UK Health Security Agency

Safer Radiotherapy

e-Bulletin #8
September 2022

Welcome to the Safer Radiotherapy (RT) e-bulletin, which provides key messages and learning from radiotherapy error (RTE) reports and patient safety initiatives.

Representatives from the UK Health Security Agency (UKHSA), the Royal College of Radiologists (RCR), the Society of Radiographers (SoR), Institute of Physics and Engineering in Medicine (IPEM), NHS England (NHSE) and a lay representative from the Patient Safety in Radiotherapy Steering Group (PSRT) to support the coordination of efforts to improve patient safety in RT across the UK. This work includes the collation, analysis and promulgation of learning from RTE reports.

Anonymised RTE reports are currently submitted on a voluntary basis through the National Reporting and Learning System (NRLS) or Learning from Patient Safety Events System (LFPSE) of NHSE or the Once for Wales (OfW) Concerns Management System and directly to UKHSA, to promote learning and to minimise recurrence of these events. Safer RT accompanies the Triannual RTE Analysis & Learning Report, which summarises learning from RTE reports submitted for the preceding 4-month period. The report is designed to disseminate learning from RTE to professionals in the RT community to positively influence local practice and improve patient safety.

Please email **radiotherapy@ukhsa.gov.uk** for advice on reporting and learning from RTE and with suggestions for the e-bulletin. Published three times a year, the next issue will be shared in January 2023. To subscribe to future editions please follow this link.

Thank you to all RTE reporters who facilitate this work.

UKHSA update

Please note the Medical Exposures Group has transitioned from PHE to UKHSA email accounts. Emails can now be received at **radiotherapy@ukhsa.gov.uk**.

Advancing Safer Radiotherapy – update

The PSRT is developing guidance for UK radiotherapy stakeholders to support the advancement of safer radiotherapy through the adoption of contemporary thinking in the patient safety field. Further detail on this can be seen in Safer Radiotherapy e-bulletin issue 7.

Many thanks to all who volunteered to participate in this work. The sub-groups are now being formed and volunteers will be contacted shortly with details of how this work will progress.

WHO World Patient Safety Day 2022

WHO reports medication-related harm constitutes the greatest proportion of the total preventable harm due to unsafe care. Acknowledging this burden and recognising the complexity of medication-related harm prevention and reduction, "Medication Safety" was the theme for World Patient Safety Day 2022 on the 17th September. This links to the WHO Global Patient Safety Challenge: Medication Without Harm, emphasizing the need to adopt a systems approach and promote safe medication practices to prevent medication errors and reduce medication-related harm.

New UKHSA learning resources

A series of 15-minute presentations which introduce the national approach to learning from RTE are available to RT healthcare professionals. These learning resources, supported by the PSRT, are intended to be used as part of local induction and CPD programmes. Topic suggestions can be emailed to **radiotherapy@ukhsa.gov.uk**.

Current topics include:

- Introduction to learning from radiotherapy errors and near miss events (RTE)
- Introduction to RTE terminology and taxonomies
- Application of RTE taxonomies
- Learning from RTE analysis
- Study of risk of accidental or unintended exposures – just added
- Reporting methods of detection – coming soon

PSIRF update

The Patient Safety Incident Response Framework (PSIRF) has been published. This replaces the Serious Incident Framework (SIF) (2015) and makes no distinction between 'patient safety incidents' and 'serious incidents'. This guidance defines how NHS organisations should respond to patient safety incidents and ensure compassionate engagement with all those affected.

Secondary care providers will be asked to begin preparing to transition to PSIRF from September 2022, with all organisations transitioning to PSIRF by Autumn 2023. A range of resources to support organisations with this process will be made available on the NHS England website and FutureNHS.

Future NHS collaborative platform

Future NHS platform is a collaboration platform that empowers everyone working in health and social care to safely connect, share and learn across boundaries. The Learning from Patient Safety Events (LFPSE) service workspace contains updates on this work. The LFPSE is replacing the current National Reporting and Learning System (NRLS) and Strategic Executive Information System (StEIS), to offer better support for staff from all health and care sectors.

The LFPSE workspace includes a countdown to making the switch to LFPSE and useful documents such as a step-by-step guide to getting connected with a Q&A section. Further information is available on **https://future.nhs.uk/NHSps**.

Safer Radiotherapy resources
Safer RT: triannual error analysis and learning reports contain analysis and learning from RTE reported voluntarily by UK RT providers and the relevant reporting authorities.
Safer RT: e-bulletins provide key messages from the national patient safety initiative
A series of 15 minute RT learning resources developed to support RT healthcare professionals in learning from RTE are included on the Medical Exposures Group webpages
Towards Safer Radiotherapy contains the classification taxonomy for use when assigning a RTE severity level
Development of Learning from Radiotherapy Errors provides the pathway coding safety barrier, method of detection and causative factor taxonomies

Safer Radiotherapy and Clinical Trial Participation

All radiotherapy centres undertake routine quality assurance (QA) of their equipment and practices. This ensures safe delivery of treatment at that centre. The QA activity required for participation in radiotherapy clinical trials may be over and above this routine activity, particularly in trials where advanced radiotherapy techniques are employed which may not be in routine use in that centre.

Central independent RT QA for clinical trials is essential to monitor protocol compliance in a multi-centre setting hence minimise variations and ensure trial outcomes reflect differences in randomisation schedules rather than departures from protocol. Poor quality radiotherapy can compromise the outcome of a trial but there are also negative consequences on patient outcomes; deviations from protocol are associated with increased risk of treatment failure and overall mortality.

There are therefore compelling reasons to have high conformance through central RT QA in multi-centre clinical trials and consequently radiotherapy trials QA has become an integral and essential part of the radiotherapy trial process.

The National Institute for Health Research (NIHR) funded Radiotherapy Trials QA (RTTQA) Group is a national resource providing central RT QA programmes for all NIHR Clinical Research Network (CRN) Portfolio trials that include a radiotherapy component and ensures that RT trial QA processes are as streamlined as possible to facilitate timely engagement whilst maintaining standards. The group exists as a single multi-professional network of staff working across a number of NHS sites.

