UK Health Security Agency

Safer Radiotherapy

Triannual RTE analysis and learning report

Issue 48: full radiotherapy event data analysis, August to November 2025

Contents

Radiotherapy event data analysis

The Safer Radiotherapy publication series facilitates comparison of locally identified trends against the national picture. The Patient Safety in Radiotherapy Steering Group (PSRT) recommends implementing learning from this analysis locally. In doing so it is expected that these events might be mitigated in the future.

This analysis has been undertaken by the UK Health Security Agency (UKHSA) on anonymised radiotherapy events (RTE) reported voluntarily by UK radiotherapy (RT) providers.

As with any voluntary reporting system, the data will only reflect those events that are reported and may not necessarily be representative of the actual level of occurrence. As such, this data needs interpreting with care.

To facilitate timely analysis and learning both locally and nationally, all providers are asked to apply a trigger code (TSRT9), classification level, primary pathway subcode, additional pathway subcoding, method of detection (MD), contributory factors (CF) and modality code (D) to their RTE reports to facilitate both local and national analysis and submit data to UKHSA at the earliest opportunity, for example monthly.

Providers reporting through the LFPSE are encouraged to include the TSRT9 trigger codes for all RTE once the required investigation is complete and RTE taxonomy has been applied. If a report does not contain the TSRT9 trigger code, it will not be shared by LFPSE with UKHSA.

More information, including the full taxonomy, case studies and recommendations for application, can be found in the National patient safety radiotherapy event taxonomy publication.

Further information on the PSRT, patient safety initiative and RTE reporting can be found online or accessed via the QR code located on this page. If individual providers would like to comment on the analysis or share experience of learning from RTE analysis, please email the RT team at radiotherapy@ukhsa.gov.uk

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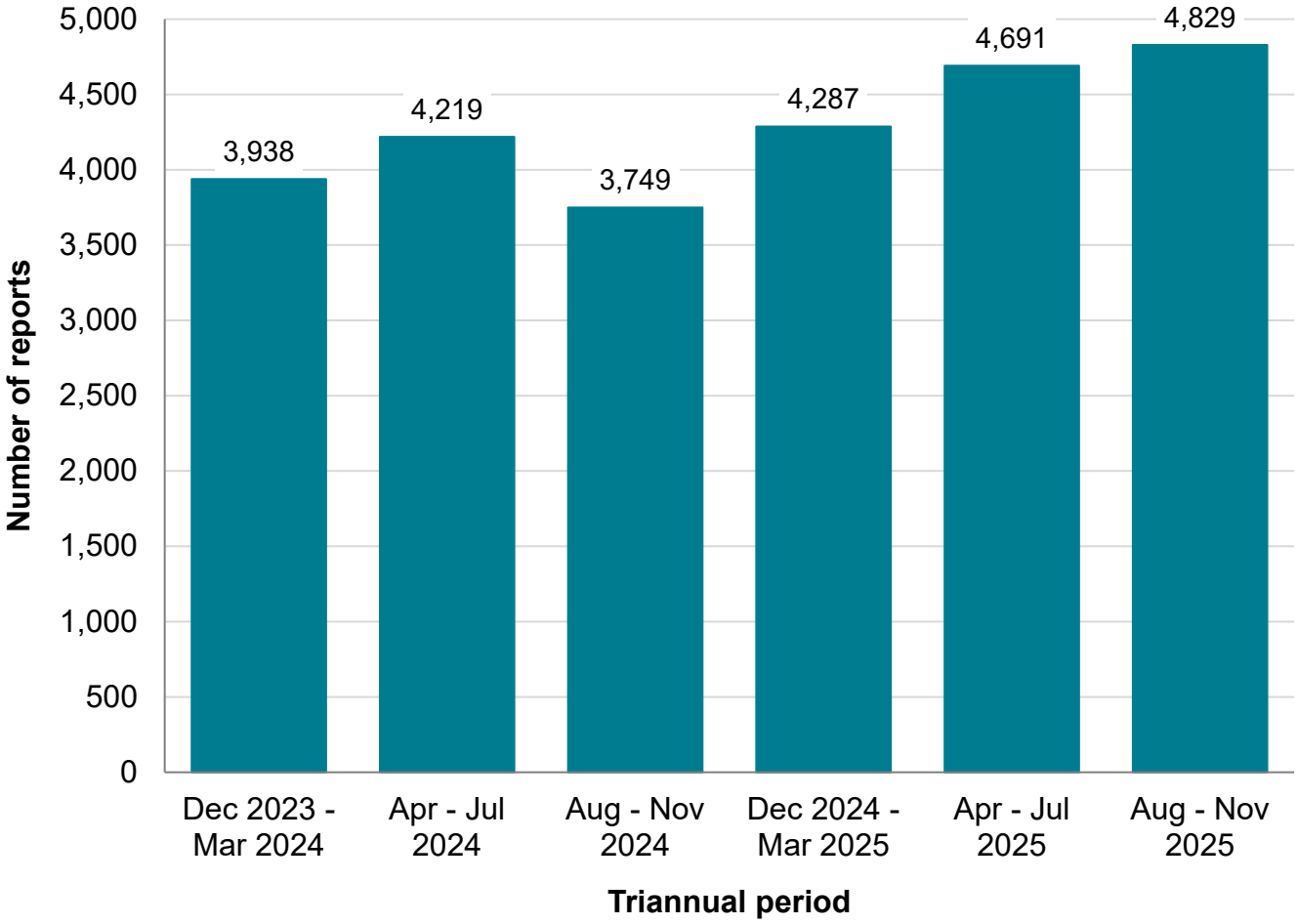
Please share your thoughts with the radiotherapy team at radiotherapy@ukhsa.gov.uk

August to November 2025 national data analysis

Number of RTE reports

A total of 4,829 classified RTE reports were received between August and November 2025 reflecting an increase of 2.9% (n = 4,691) when compared to the previous analysis (issue 47) and an increase of 28.8% (n = 3,749) when compared to the same reporting period between August and November 2024 (issue 45). During the current review period there were 88 reported events which involved multiple patients, ranging from 2 to 10 patients, resulting in 224 RTE. The volumes of classified reports received over the past 6 triannual analysis periods are shown in Figure 1.

