in our case) is the official prescription. If the dose in Eclipse is different from protocol or different from the original "Planning requisition" a note is usually entered in "Journal Notes"- within the R&V software. Note, in our case, protocols are not built into the R&V."

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 30. For each of the resources listed below, how/where is plan signoff officially indicated?

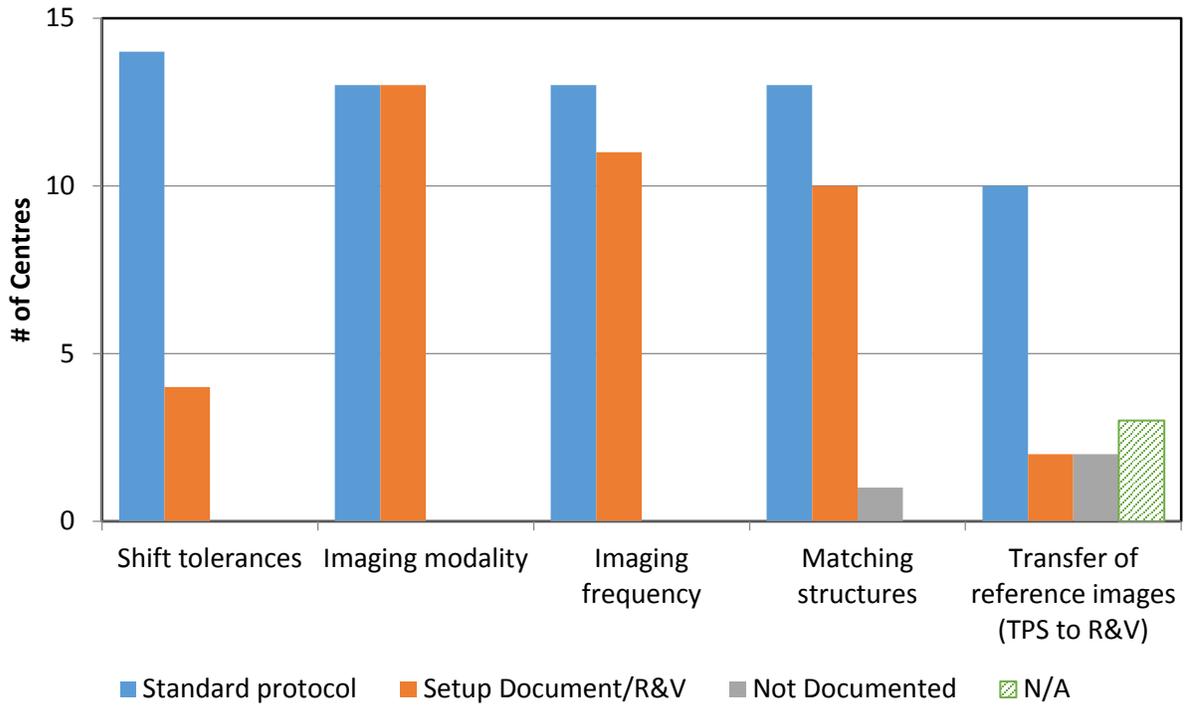


Selected question comments:

- “Dosimetrist, Checking Therapist, Physicist: They sign-off in an electronic document in patient record. Treatment therapist: For palliative cases, they will sign-off (“treatment approval”) in R&V system.”
- “Only one check performed by therapy, assumed to be checking therapist. We don’t distinguish between checking and treatment therapist.”

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 31. How are the following IGRT instructions documented?



Selected question comments:

- “RV documentation for off protocol imaging requests”
- “If extra imaging is required outside protocol, this is communicated by RO.”
- “Transfer of reference images also documented in TPS”

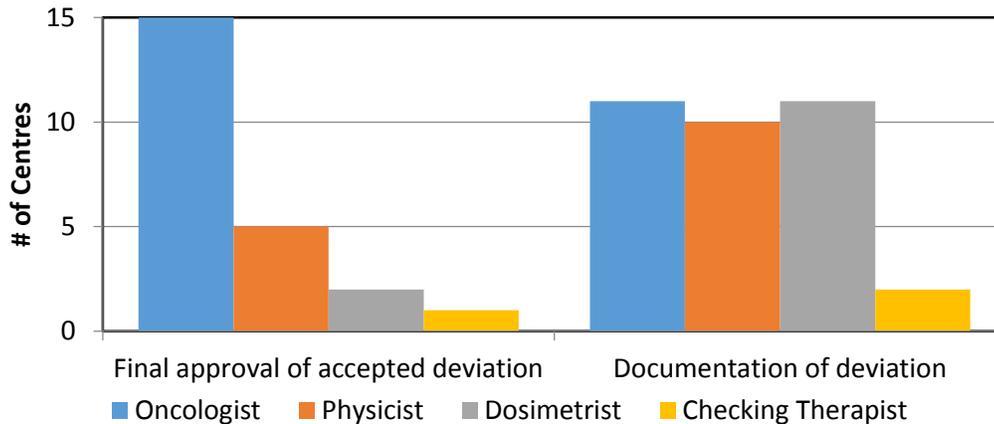
CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