In the clinical trial setting, there is a distinct difference in and purpose for the activities of central radiotherapy trial QA as performed by the RTTQA Group, and local radiotherapy trial QA completed at the radiotherapy centre. It is however important to emphasise that neither function is in isolation and there is always close interaction between the two, particularly when new techniques are being evaluated.

Central trial QA: The national RTTQA Group formulates guidance on the radiotherapy delivery for individual trials, designs QA programmes to be implemented for each radiotherapy trial and undertakes the processes required to fulfil the programme thus defining and monitoring the standard and consistency of radiotherapy required for that trial and providing independent external review and verification.

Local trial QA: There are distinct tasks that must be performed by individual centres if they choose to participate in a clinical trial. These tasks are defined by the central RTTQA Group but are performed as part of the trial set up and approval process by staff at the local centre.

For any specific queries relating to trial RT QA complexity and activity please contact the RTTQA group on **rttrialsqa.enh-tr@nhs.net**.

Elizabeth Miles, National Radiotherapy Trials QA (RTTQA) Group

Dates for the diary	
IPEM, Clinical risk management foundation course	4 October, online
SRP, Radiation protection in 2022	12-13 October, Somerset
RCR Annual Conference 2022	13-14 October, Birmingham

Study of risk of accidental and unintended exposures survey

IR(ME)R requires a quality assurance programme be undertaken in respect of radiotherapeutic practices which includes a study of risk of accidental or unintended exposures (Regulation 8(2)).

A short survey was deployed by UKHSA to the 66 UK RT providers in April and closed at the end of June. The aim of the survey was to understand local practice in regard to study of risk. The questions were:

Q1. Does your clinical department have a study of risk as required by Regulation 8(2) of IR(ME)R?
Q2. Who has oversight of the study of risk?
Q3. Does the study of risk include a risk scoring matrix?
Q4. Are there controls to manage identified risk?
Q5. How often are risk scores reviewed?
Q6. Please provide further comments you would like to share in regard to study of risk

A response rate of 50% was achieved. 97% (n = 32) reported they had a study of risk in place. One respondent stated they did not have a study of risk but also stated their risk scores were reviewed on a yearly basis, which suggests they may have a study of risk in place.

30 of the 33 respondents suggested a multi-disciplinary approach to completion and oversight of the study of risk which is encouraging. It was also positive to note, 30 of the 33 respondents stated they included a risk score matrix. However, when asked when the risk scores were reviewed only 1 respondent did not give a timeframe. This indicates that 32 of the respondents did include a risk score.

All 33 respondents stated they had controls to manage identified risks.7 respondents stated that the risk scores were reviewed annually, or if there was a change in practice or in response to an accidental or unintended exposure.

When asked for general comments on this topic, two respondents stated the study of risk was discussed at a regular meeting, one stated that this led to a review of policy, and another stated these meetings allowed risks to be raised at board level. One respondent stated they had a separate policy for unusual or rare techniques to ensure any risks were minimised for the patient.

This limited survey suggests respondents had a study of risk in place to reflect the requirements of IR(ME)R.

Further information on the adoption of a study of risk is included in the European Commission general guidelines on risk management and the Radiotherapy Board IR(ME)R implementation guidance. It also includes worked examples of study of risk. Further examples are included as part of case studies in the Safer Radiotherapy triannual error analysis and learning reports. Finally, a 15 minute presentation on study of risk is available on the Medical Exposures Group webpage.

Review of use of end of process checks (13hh)

End of process checks (EOP) are a subset of safety barriers (SB) undertaken locally by operators at the end of each discrete part of the radiotherapy pathway. Analysis of EOP can identify failed and effective SBs, so resources can be focused where they would be most beneficial in mitigating radiotherapy error and near miss (RTE).

A focused review of SB RTE data has highlighted treatment unit EOP (13hh), as the most frequently reported failed safety barrier (FSB). It also revealed 13hh as one of the most frequently reported method of detection (MD) of RTE.

To better understand the efficacy of treatment unit EOP, a request to share local key criteria included in checks was sent to the RTQSIG webmail. The group were asked to share key criteria in the following subcategories:

1. In-room checks (such as confirming the correct patient position, move from reference marks, correct treatment site and ancillary equipment)
2. Pre switch-on checks (such as confirming imaging or MU, energy, inclusion of MLC) this may also be referred to as a pause and check criteria
3. Checks on completion of treatment exposures (such as confirming all fields are treated and complete, confirming the recording of additional information)

We are grateful to the 8 providers who shared a total of 17 EOP lists. The lists shared ranged in format and included standard operating procedures (including checking documents), work instructions, and checklists.

Examples of good practice seen in the examples shared included:

- Use of active checks
- Reference to the data source or primary source data for checks
- Statements which described each operators' responsibilities
- Specified questions and answers for active checks
- Statements to specific that staff who start a procedure must complete it
- Instructions on what to do if an error was detected during the EOP
- Presenting the checks in a table with supporting work instructions
- Use of local and national RTE analysis to affect local EOP
- Inclusion of local imaging requirements in the EOP

From reviewing the EOP shared it is clear there were differences in the minimum criteria for checking in the 3 subcategories within 13hh. Checks also differed by modality and treatment technique.

A number of the minimum criteria for checking were repeated across the three EOP, these included patient ID and dataset ID. Imaging requirements were stated differently across the different EOP, however the requirement to ensure the correct imaging occurs, the correct setting of the imaging parameters and the documentation of the imaging was seen across the multiple protocols.

Minimum criteria included in the different EOP (along with any associated primary pathway subcodes can be seen in the table below. Items highlighted in yellow are shown across more than one of the EOP subcategories.