Figure 1. Number of voluntary RTE reports received by UKHSA over time



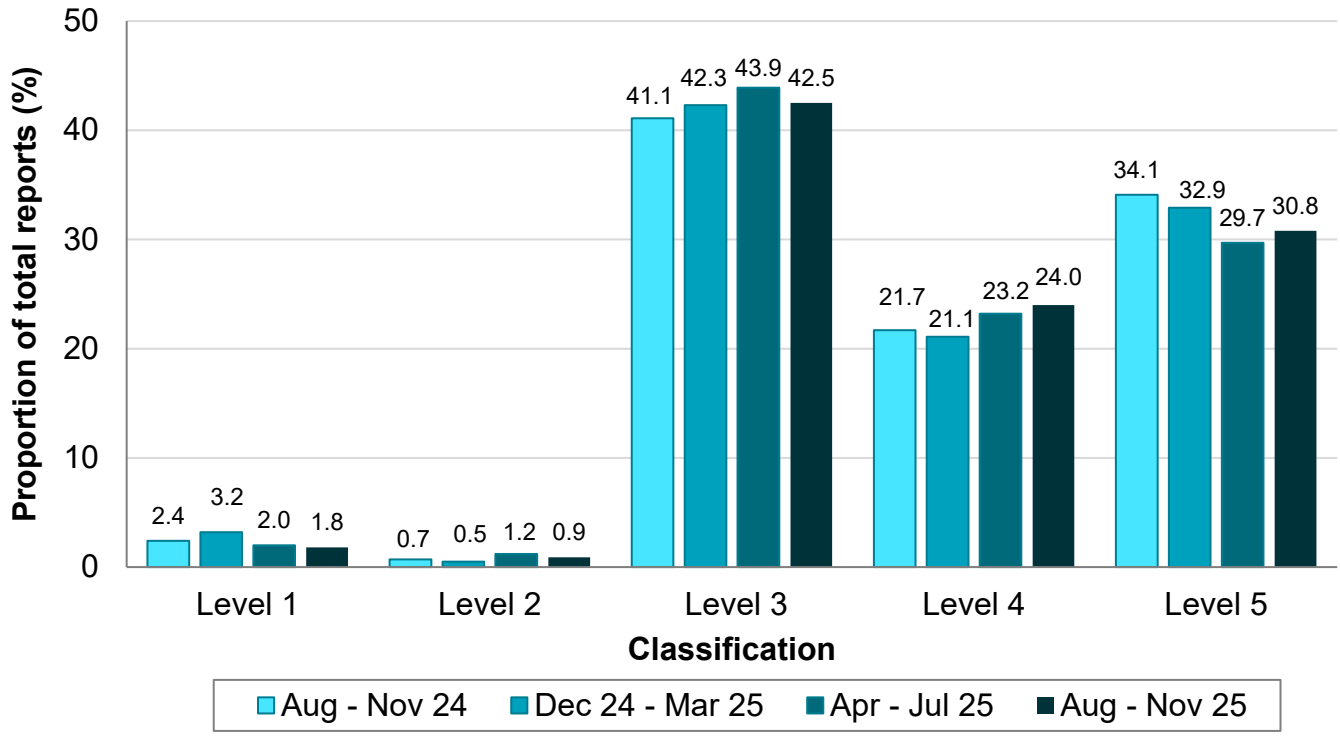
For this reporting period, data was received from 56 providers, including the NHS and independent sector. An average of 86 reports per provider were received, reflecting a minor increase of 3.6% (n = 83 reports) from the previous reporting period (issue 47). It should be noted that this increase does not mean every individual provider experienced an increase in reporting. Finally, those reporting higher numbers of RTE represent providers with mature reporting cultures and should be encouraged to continue reporting. The national analysis of reported RTE data is presented below.

Classification (level) of RTE

Each of the 4,829 RTE reports was classified either as Level 5 ‘other non-conformance’ (30.8%, n = 1,487), Level 4 ‘good catch’ (24.0%, n = 1,158), Level 3 ‘non-reportable (minor) radiation or MRI incident’ (42.5%, n = 2,053), Level 2 ‘non-reportable (moderate) radiation or MRI incident’ (0.9%, n = 42), or Level 1 ‘reportable radiation incident or other notifiable event’ (1.8%, n = 89).

It is reassuring to note that 97.3% (n = 4,698) of RTE reports were Level 3 to 5 events with little or no impact on patient outcome. Of the remaining 2.7% (n = 131) of reports, 1.8% (n = 89) were reportable under IR(ME)R to the appropriate enforcing authority (Level 1). This represents a continued reduction from the previous reporting periods when 2.0% (n = 96) of all RTE reports were classified as Level 1. The proportion of reports for each classification level across the 4 most recent triannual periods (August 2024 to November 2025) is shown in Figure 2.

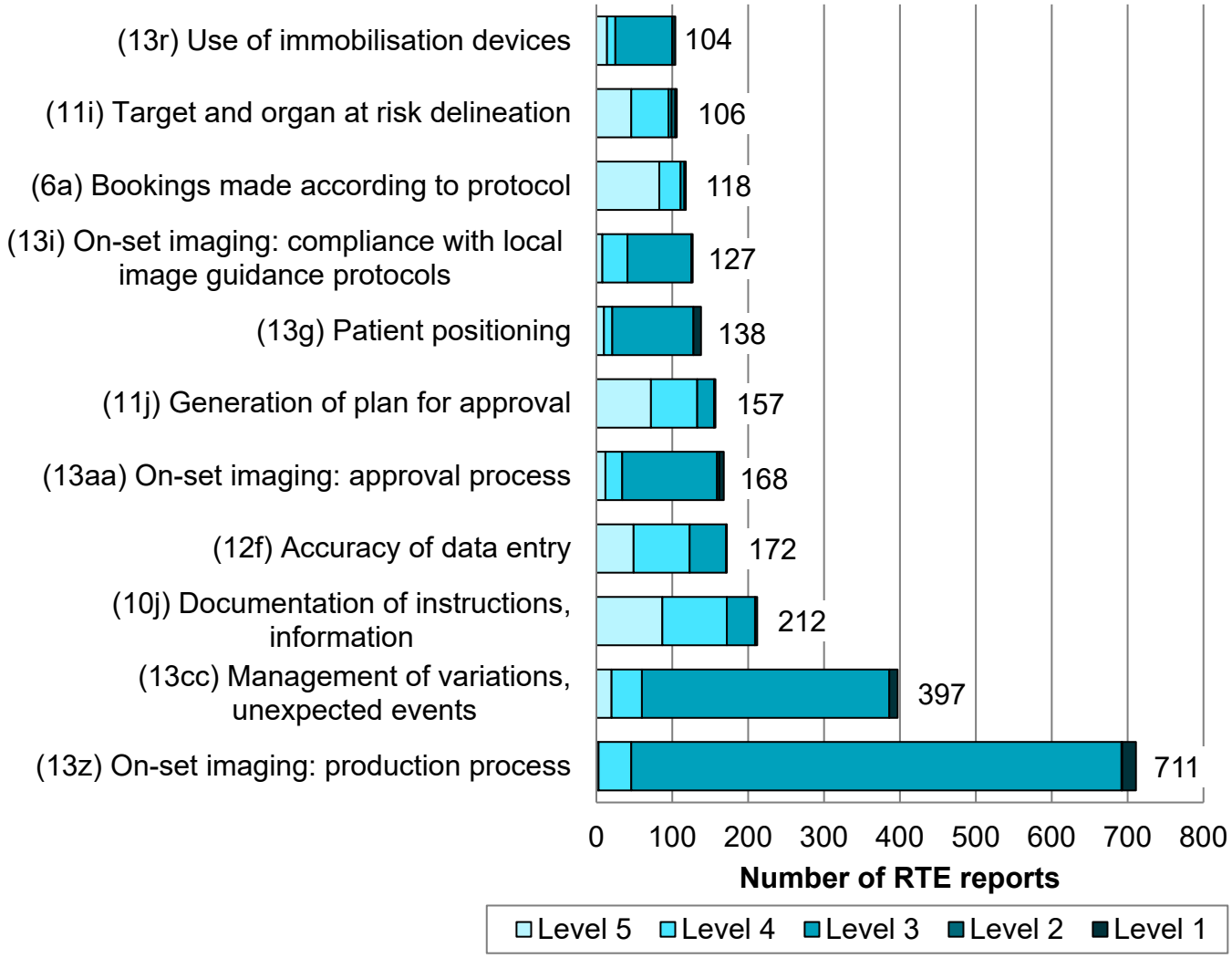
Figure 2. Classification (level) of RTE reports over last 4 triannual periods