Question 32. For those treatments planned according to a standard protocol defined at your centre, are deviations from protocol of the planning elements (e.g., delivery technique, target/OAR metrics) ever accepted?

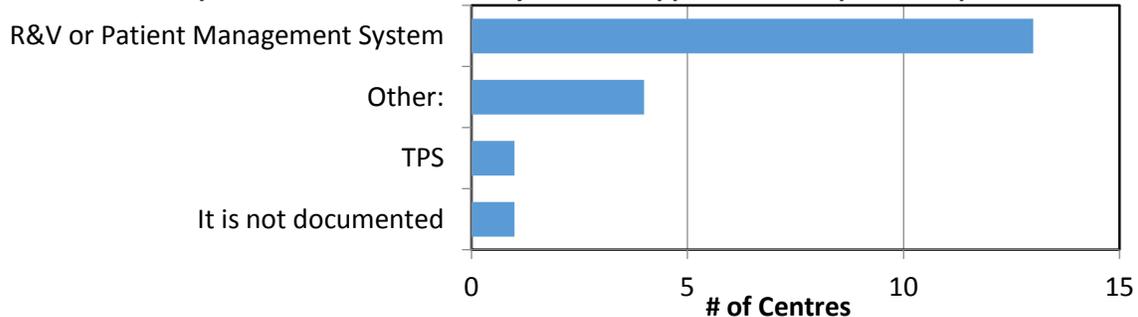
Summary of responses:

- All centres accept protocol deviations.

32a When deviations occur, who performs the following actions?



32b Where is acceptance of the deviations by the final approver of the previous question documented?



Summary of responses:

- Other Included:
 - QA rounds
 - Web Publishing system
 - Published plan
 - Paper treatment record

Selected question comments:

- “Plans with accepted deviation are approved the same way as normal plans.”
- “We do not have a consistent way of documenting this. Practice is site-dependent. Some sites have frequent deviations from protocol that are accepted.”

Question 33. For non-protocol treatments, is the approval and documentation of deviations from the prescription the same as for protocol plans?

Summary of responses:

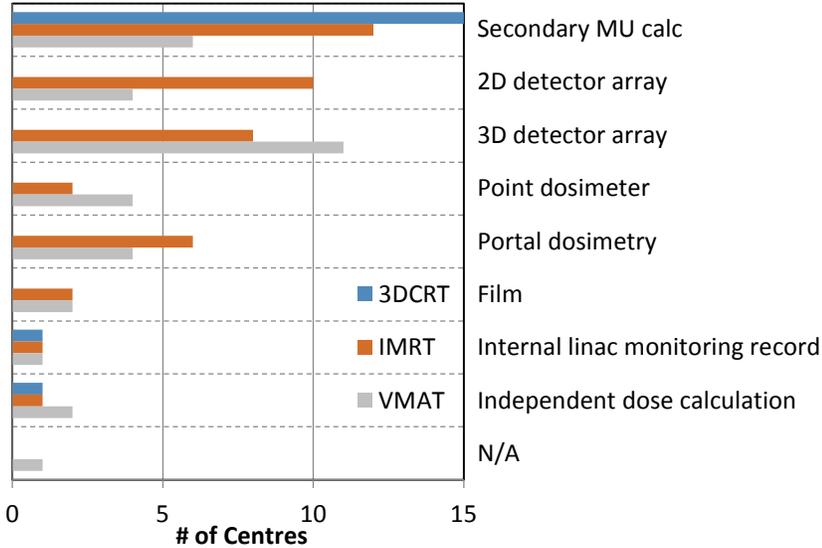
- All centres agreed that approval and documentation of deviations from the prescription are the same for protocol vs non-protocol plans