Table 1. active checks for EOP

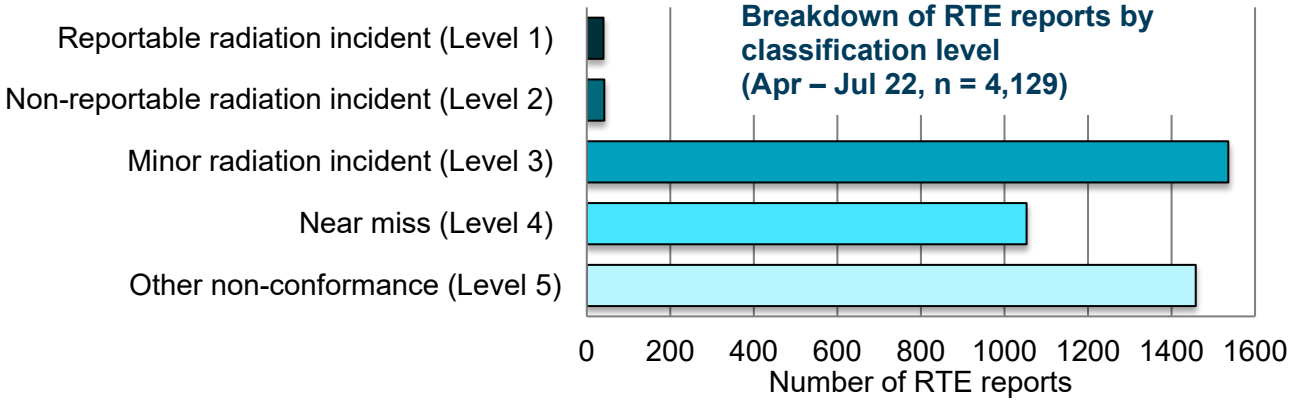
Active check – In room check	Active check – Pre switch on check	Active check – Completion of treatment
Patient ID (13b)	Patient ID (13b)	Document all imaging including any following actions required (13bb)
Patient data ID (13c)	Dataset ID loaded onto all terminals correctly, including correct plan ID (13c)	Confirm the dose and fractionation are recorded in the patient management system (13ff)
Assess the patient's general wellbeing and fitness for treatment before each radiotherapy treatment (13f)	Confirm prescription is authorised (11k)	Confirm the dose recorded are the same as those calculated (13ff)
Laterality confirmation (for one provider this was only completed on the first day)	Confirm patient consent and laterality (8b)	Activity or encounter is captured (13ee)
Patient immobilisation set correctly (13r)	Check any actions from reviews have been completed (14d)	Confirm all treatment fields complete before entering room (13hh)
The correct reference marks are used to locate the treatment (13k)	Check CCTV and audio to ensure no patient movement and monitor throughout treatment	Ensure both operators sign or enter password to indicate completed treatment (13ii)
Origin to isocentre moves is completed in the correct direction and of the correct magnitude (13l)	First fraction/new phase - Field name, energy, and MU's gantry angle/floor/field size (13x, 13y)	Confirm any review appointments (14a)
Skin rendered image used to confirm field placement/patient positioning etc (13j)	Field name, energy, and Mus (13x, 13y)	Confirm any follow-up actions or escalations required following treatment
FSD check (13g)	First fraction – all pretreatment checks completed (11t, 12g)	
Gantry/floor and collimator angles correct for start of first beam or image field (13q)	Confirm bolus/wax or any other beam modifiers are positioned (13u)	
For electron treatments check the field size, orientation and if it is a custom end frame (13t)	Imaging requirements including correct fractionation modality (13i), field size and placement of image panel, filters etc (13z)	
Any bolus/wax or other beam modifiers are in place. The thickness and area covered are appropriate (13u)	Check previous images have been reviewed and actioned (13bb)	
Imaging requirement including correct fractionation and modality (13i)	Take corrective action following imaging and record all results (13aa)	
Image pre-sets / correct filter where required (13z)	Discuss any discrepancies and reason for override of field parameters (13cc)	
Image panel is in the correct position (13z)	Check that any relevant alerts have been actioned (13gg)	
Out of tolerance parameters checked and verified (13cc)	Confirm if DIBH and monitor during treatment (13g)	
Operators must inform the patient that they are leaving the room and agree a method of the patient alerting the operators to any problem (13d)	If required MLC are moving during beam on (13s)	

RTE data analysis – April to July 2022

The full detailed data analysis is available here and includes data on primary process subcoding, safety barriers, methods of detection, causative factors, and the severity classification of the RTE. These taxonomies are described in the Development of Learning from RTE. A summary of findings is presented below.