Breakdown of primary pathway subcodes

The most frequently reported primary pathway subcodes are presented in Figure 3. This subset of data was also broken down by classification level so the main themes could be derived. The most frequently reported RTE was ‘on-set imaging: production process’ at 14.7% (n = 711) of all reports. This is a reduction from the previous analysis, (issue 47) at 16.6% (n = 779). Of this subset, 97.3% (n = 692) of the reports were minor radiation or MRI incident, good catch or other non-conformities with little or no impact on patient care. A large proportion of these reports were associated with contributory factor ‘equipment or IT network failure’ (56.0%, n = 398).

Figure 3. Breakdown of most frequently reported RTE primary pathway subcodes by level (n = 2,410/4,829)



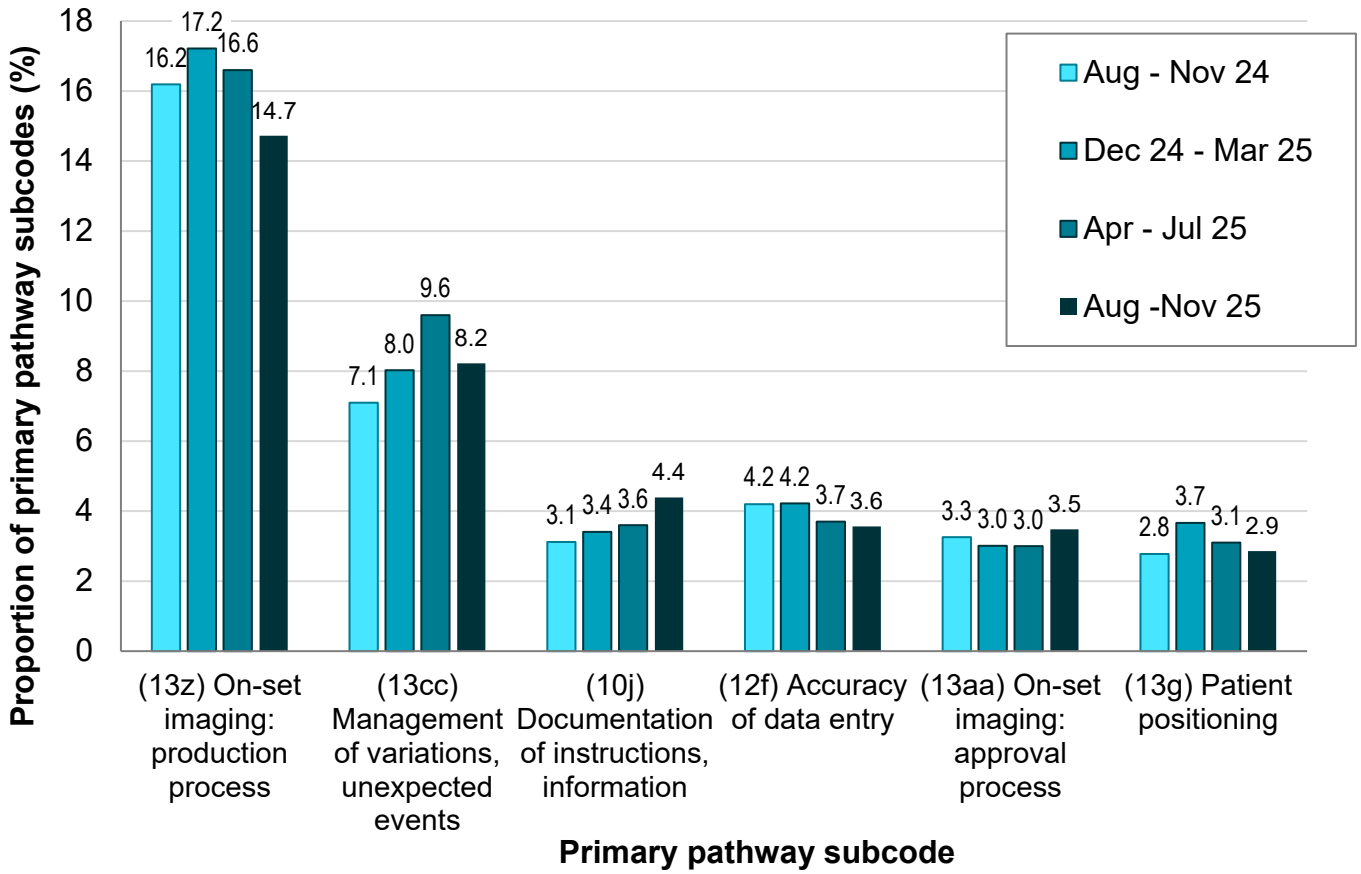
The second most frequently reported RTE was ‘management of variations, unexpected events’ at 8.2% (n = 397). Similarly, this pathway subcode is often associated with contributory factor ‘equipment or IT network failure’ (85.9%, n = 341) and with a large proportion comprising of minor radiation or MRI incident, good catch or other non-conformities with little or no impact on patient care (97.2%, n = 386).

Figure 4 demonstrates a frequency trend analysis over time for the 5 most frequently occurring primary pathway subcodes for the current triannual period.

Primary pathway subcode ‘on-set imaging: production process’ is proportionally less than the last 4 triannual periods and has decreased over the past 3 triannual periods. Additionally, ‘management of variations, unexpected events’ has also decreased from 9.6% (n = 450) in the previous analysis (issue 47) to 8.2% (n = 397).

Primary pathway subcode ‘documentation of instructions, information’ has increased steadily over the past 4 triannual periods.

Figure 4. Breakdown of most frequently reported RTE primary pathway subcodes over time



Failed safety barriers

Safety barriers (SB) are additional tasks undertaken across the radiotherapy pathway with the primary purpose of identifying and mitigating an event. These process steps are over and beyond core tasks undertaken as part of the planning and delivery of radiotherapy treatment (1). Identifying those safety barriers that fail (FSB) most frequently is important in learning where vulnerabilities in radiotherapy safety systems reside.