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

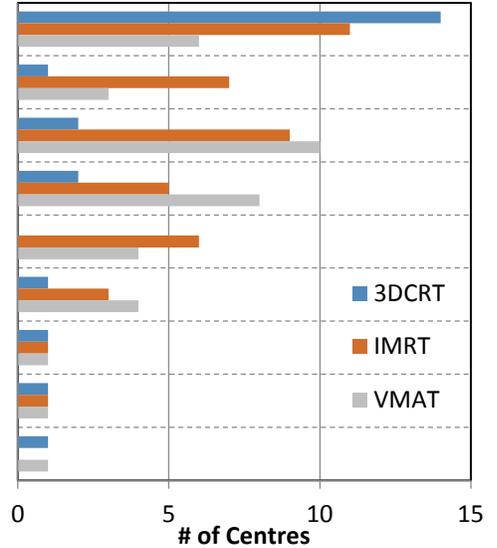
MU / Dose Verification

Question 34. Which of the following (pre-treatment) patient-specific QA is performed?

For standard-Fractionated Treatments



For Hypo-Fractionated Treatments



Notes:

- Point dosimeter refers to ion chamber or diode
- Portal dosimetry can be qualitative or quantitative
- Internal linac monitoring record refers to data such as log files of MLC positions.
- Independent dose calculation refers to calculations in a secondary TPS or using Monte Carlo

Summary of responses:

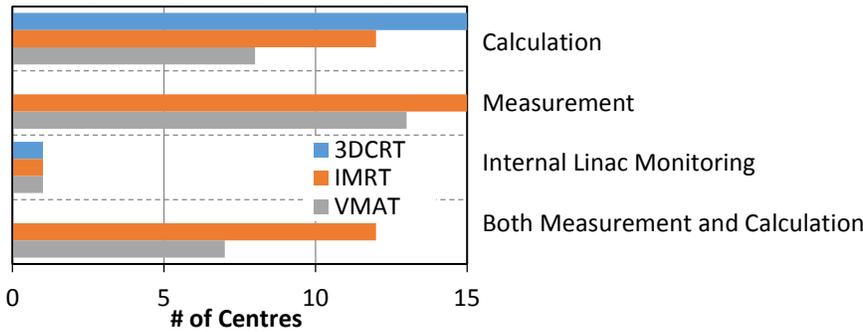
- None of the centres indicated using Gels, MosFETs, TLDs or OSLs for patient specific QA
- Although an option was provided to indicate other QA methods, none were given

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

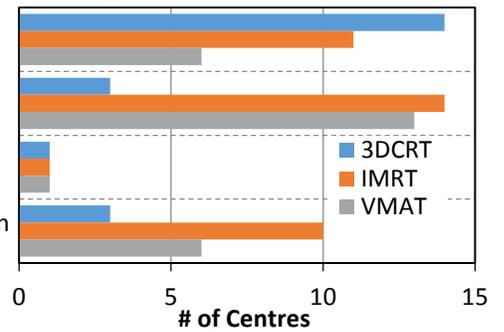
The categories in the next graph were generated by combining categories from the question 34 responses as follows:

- “Calculation” consists of: Secondary MU calc and Independent Dose calculation
- “Measurement” includes: 2 and 3D detector arrays, Point dosimeter, Film and Portal Dosimetry

For standard-Fractionated Treatments



For Hypo-Fractionated Treatments



Observations:

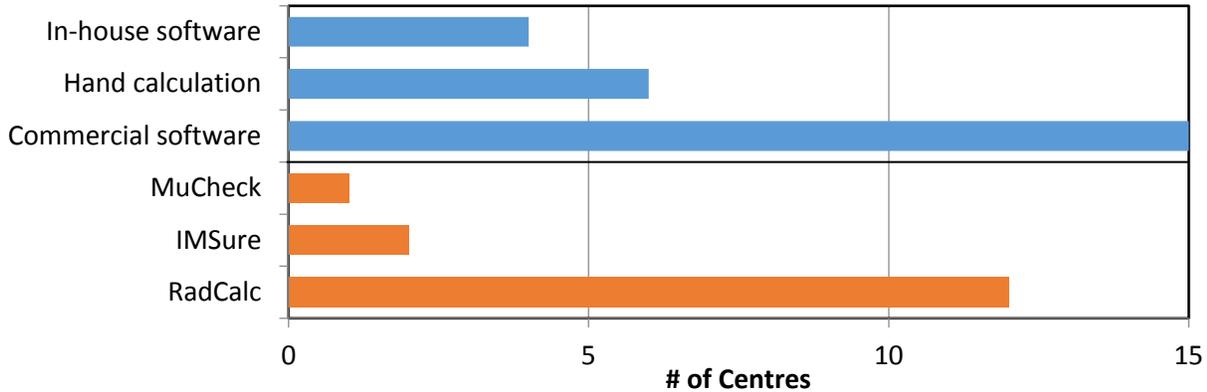
- Some centres perform more than one type of patient specific QA, illustrated in the lower graphs.