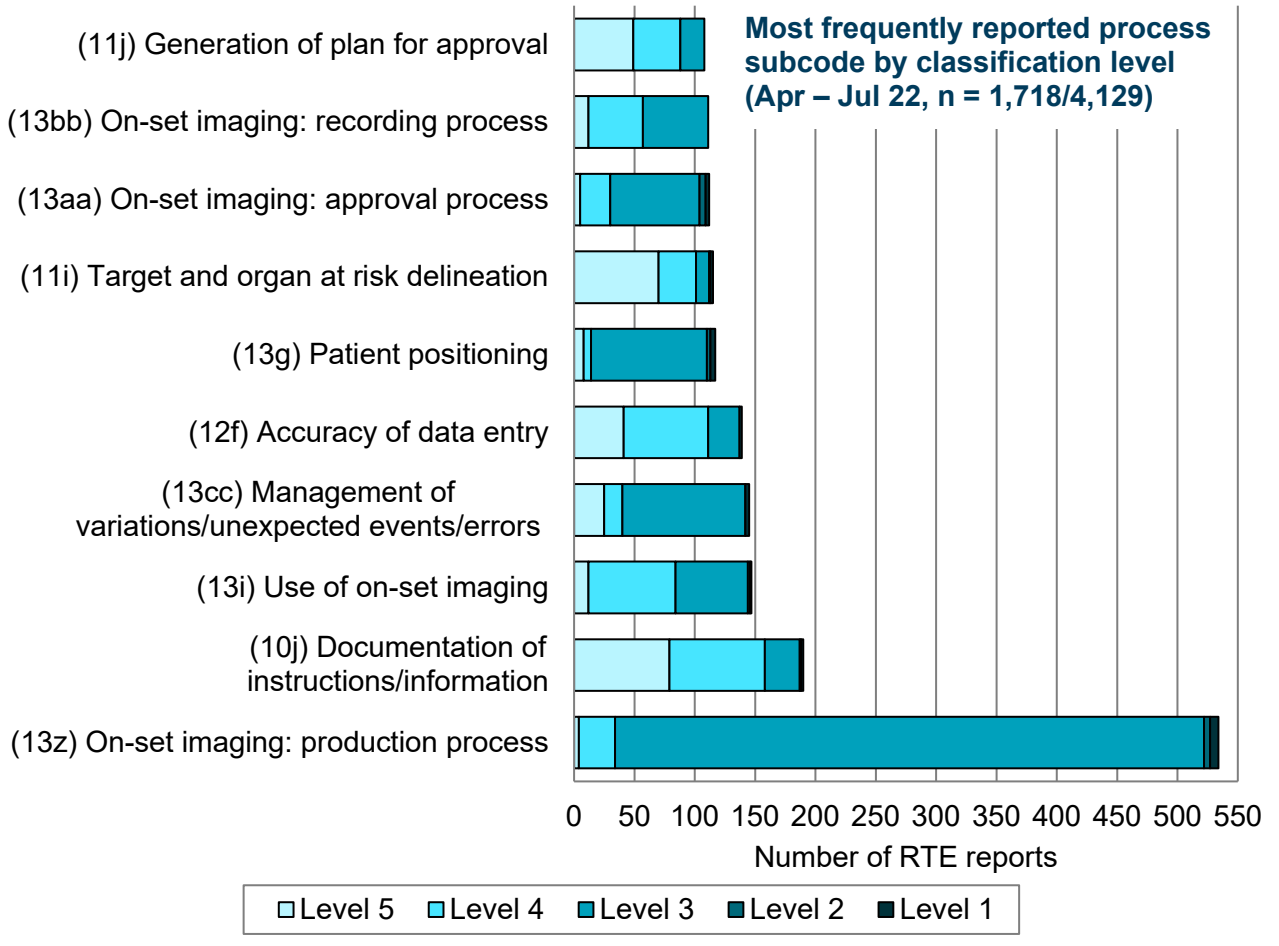
Classification (Level) of RTE

Of those 4,129 RTE reported, 4,047 reports (98.0%) were classified as minor radiation incidents, near misses or other non-conformances (Level 3-5). These had no significant effect on the planning or delivery of individual patient treatments or their outcome.



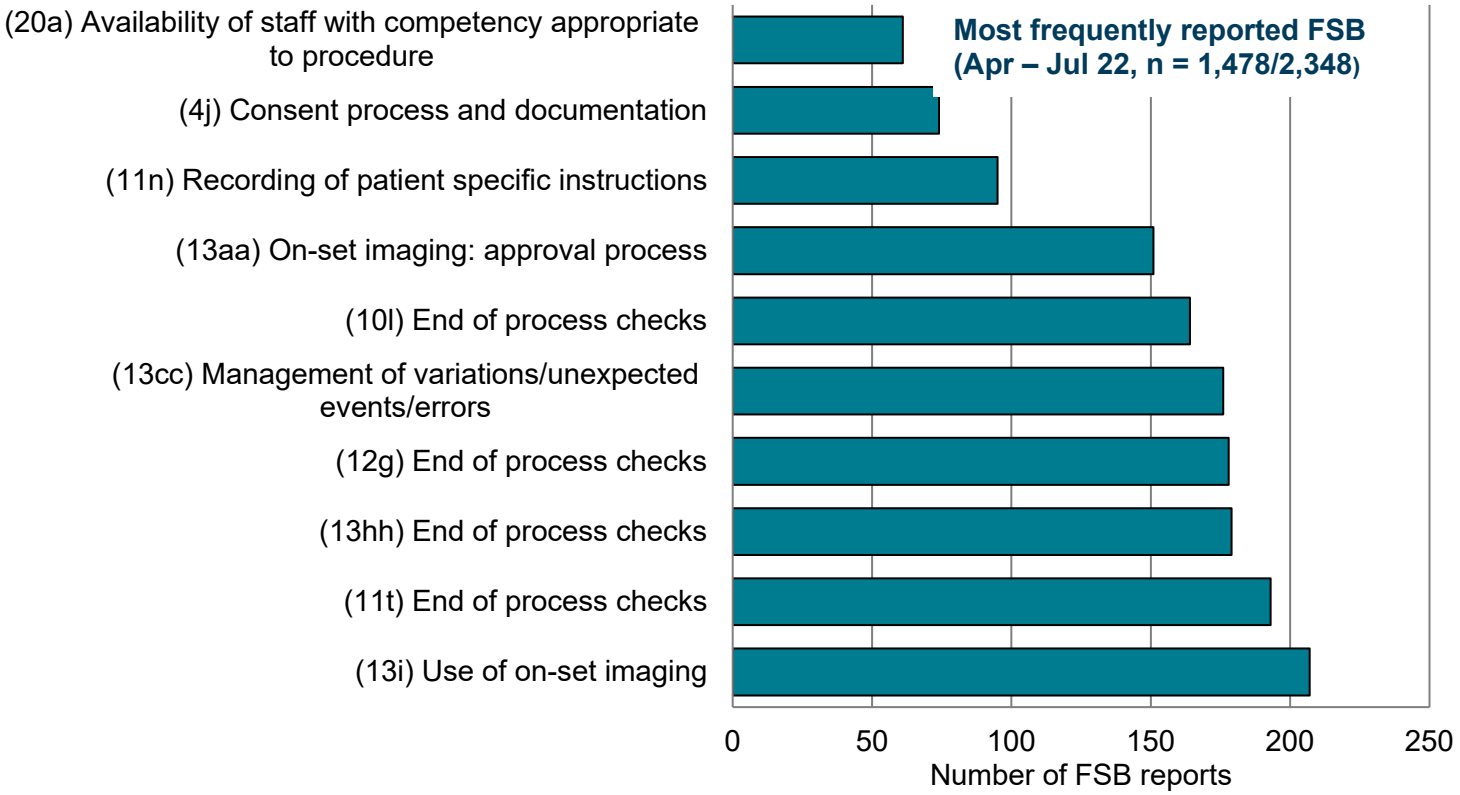
Primary process subcode

The most frequently reported points in the patient pathway where the RTE occurred are shown below. This is broken down by classification level. Consistent with the previous analysis 'on-set imaging: production process' was the most frequently reported process code (12.9%, n = 534/4,129).