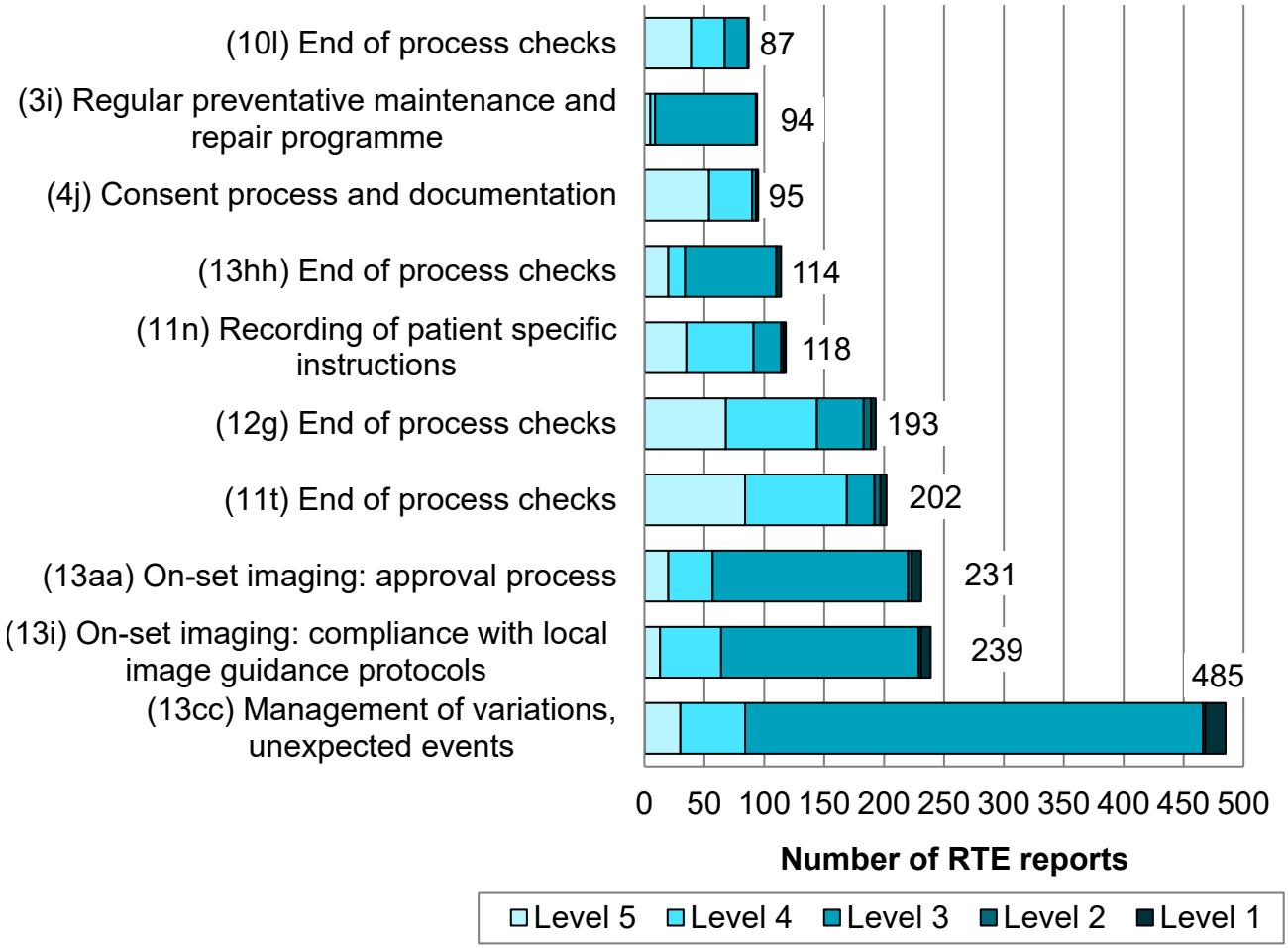
Based on feedback from the radiotherapy community, the recent National patient safety radiotherapy event taxonomy guidance has refined many pathway subcodes, including the expansion of end of process check (EOPC) subcodes, for increased granularity. EOPC are a subset of the pathway taxonomy that are often allocated as a failed safety barrier. Due to these changes the PSRT are currently reviewing FSB with the aim of refining those pathway subcodes that meet the criteria of an SB. Results from this ongoing work will be shared shortly.

In the interim period, Figure 5 shows the breakdown of failed safety barriers based on the existing criteria. Multiple FSB codes can be attributed to each individual RTE. A total of 3,016 failed safety barriers (FSB) were identified from the RTE reported.

Treatment unit process ‘management of variations, unexpected events’ was the most frequently reported FSB (16.1%, n = 485). An example of an RTE with this FSB includes when a machine failure occurs at the treatment unit, and the correct course of action is not taken in accordance with departmental protocol.

As previously stated the updated National patient safety radiotherapy event taxonomy included expansion of the EOPC pathway subcode, previous EOPC treatment subcode 13hh ‘end of process check’ has been archived, during this transition period there were 3.8% (n = 114) of all FSB allocated as 13hh. The expanded pathway subcodes include 13mm ‘in-room end of process checks’, 13nn ‘pre exposure end of process checks’ and 13oo ‘completion of treatment exposure end of process checks’, these combined made up 4.9% (n = 148) of all FSB.

Figure 5. Breakdown of failed safety barriers (n = 1,858/3,016 subset of RTE data)



Method of detection

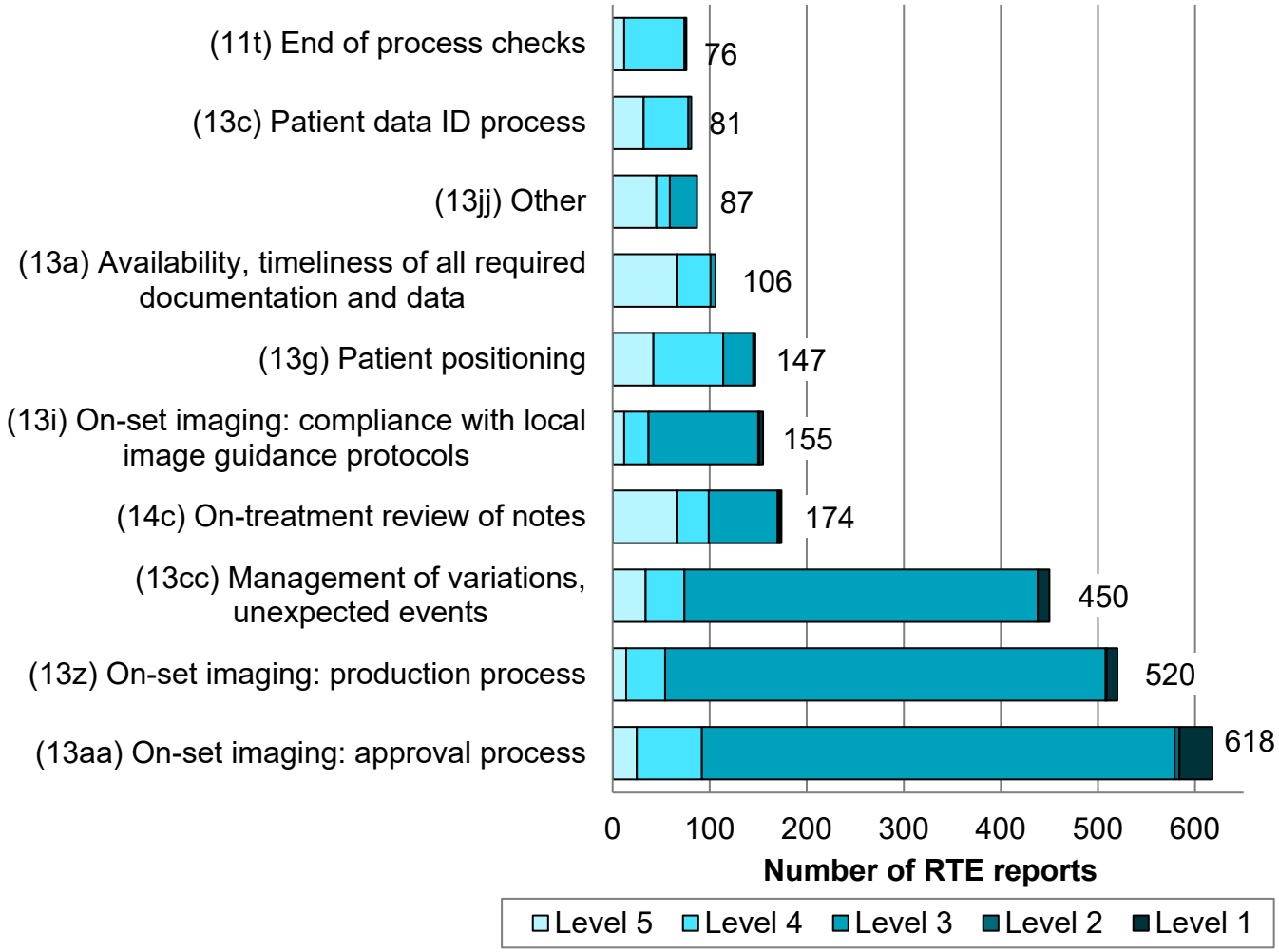
A method of detection (MD) is the process that identified the event and can be coded using the entire pathway taxonomy. The most frequently reported MD can be seen in Figure 6.