Selected question comments:

- “MU calc for IMRT is only done for hybrid-breast (DMLC)”
- “Ion chamber measurements are only done for failing results (in ArcCheck)”
- “Film is used very infrequently, usually as a backup.”
- “2D detector array used only on an as-needed basis.”
- “We don't always perform point dosimeter measurements, only when required.”
- “All portal dosimetry is qualitative. “
- “Film is only used for large fields that do exceed the EPID size.”
- “MOBIUS 3D implementation in progress.”
- “Second planning system (Eclipse) used to verify primary plan distribution and RV import.”

CURRENT PRACTICES OF MEDICAL PHYSICS EXTERNAL BEAM PLAN CHECKING

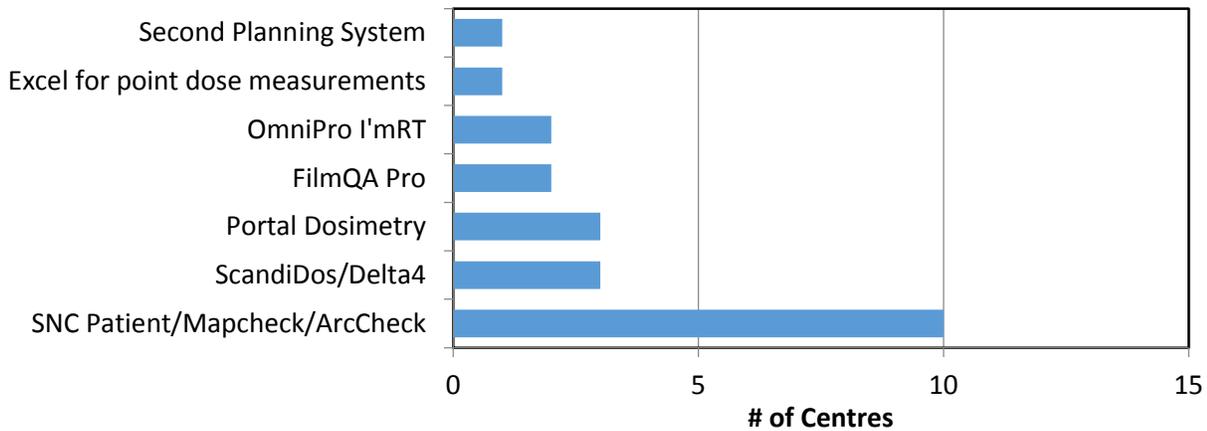
Question 35. What is used to perform the secondary MU/dose calculation check?



Selected question comments:

- “Hand calculation is used only in emergency such as when software fails to open.”
- “In house only for SRS, handcalc for ortho, electrons or if Radcalc breaks”
- “In-house software: Treatment Time Calculator”

Question 36. What is used to analyze your (pre-treatment) patient-specific IMRT/VMAT dose verification?



Summary of responses:

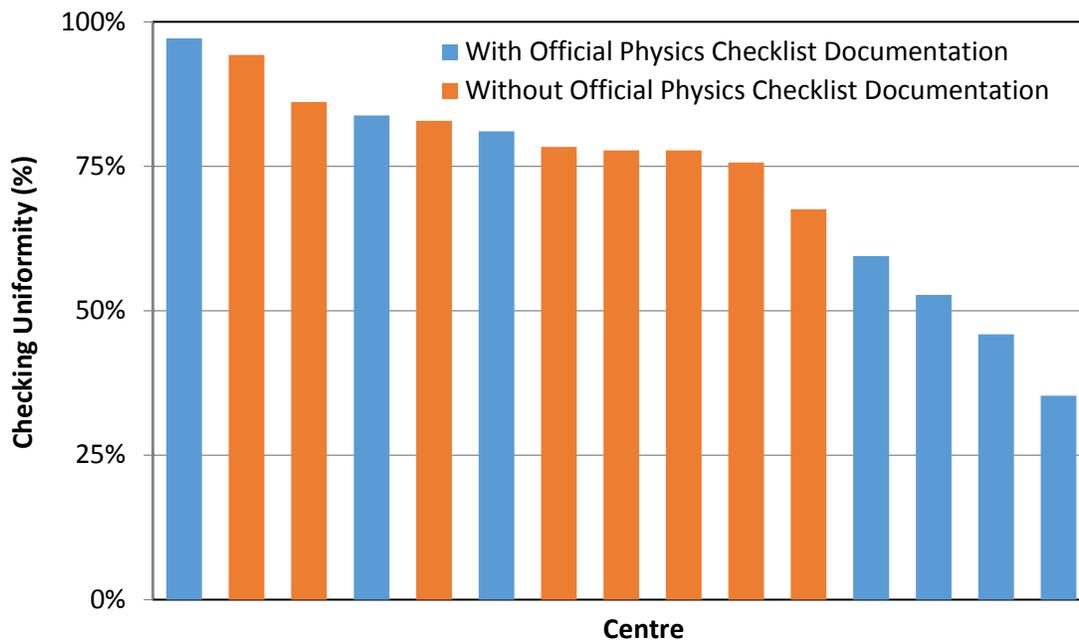
- All centres use a commercial software product for analysis of pre-treatment patient specific measurement QA.