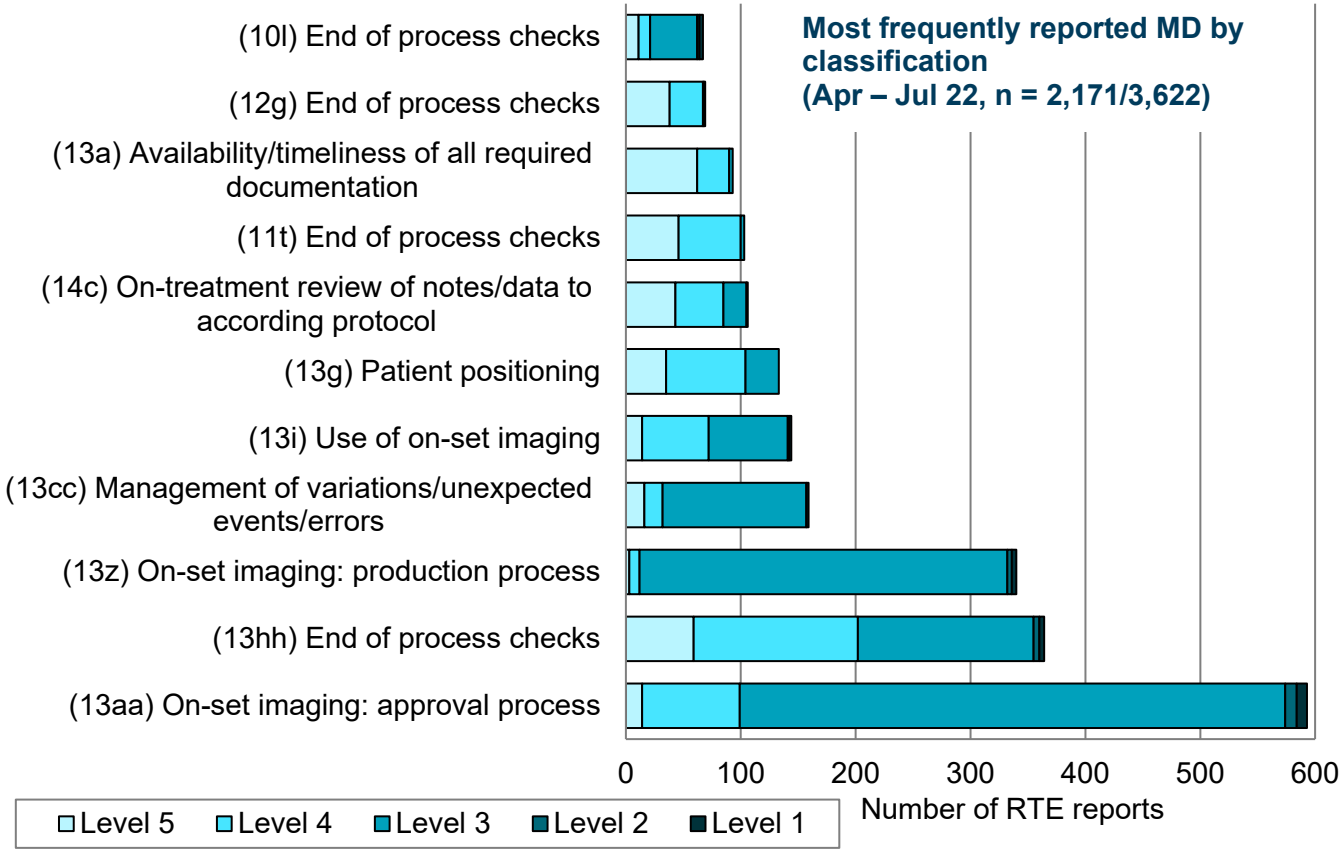
Failed Safety barriers (FSB)

Multiple FSB can be attributed to each individual RTE. A total of 2,348 FSB were identified across all the RTE reported. The most frequently reported FSB can be seen below. Treatment unit process 'use of on-set imaging' was the most frequently reported FSB (8.8%, n = 207).