The most frequently reported MD was ‘on-set imaging: approval process’ (13.7%, n = 618). This MD was most frequently reported with a primary process code ‘on-set imaging: production

process' (24.6%, n = 152) and a primary contributory factor of 'slips and lapses' (50.2%, n = 310). Eight of the most frequently reported MD occurred at the treatment unit process.

EOPC occur at the end of each discrete part of the patient pathway and include multiple different pathway subcodes. These comprised of 8.4% (n = 379) of all MD of which 52.2% (n = 198) were classified as Level 4: good catch, detecting and preventing a radiation or MRI incident from occurring. Only 15.8% (n = 60) of the EOPC reported as MD for this triannual period were coded using the archived pathway subcode 13hh 'end of process checks'. The expanded EOPC pathway subcodes are described within the FSB section, these include 13mm, 13nn and 13oo, these accounted for 35.1% (n = 133) of all EOPC MD.

Figure 6. Breakdown of method of detection by level (n = 2,414/4,511 subset of RTE data)



Contributory factors

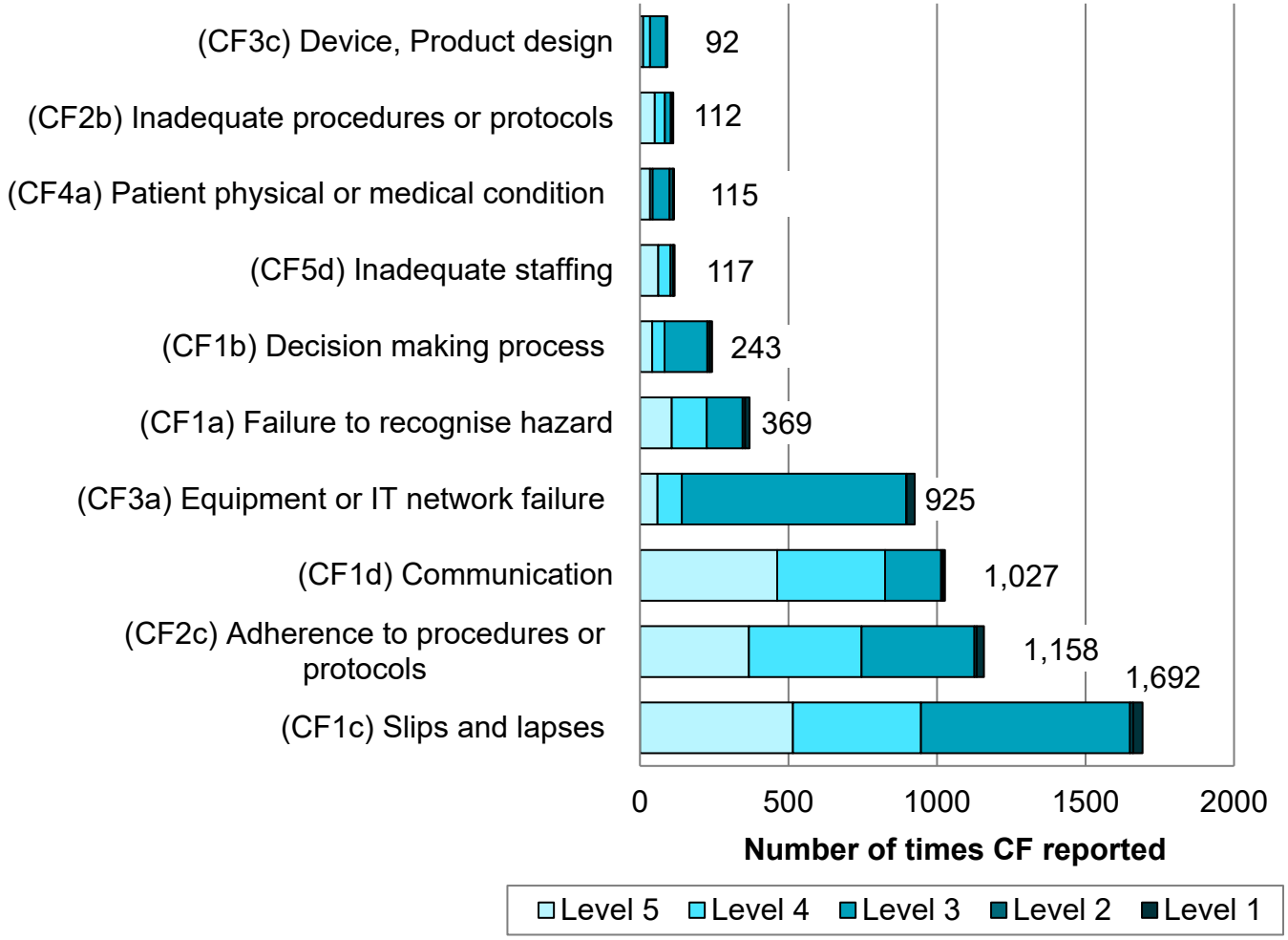
Including contributory factors (CF) within a RTE taxonomy enables identification of system problems that could precipitate a range of different events (2).

A systems-based approach to RTE analysis may identify multiple CF for a single event. During the current review period, a total of 6,262 CF codes were assigned to 4,729 RTE, with 1,171 reports containing multiple CF, this is a positive increase since the previous analysis (issue 47)

when a total of 5,835 CF codes were assigned to 4,226 RTE, with 999 reports containing multiple CF.