Intra-Centre Variability of Physics Checks

- An index labeled “Checking Uniformity” was created to estimate the variability of the physics checking within each centre.
- The estimate was based on the combined responses to questions 17a (Contours), 19a (Plan), 21A (setup), 37 items in total.
- The “Checking Uniformity” index (UI) for a centre was calculated by the ratio of the number of items that centre responded with “All Physicists” or “None” over the total number of items that the centre responded to with any of “all”, “Most”, “Some” or “None” (i.e. Total Items – “N/A” responses):

$$UI = \frac{\sum(All + None)}{\sum(All + Most + Some + None)}$$

- There were some differences between the centres in the interpretation of what constituted “Most” and “Some”, but it is expected to have a minimal impact on the index.
- This measure of variability is biased against centres with a large number of physicists, since more physicists in the group increases the likelihood that one of them will do something different from the rest.
- The Checking Uniformity index was linked with the responses to question 28 to see if the existence of an official checklist affected the uniformity.



Observations:

- Most of the centres were uniform in their checking for over 75% of the checking items that were in the survey
- Uniformity does not appear to correlate with whether a centre has an official checklist document.

Selected Closing Comments:

- The following comments were given at the conclusion of the survey:
- “Would like to see how many centres have plan check QA rounds for physicists.”
- “Would like a survey for other groups to see what they check in a plan.”
- “Would like to see how other centres evaluate combined doses from previous radiation course(s) and current course, specifically, how to tackle different fractionated doses, whether rigid or deformable registration is done to the CTs before combining the doses, and who does/checks the registration.”
- “Would like a guideline on plan check for other groups as well.”
- “Question should be included RE: time given to check a plan. This influences plan quality and robustness of checks “
- “Need question that shows what the influence of time constraints will impact plan check quality.”
- “What is the expected turnover time for a physics check? We get ~ 40% of plans that need to be completed within a working day which impacts our decision regarding "sub-optimal" plans.”
- “With different planning platforms, some checks are required where others aren't so answering some questions was challenging.”
- “It was a useful exercise as a group, though, to see what checks everyone was and wasn't performing.”

Table of Definitions

"You":	Physicists
Other groups:	All those resource groups other than the dosimetrist (e.g. the second therapist checker if applicable, oncologist, treatment unit therapist)
Dosimetrist:	The radiation therapist who generates the treatment plan (a.k.a. "treatment planner")
Plan signoff:	Method used by each resource in the centre to indicate completion of their involvement with the plan
Checking therapist:	The dosimetrist or therapist, independent of the treatment planner, who checks the plan
Plan publishing / published plan:	A plan summary report of the final treatment plan generated from the treatment planning system which is signed by all resources involved; this process can be on paper or paperless
TPS:	Treatment planning system
Field-based plan:	Field borders are defined by anatomical landmarks; prescription is typically to a point as opposed to coverage of a contoured structure by an isodose; a "simple" plan, often palliative
TTH:	Tattoo to table top height
ICTH:	Isocentre to table top height
Protocol:	A standardized approach within a centre to planning a treatment site; a protocol may include elements such as prescription dose, margin expansions, dose metrics for targets and OARs, treatment delivery technique, imaging strategy, etc.
Troubleshooting and Consultation:	The investigation and adjustment of plans which do not meet expected criteria or are deemed suboptimal. Consultation generally refers to situations when this is done at the request of others. Troubleshooting generally refers to situations when this is done at the physicists own initiative.