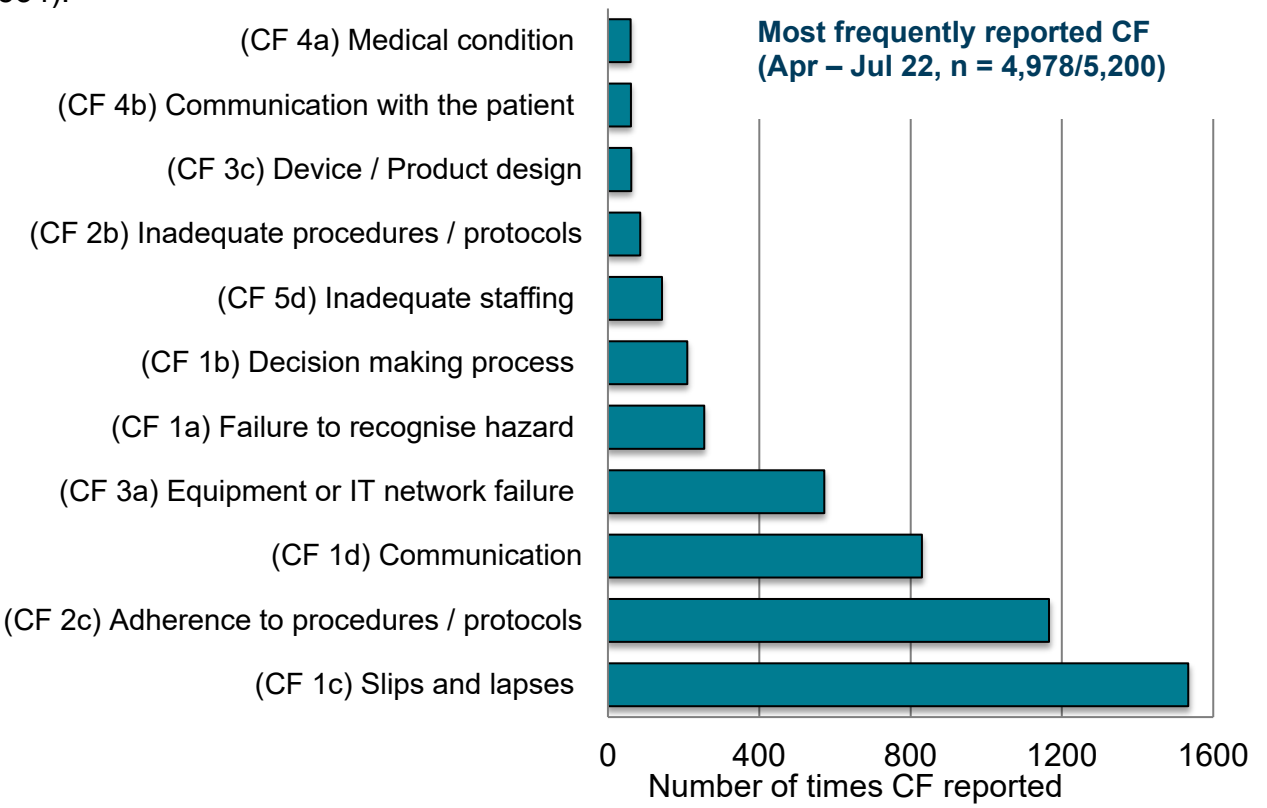
Method of detection (MD)

For this reporting period 3,622 reports included MD coding or data. The most frequently reported MD was 'on-set imaging: approval process' (16.4%, n = 593).



Causative Factors

Each RTE can be assigned multiple CF codes. A total of 5,200 CF were reported in this period. The most frequently reported CF was individual 'slips and lapses' at 29.5% (n = 1,534).

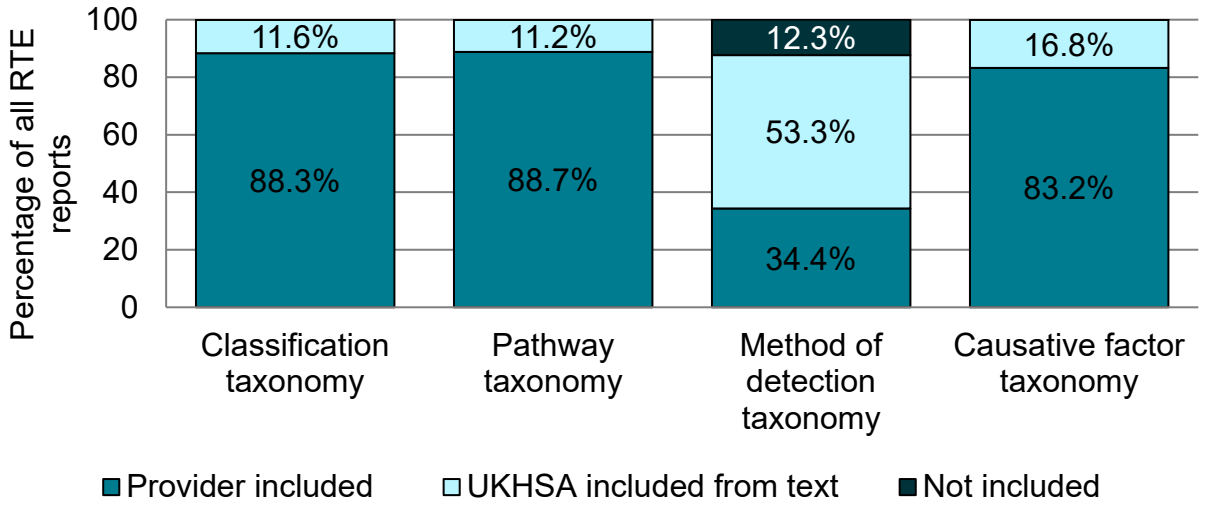


Monitoring of RTE coding by RT providers

All providers are asked to apply a trigger code, classification, pathway coding (including failed safety barriers), method of detection and causative factor coding to their RTE reports to facilitate both local and national analysis. These should be included in the first open text field in the following format:

TSRT9/ Level 1/ 11j/ 11k/ 11t/ MD11j/ CF1a/ CF2c/ CF6a/ CF2d

The application of these taxonomies by provider for RTE reported between April and July 2022 (n = 4,129) can be seen below.



Thanks to all those that apply the coding locally and include it in submissions to UKHSA. Please email **radiotherapy@ukhsa.gov.uk** with any queries about this and particularly with any issues with the application of the MD coding.

RTE reporting classification levels

Between January 2020 and December 2022 18,681 RTE reports were received from the majority of NHS RT providers, 57 (96.6%).

There is some variance in the number of RTE reports submitted by provider, this ranged from 3 to 2,111. This variance is reflected in the submission of classification levels of RTE. Of the 57 providers, 29 (50.1%) reported all levels of RTE. These represent providers with mature reporting cultures.

The national survey on reporting culture published in the January 2022 issue of Safer Radiotherapy indicates that RTE reports of classification level 4 to 5 are less likely to be shared due to resource constraints and use of multiple reporting systems.

For the two-year period 2020 to 2022 the reported RTE were broken down by classification level. The table below indicates the most frequently reported primary pathway subcode (point on the pathway where the RTE first occurs) by level.