The most frequently occurring CF codes are illustrated within Figure 7. The most frequently reported CF was ‘slips and lapses’ making up 35.0% (n = 1,692) of all reports. Although individuals are often involved in the last interaction prior to an event, actions and behaviour are the product of influences from the whole system, requiring a holistic approach to any response.

Figure 7. Breakdown of most frequently reported CF (n = 5,850/ 6,262 subset of data)



Advancing Safer Radiotherapy reflects and consolidates contemporary approaches to patient safety, including systems thinking, and recommends all CF are identified and used to inform actions required to reduce risk and potential for harm. The range of CF is broadly similar to the previous analysis (issue 47).

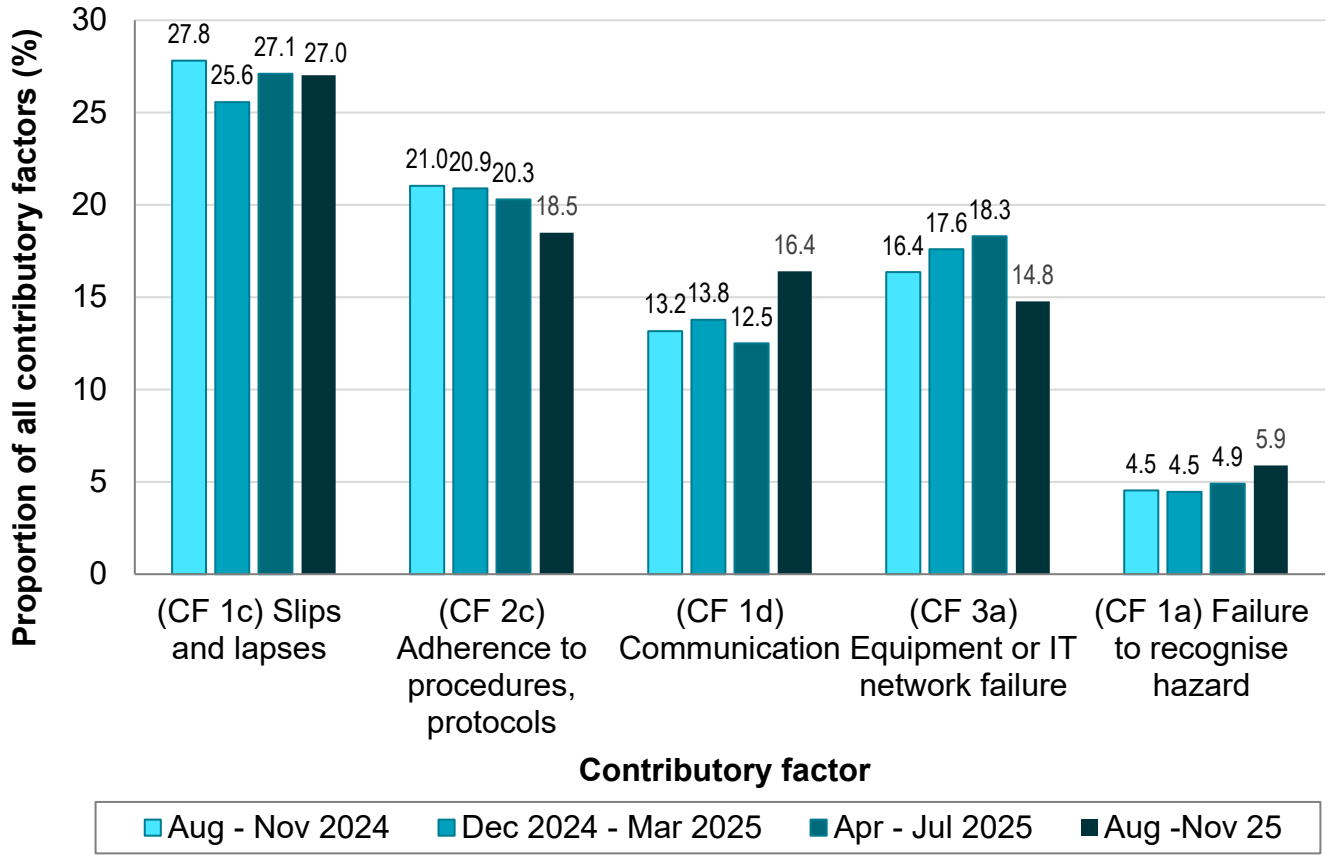
Figure 8 illustrates the proportionality of the 5 most commonly cited CF over time. There are no statistically significant trends over these 4 triannual periods.

This trend analysis overview highlights notable changes over the 16-month review period. The decreasing proportion of ‘on-set imaging: production process’ and ‘management of variations’ pathway subcodes illustrated in Figure 4 may, in part, be attributable to the decrease in the CF

'equipment or IT network failure' indicated in Figure 8. It should be noted this is the first instance since the publication of the Safer Radiotherapy biennial report where this CF has seen a proportional decrease and future trends should be monitored.

The increase in 'documentation of instructions' pathway subcode in Figure 4 is also reflected in the increase in the contributory factor 'communication' seen in Figure 8. Further guidance can be seen in previous analysis (issue 33).

Figure 8. Breakdown of most frequently reported RTE contributory factors over time