It can be seen that the most frequently reported RTE (level 1 to 3) occur during treatment unit processes (13) and have similar primary pathway subcodes. The prevalence of level 1-3 RTE at the treatment unit may be due to the treatment process presenting the last opportunity to identify errors. This may also in part be due to a reliance on the correct interpretation of the treatment plan and set-up details at each fraction of treatment

The level 4 and 5 RTE show events which are more likely to occur on the unseen part of the patient's pathway (when the patient is not present). These RTE are detected before a radiation incident occurs. Learning from these incidents can contribute to a review of minimum criteria for checking at the end of each part of the pathway. This type of review can lead to mitigation of similar RTE and reduce the chance of the errors propagating through the pathway and becoming a radiation incident.

Table 2. Top three most frequently reported primary pathway subcode by classification level.

Reportable radiation incident (Level 1) by process subcode	Non – reportable radiation incident (Level 2) by process subcode	Minor radiation incident (Level 3) by process subcode	Near miss (Level 4) by process subcode	Other non-conformance (Level 5) by process subcode
(13z) On-set imaging: production process	(13aa) On-set imaging: approval process	(13z) On-set imaging: production process	(13i) Use of on-set imaging	(10j) Documentation of instructions/information
(13aa) On-set imaging: approval process	(13g) Patient positioning	(13aa) On-set imaging: approval process	(10j) Documentation of instructions/information	(6a) Bookings made according to protocol
(13l) Movements from reference marks	(13z) On-set imaging: production process	(13cc) Management of variations/unexpected events/errors	(12f) Accuracy of data entry	(11j) Generation of plan for approval

The PSRT recommend reporting all classification levels of RTE to optimise learning opportunities.

Workforce

Safe delivery of RT is reliant on an adequately resourced and skilled workforce.

Workforce censuses

The IPEM Workforce Census Summary Report 2021 is now available. Data was gathered from clinical scientists and clinical technologists. The reports states that this workforce is currently managing to provide an adequate service. However, it has little to no provision for training and service development. The average vacancy rate is 8%.

The RCR Clinical Oncology Census Report 2021 has been published. The report states the clinical oncology workforce has grown at 3% per year since 2016 and is short of 189 consultants. The report indicates vacancy rates vary across regions. The highest vacancy rate was recorded across England at 10%. Some 67% of cancer centre heads of service were concerned about workforce shortages affecting the quality of patient care.

The Radiotherapy Radiographic Workforce 2021 UK Census has also been published by the CoR. The NHS radiotherapy radiographic workforce grew by 28% between 2012 and 2021. The report shows the current vacancy rate is 8.4%, with 304.9WTE positions vacant. This is the highest recorded vacancy rate since data collection began in 2012.

BIR survey on the radiotherapy dosimetrist workforce

An online national survey of the Radiotherapy Dosimetrist workforce in the UK was deployed in 2021. It was devised by a small working party from the BIR's Radiotherapy and Oncology SIG. Thank you to all who kindly contributed. Over 200 people responded, and the results of the survey are in the final review stages for publication in BJR. Many different aspects were revealed from the survey, from a section of the UK RT workforce which has seldom been researched individually previously and yet has a vital role in delivering high quality, high precision, and often highly complex RT.

Results illustrated the various training routes undertaken (through both therapeutic radiography and clinical technology); the different job tasks undertaken, with computerised treatment planning featuring prominently, but not exclusively; a 'mixed-economy' of registration – some being part of mandatory, statutory registration (e.g., HCPC) and others with access only to voluntary registration; and a notable variety of experiences with CPD and CPD schemes.

The latter point supplies much needed research evidence to support the recent work of professional groups such as IPEM in identifying that statutory registration would enable better protection of the public by, as detailed by HCPC, developing skills and knowledge further and therefore being able to practice more safely and effectively. Statutory registration for professionals, like dosimetrists, would also give the NHS more flexibility and capacity in crises, like the recent pandemic.

The paper has more within it, including comparisons with published literature. The many useful, qualitative comments from the survey will be published separately.
In light of the richness of the research data obtained, a similar survey is being planned focussed on an equally vital part of the RT workforce – Linac engineers. Look out for the call-out to take part in that!

Many thanks
Mike, The Revd Canon Dr Mike Kirby; Chair – BIR Radiotherapy and Oncology SIG

Guest editorial and learning from excellence

Best practice for recording and auditing imaging dose in radiotherapy

Tim Wood, Principal physicist, Castle Hill Hospital, Chair of IPEM RT imaging working party

Since June 2016, the IPEM Diagnostic Radiology (DR) and Radiotherapy (RT) Special Interest Groups (SIG) have been supporting a working party auditing imaging doses for the higher dose imaging procedures undertaken in UK RT centres. The aims of the 'doses to patients from x-ray imaging in radiotherapy' working party were to collect and analyse a range of metrics that would allow comparisons of doses between centres, the identification of best practice, and the proposal of useful reference doses to which centres can benchmark their practice. As part of this work, it has become apparent that it would be useful to the wider RT community to share some common findings and 'best practice' that has been identified with respect to recording and auditing imaging doses.

The most fundamental part of recording and auditing imaging dose is to ensure the right data is collected, and this is done in a way to make it easy to access for processing and analysis. Fundamentally, it is a legal requirement under IR(ME)R to include in the patient record factors relevant to patient dose. To this end, when it comes to CT and cone beam CT (CBCT) exposures, the absolute minimum that should be recorded for each patient would be the Dose Length Product (DLP) and CT Dose Index (CTDI). It must be noted that older generations of Linac based imaging systems do not necessarily provide these values on the user interface. It should also be noted that given the simple nature of CBCT imaging systems where there is no automatic exposure control, a simple record of the protocol used that can then be linked to the written exposure protocols, would suffice in a lot of cases. Supplementary information recommended for collection to enable a more thorough evaluation of patient doses includes other technical parameters such as tube kV, tube current, exposure time, scan length, etc. When it comes to simpler imaging techniques, such as kV planar imaging, it may only be possible to record the exposure factors and/or protocol that was used for the imaging event. Where more complex techniques are utilised, such as 4D CT, standard exposure factor based records remain appropriate, as in most cases these types of imaging are much the same as their conventional 3D equivalent but with a longer scan time (through lower pitch factors, longer rotation times, etc). However, this should be validated locally should any new advanced techniques become available that deviate from this recommendation.

When it comes to recording dose information, there are a wide range of techniques available in RT, with one of the best and most 'data rich' options being the implementation of an automatic dose management system (DMS). These systems are capable of collecting all exposure parameters related to the imaging exposures, which enables both a simple analysis of basic parameters such as DLP and CTDI for planning CT exposures and a more in-depth interrogation of the data for the purposes of optimisation. It is also possible to export structured dose reports direct to the DMS with the latest generation of Linac based imaging systems. However, it must be acknowledged that the level of detail included in these reports is much poorer compared with the diagnostic imaging derived planning CT scanner systems. Where DMS is not an option, many other options are available to centres. The most obvious one is through the OMS and creating data capture forms within these systems. In some systems these can take the form of questionnaires that are

completed after the exposure to capture all the required information for that exposure. This includes both simple 2D verification images, or more complex data for a planning CT exposure. The big advantage of this approach is that the data becomes readily available for audit through the data export functions within some systems.

It is also true that all imaging exposures in the modern RT centre will be based on digital technology, so the DICOM images themselves will store the information related to dose. However, there are many potential pitfalls with this approach as it has been noted that older Linac based imaging systems do not always accurately record the actual exposure factors used on individual patients. This is especially true if they have been changed from the base protocol that was selected at the start of treatment (e.g., if the exposure is optimised for that patient, it may be found that the dose recorded in the patient image is that for the base protocol, not the actual factors used). It is also very difficult and time consuming to access this information as it involves opening each patient, interrogating the DICOM information, and then storing this in an appropriate format.

One final option for recording patient dose, but is no longer the recommended technique is through paper based records. These have the challenge of being difficult to use, store and interrogate after the event. If no other options exist, a paper-based data collection for the purposes of audit to check on typical dose levels in the RT centre on a small sample of patients might be considered.

Once a centre has established the method for routine recording patient doses, it is important to make sure this data is used appropriately. It is recommended that on a regular basis (something in the range 1 to 3 yearly would be deemed appropriate in most circumstances but should be determined in consultation with local Medical Physics Experts (MPE)), and where new systems and new techniques are introduced, audits are completed.

Recommendations for performing a patient dose audit are:

- Determine the clinical indication(s) to be audited for a particular modality in your centre e.g., planning CT scans for brain, breast, prostate, lung 3D, etc. Do not mix different types of scans in a single dataset as this may skew the results – for example, using ‘pelvis’ as a generic group for auditing may result in a mix of prostate and gynaecological scans which may have different scan ranges, exposure settings, etc.
- Collect data on each system for as many patients as possible from an appropriate timeframe. MPE judgement should be used on sample sizes. The bigger the sample size the better, but an absolute minimum of 20 patients would be recommended.
- Determine the median dose parameter for each system/clinical indication you are auditing
- Compare the systems to check they are consistent in terms of dose. This may lead to image quality comparisons. If you have two identical systems, are they giving the same median dose to a large sample of patients – if not, why not? If you have two different types of system, can you optimise one to match the other if differences are noted?
- Compare the scanner median doses to national dose reference levels. UK CT values are published here: National Diagnostic Reference Levels (NDRLs) from 14 June 2022. If you are above the national values, do you need to optimise your protocols? What action can you take to bring dose down? What about image

quality? Do you need to consider replacing your scanner? What if your doses are too low; are your images good enough for the clinical task?

- Determine a local dose reference level (LDRL). Use MPE judgement, but as a guide the mean of the scanner medians is often appropriate. Compare scanners to this value. It is recommended that the LDRL is kept under review. If you are doing annual dose audits it may not be appropriate to change it every year – 3 years may be a more suitable timeframe. When reviewing LDRLs, if the value calculated goes up, consider if this is appropriate (e.g., change in technique) or if the LDRL should remain at the previous value, and corrective action taken to bring doses down.

Potential issues to be considered when recording and auditing doses:

- Dose index display on Linacs. The implementation of this is variable on different systems, including many older systems that do not have any display whatsoever. Where you have different models/software versions in your centre, assure yourself that the dose index display is accurate and measured in the same way (e.g., wide beam CTDI vs narrow beam CTDI). It is also the case that the dose index on CBCT protocols may not be automatically linked to a central calibration of the scanner – on some systems, the dose displayed is literally just a number that is typed in against the protocol.
- Patient sample sizes. This can be challenging as numbers can be relatively low compared with the sample sizes used in diagnostics. Use professional judgement to determine if there are enough patients to draw valid conclusions – if not collect more data.
- Do you have optimised protocols in your centre? If every pelvis patient gets the same exposure factors for CBCT, there is little benefit in auditing doses. If you have optimised protocols for patient size, length of treatment volume, etc, dose audit is vital to ensure these are operating correctly (small patients use small modes, large patients in large mode, and a spread in between)

When performing dose recording and audit activities, it is vital to ensure a multi-disciplinary team is involved. This could involve many different professions, and as a minimum it is recommended that at least one MPE is involved (this could also include a diagnostic imaging MPE if they have the required expertise), Radiographers and Clinicians (who are generally the IR(ME)R Practitioners justifying these exposures). Other Physicists and disciplines may be required such as clinical computing colleagues, dosimetrists, etc. The key is to form an appropriate group to ensure the data is clearly identified, recorded and available for audit, and the results fed back to all relevant staff who are involved in the evaluation and use of the images generated. Aside from the issues of dose recording and auditing, the IPEM working party has also identified useful information and ‘best practice’ on the process of optimisation for imaging in RT centres, and this will be shared in greater detail in future publications.

Tony Murphy, PSRT stated ‘Patients may not be aware of the detailed considerations that go into radiotherapy imaging, and these should be communicated to the patient’.

Do you have any **learning from good practice** that you would like to share? Please email **radiotherapy@ukhsa.gov.uk** with your ideas for inclusion in future editions of a Safer Radiotherapy e-bulletin.