Brachytherapy RTE

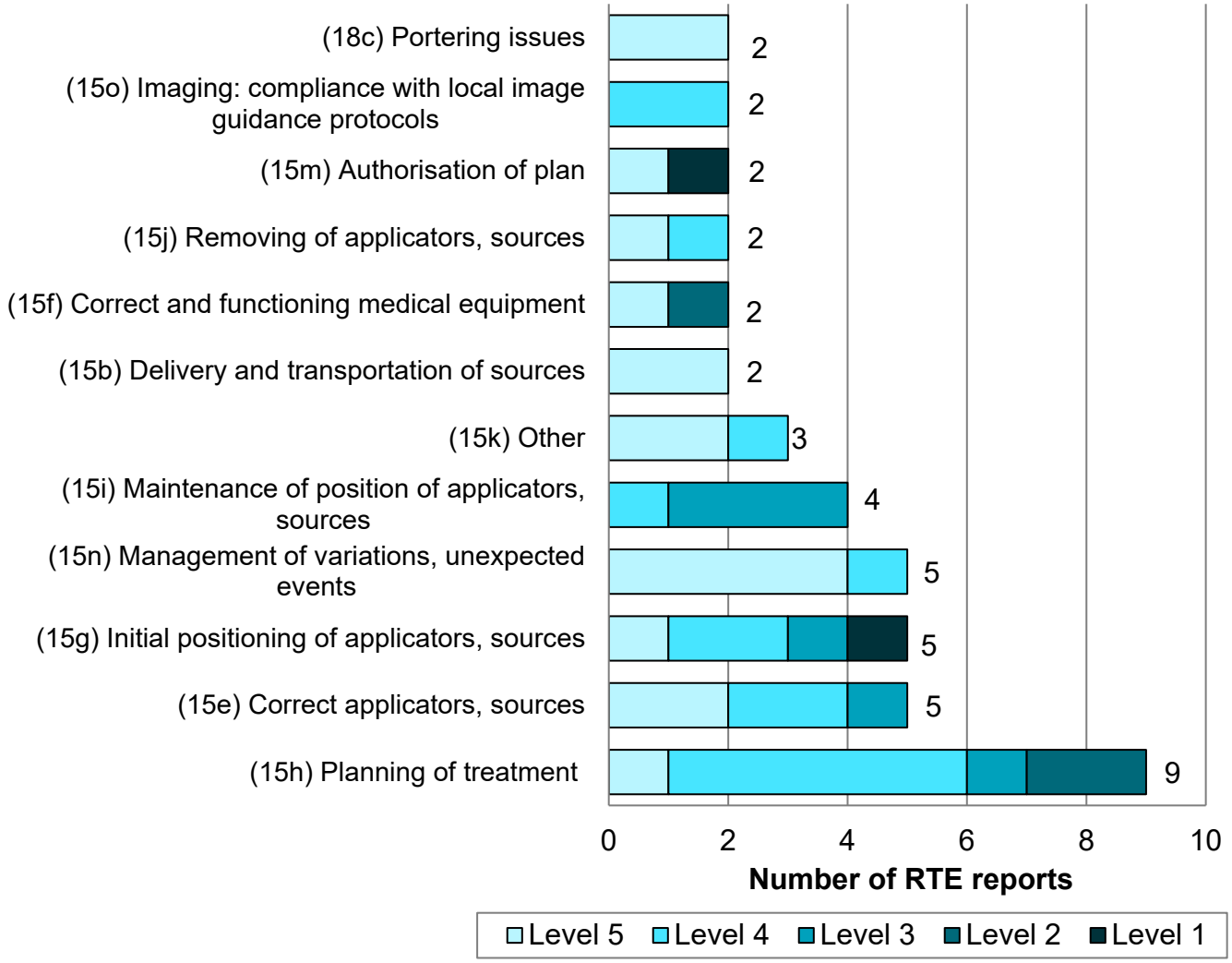
Brachytherapy (BRT) is a RT sub-speciality which involves radiotherapy treatment inside or close to the treatment area. BRT makes up less than 3% of all RT episodes (3). Therefore, the number of BRT associated RTE would be expected to be low and should be interpreted with caution.

For this reporting period there were 44 reports coded with BRT process subcodes as the primary code, a further 7 reports included the modality taxonomy D12 'brachytherapy', this resulted in BRT RTE accounted for 1.1% (n = 51) of reports, a slight increase from the previous analysis issue 47 (0.7%, n = 33). Providers reporting BRT RTE has also increased to 17

compared to 15 within the previous analysis. A breakdown of the BRT RTE can be seen in Figure 9.

The most frequently reported BRT process subcode was ‘planning of treatment’ comprising 17.6% (n = 9) of all BRT RTE. This reflects a slight decrease in proportionality from the previous analysis (issue 47), where this type of event made up 18.2% (n = 6) of all BRT RTE.

Figure 9. Breakdown of most frequently reported BRT RTE coded ‘15’ by level (n = 43/51)



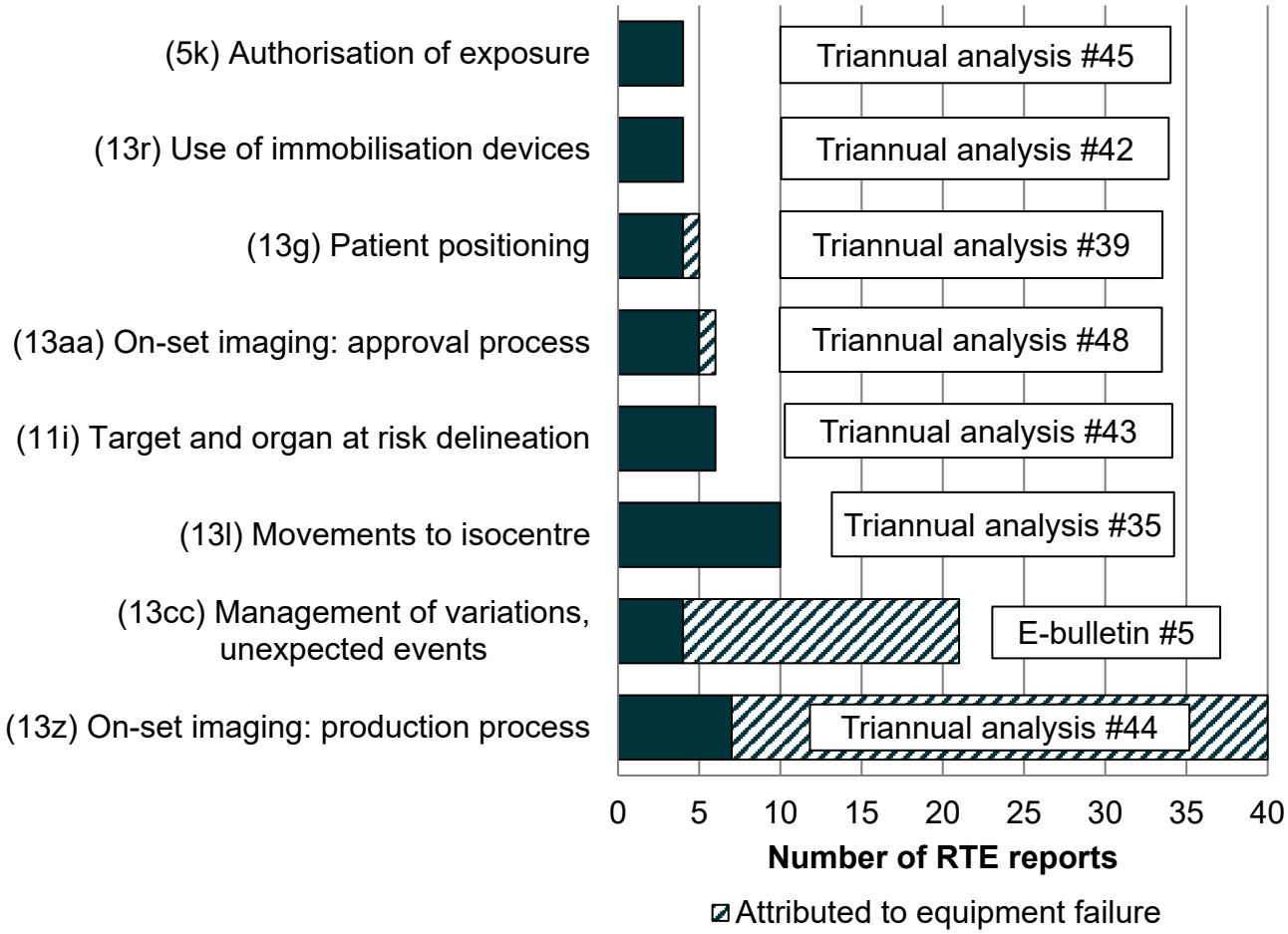
Inspectorate data

A breakdown of the inspectorate data for this reporting period can be seen in Figure 10. The inspectorates shared 133 anonymised closed synopses of reported SAUE. This is an increase since the previous analysis (issue 47) when 110 reports were shared. Of these reports one event affected multiple patients over numerous years. The event was not considered clinically significant, and the corresponding regulator will share learning within their annual report.

The most frequently reported notifications were associated with ‘on-set imaging: production process’ (30.1% n = 40). This represents an increase since the previous analysis (issue 47) where 25 reports (22.7%) were associated with ‘on-set imaging: production process’.

Publications with relevant case studies considering each pathway subcode are indicated in Figure 10.

Figure 10. Breakdown of most frequently reported inspectorate Level 1 pathway subcodes from closed notifications (n = 96/133 subset of data)



As seen in Figure 4 there has been a decrease in proportion of voluntary reports associated with ‘on-set imaging: production process’. Conversely, there is an increase in the proportion of associated inspectorate data, this difference in part is due to the time lag in receipt of the data. Further analysis of the inspectorate data can be seen in table 1, this shows that 71.4% (n = 95) notifications led to additional verification imaging and did not affect the patient’s treatment. The most frequently occurring primary pathway codes for inspectorate notifications which affect treatment delivery, are ‘target and organ at risk delineation’ (24.0%, n = 6) and ‘on-set imaging: approval process’ (16.0%, n = 4), none of these were reported as clinically significant.

Table 1. Notification category

Notification category	Proportion and number of notifications
Additional pretreatment (planning) imaging	9.0%, n = 12
Additional treatment verification imaging	71.4%, n = 95
Affected treatment delivery	18.8%, n = 25
Other	0.8%, n = 1

Case study 18: On-set imaging: approval process (13aa)

On-set imaging: approval process includes events where image review is not completed, image review is inaccurate, where the incorrect reference image is used, and when matching structures are incorrectly prioritised. This type of RTE is consistently included in the most frequently reported pathway subcodes and within the reportable radiation incident data over the past year. This type of event may affect a patients treatment delivery, therefore have potential significant impact on the patient's treatment. There were 6 notifications from the inspectorate data for this triannual period coded using this pathway subcode and 4 of these affected a patient's treatment.

Synopsis

This notification is for a partial geographic miss.

Patient receiving radiotherapy to spinal metastases. Treatment of 20Gy in 5# to both T4 – T7 and T11 – L2. Patient received CT planning scan, the 2 areas were marked and planned using virtual simulation. Patient treated on Linac 2 for first 2 days.

The third # was treated on Linac 3, patient correctly positioned for treatment using 2 anterior marks. First treatment of T11-L2 kV image acquired and patient treated. Second kV image of T4-T7 treatment acquired, image matched with a 0.6cm digital move inferior required, this was within the local image protocol threshold. Patient treated; it was noted the image was difficult to match due to limited anatomical markers.

During offline review of the patient's treatment it was noted that on the third fraction there was a mismatch on the long of 2.6cm. At this point a second radiographer was consulted who agreed there had been a mismatch. The images were sent for dosimetric review. An MPE report was completed which identified a partial geographical miss. With the aid of the MPE report the consultant then concluded there was no clinical harm to the patient.

The final 2 treatments were completed on Linac 2 without the need for the patient to receive compensatory treatment

On investigation it was noted that the kV image were the same width and length as the treatment field, indicating no distinguishable anatomy.

Coding: TSRT9/ Level 1/ 13aa/ 13z/ MD13aa/ CF1b/ CF2d

RTE response

A robust RTE response will maximise potential learning from this event. Table 2 contains the key stages to an RTE response and further considerations for this case study (4).

Table 2. Key response stages to RTE described above (13aa)

RTE response stage	Considerations
Identification and local reporting of RTE	Staff are appropriately trained and supported to identify and report RTE locally. Update training on the use of the 2025 national patient safety radiotherapy event taxonomy was given in September. This event was detected during the offline review task (MD13aa) and reported on the local reporting system.
Decision to investigate	During offline review it was noted that the image match was incorrect by a magnitude of 2.6cm which led to a partial geographical miss. This meets the criteria for reporting under SAUE guidelines for 9.2 partial geographical miss. In accordance with SAUE guidance, this event is therefore a reportable radiation event (Level 1) which requires a detailed investigation in accordance with local procedures.
Planning and selection of investigation team	An interdisciplinary team, including staff from pre-treatment, treatment, clinical oncology, the imaging lead, palliative lead and an MPE from the local image optimisation team, was formed to investigate the event.
Recording of investigation	The local investigation report template was utilised to guide the investigation and capture the relevant information.
Information gathering	Operators involved in the event contributed to the investigation. A review of relevant documentation and a walkthrough of the palliative pathway were carried out. During the investigation a retrospective audit of RTE was completed to determine if this type of event was thematic, there was no evidence that this was the case. An image quality audit of all palliative patients over the past 6 months was completed to determine if this type of image quality issue had occurred previously.
Analysis and identification of contributory factors	Analysis was completed using a SEIPS (5 to 6) framework. Investigation established that the change of Linac on the third day led to operators who were treating an unknown patient for that linac and decision making was inadequate on the image match (CF1b). On further inspection it was noted that the local imaging protocol was to have the image jaws the same width and length

RTE response stage	Considerations
	as the treatment field, this led to no discernible anatomical features (CF2d). The investigation team also considered the workload of staff and the environment in which the image analysis was undertaken. At the time of the event, the workload was not considered excessive, sufficient staffing numbers and skill mix were available, and the environment was also considered to be sufficient.
Identification of areas for improvement and agree action plan	To address the areas for improvement identified, the following actions were agreed within a local action plan: • ensure the verification image is of sufficient quality and captures appropriate anatomy for accurate matching, including an appropriate field of view not just the treatment field • contour appropriate anatomy structures for the purpose of the match such as carina or adjacent structures • review local imaging procedures and training to ensure the changes to imaging practice are reflected • imaging audits should be considered to monitor image quality and to ensure image analysis remains at an acceptable standard • ensure change of linac is kept to a minimum for patients to ensure nonroutine patients are seen by the same team across their treatment • review local study of risk of accidental and unintended exposures to ensure learning form this event is appropriately reflected
Dissemination of learning	A summary of the investigation was shared with staff at different staff meetings and through an email alert. Feedback was sought from staff for areas for improvement ideas. Training provided as per action plan.
Assessment of effectiveness	An audit of improvement actions to be completed 3 months after implementation. An image review audit to be carried out at 6 months to assess image quality.

Further guidance and national tools to aid investigations are available (4 to 6).

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2. Clark BG, Brown RJ, Ploquin JL, Kind AL, Grimand L. 'The management of radiation treatment error through incident learning' Radiotherapy and Oncology 2010: volume 95, issue 3, pages 344 to 349
3. CancerData statistics
4. UKHSA. 'Advancing safer radiotherapy'
5. NHS England. 'Patient safety learning response toolkit'
6. NHS England. 'Systems Engineering Initiative for Patient Safety (SEIPS)'

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Prepared by: Medical Exposures Group
For queries relating to this document, please contact: radiotherapy@ukhsa.gov.uk

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