Safer Radiotherapy
The radiotherapy newsletter of Public Health England

Supplementary Data Analysis
Issue 25 – Full radiotherapy error data analysis
December 2017 to March 2018
About Public Health England

Public Health England exists to protect and improve the nation’s health and wellbeing, and reduce health inequalities. We do this through world-leading science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health and Social Care, and a distinct delivery organisation with operational autonomy. We provide government, local government, the NHS, Parliament, industry and the public with evidence-based professional, scientific and delivery expertise and support.

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Full radiotherapy error data analysis
December 2017 to March 2018

This analysis has been undertaken by Public Health England (PHE) on radiotherapy errors and near misses (RTE) reported voluntarily by NHS radiotherapy (RT) providers. Reports are submitted from England and Wales to the National Reporting and Learning System (NRLS) at NHS Improvement using the TSRT9 trigger code\(^1\) and directly to PHE from providers in Northern Ireland and Scotland.

The classification from *Towards Safer Radiotherapy*\(^2\) (TSRT) was employed for the analysis and the pathway coding from the *Development of learning from radiotherapy errors*\(^3\) (DoL) to include safety barriers and causative factor taxonomy. Where appropriate, comparisons have been drawn with previous issues of *Safer Radiotherapy*\(^4\) and the PHE supplementary data analyses\(^5\). The analysis has been reviewed by the Patient Safety in Radiotherapy Steering Group, whose comments have been incorporated into this document.

For this reporting period, December 2017 to March 2018, 87.1% (n = 54) of providers have submitted RTE reports, representing a majority of providers from across the UK. Between March 2017 and March 2018 90.3% (56) providers submitted reports, leaving 6 providers who did not submit reports using the TSRT9 trigger code. The RTE reports received at PHE are anonymised and received as part of a voluntary reporting scheme. New and existing NHS RT providers are welcome to contact PHE for advice on how to submit data for inclusion in these national analyses.

The average number of reports received by PHE each month for this reporting period was 659.5. This is a 6.2% decrease in the number of reports received from the last reporting period August to November 2017 (n = 702.8)\(^6\). However, this is a 7.0% increase when comparing to the same reporting period in 2016/2017 (n = 616.5)\(^6\). A mature reporting culture is reflected in the continued participation by a large number of providers in national reporting. This continued commitment of providers demonstrates the community’s drive to improve patient safety in RT.

It is clear that there is some disparity in frequency of reporting across providers, with a wide variance shown when comparing the incident date with the date reported to the national voluntary reporting scheme. This time lag ranges from a minimum of 0 days to a maximum of 467 days for this reporting period, with a mean of 45.4 days. This is a decrease on the last reporting period (mean = 73.6 days)\(^6\). To ensure timely learning from RTE reports continues to be shared nationally, providers are asked to make submissions at the earliest opportunity for inclusion in the monthly data uploads by PHE and four-monthly analyses. Issue 13\(^4\) of *Safer Radiotherapy* provides further information on the frequency of reporting. The overall analysis presented in this report will help providers to compare locally identified trends
against the national picture. In doing so it is expected that these events might be minimised in the future. However, it should be noted this data is not adjusted to reflect individual provider activity or service specification. As with any voluntary reporting system, the data will only reflect those incidents that are reported and may not necessarily be representative of the actual level of occurrence. As such, this data needs interpreting with care.

*If individual providers would like to comment on the analysis or can offer further advice in preventing any RTE please email the RT team at radiotherapy@phe.gov.uk.*

**Monitoring of TSRT classification and coding by radiotherapy providers**

The TSRT classification and coding had been applied by local RT providers to 2428 of the 2638 reports received from December 2017 to March 2018. This demonstrates a continuation of the high adoption rate (92.0%) in the application of the TSRT taxonomies.

Consistency checking was undertaken by PHE staff on the application of the TSRT classification and coding system by RT providers. Up to 4 individual pathway codes and 3 causative factors can be allocated locally by RT providers to each RTE report. During consistency checking each of these pathway codes, classification and causative factors are reviewed for all RTE classified as reportable through to near miss (levels 1 – 4) and 10% of non-conformances (level 5) RTE are audited. From the 2428 RTE reports classified and coded locally, a 90.0% level of consistency was achieved (Figure 1). The *Good Practice in Radiotherapy Error Reporting – Supplementary Guidance Series* gives examples of the application of the classification and process coding. In addition, 210 RTE were classified or coded by PHE staff using the supporting text supplied by the local providers. The document ‘Development of learning from radiotherapy errors’ includes guidance on the application of coding and classification.

All providers are asked to apply a trigger code, classification, coding, including failed safety barriers, causative factor and where applicable effective safety barrier (detection method) to their RTE reports to facilitate both local and national analysis. Failed and effective safety barriers and how to include them in report submissions are discussed further in Issue 24 of *Safer Radiotherapy*.

In total 0.6% (n = 17) of the reports received were not included in the final analysis. Non-RTE reports submitted with the TSRT9 trigger code formed 0.5% (n = 14) of all the reports for this reporting period. Data and accompanying text indicate that these were patient safety incidents (PSI). This is consistent with previous analyses. A PSI is defined by the NRLS as ‘any unintended or unexpected incident which could have or did lead to harm for one or more patients receiving care’; further information on PSI can be found in issue 5 of *Safer Radiotherapy*. Non-RTE reports were excluded from the detailed analysis. Three reports were not classified and coded and did not contain sufficient text for PHE staff to do so and
were also excluded from the analysis. A further two reports were highlighted as duplicate reports and excluded from the database and analysis.

![Figure 1. Breakdown of reports, December 2017 to March 2018 (n = 2638)](chart)

In total, 2621 RTE for the reporting period from December 2017 to March 2018 were included for analysis. The analysis is presented here.

**Number of reports per provider**

Figure 2 shows the number of RTE reported by providers during December 2017 to March 2018. The number of reports per provider ranged from 1 to 201 reports with an average 48.5 reports for this subset of data, indicating that over half of providers reporting (64.8%, n = 35) reported less than the national average. It should be noted that those centres reporting higher numbers of RTE represent providers with mature reporting cultures and should be encouraged to continue reporting. Furthermore, it is essential that the local reporting and learning system is readily accessible and offers an efficient solution to enable reporting. The third in a series of surveys of UK RT providers in 2014 on reporting culture demonstrated that those departments with fully electronic single reporting and learning solutions, which were accessible in all areas of the clinical department, were most likely to submit greater numbers of RTE. The intention in sharing this data is to allow providers to benchmark themselves against other UK NHS providers.
Breakdown of process codes

The 2621 RTE reports were categorised by process code according to DoL\textsuperscript{3} irrespective of classification, so that the main themes could be derived. Figure 3 shows 46.2\% (n = 1210) of the RTE were reported to have occurred during treatment unit processes. This was true for all classifications of RTE. Previous analyses have indicated that the majority of near misses were associated with pretreatment planning process\textsuperscript{5}. It is expected the treatment unit process code to be the most frequently reported code as RT treatments can span a number of visits, providing many opportunities during the treatment unit process for RTE to occur.
The 10 most frequently reported process subcodes in the RT pathway are presented in Figure 4. This subset of data was also broken down by classification. The most commonly occurring RTE reported was ‘on-set imaging: production process’ at 12.9% (n = 337) of all the reports; as a subset 88.1% (n = 297) of these reports were level 3 events. The second most commonly occurring RTE was ‘on-set imaging: recording process’ at 5.3% (n = 139) followed by ‘accuracy of data entry’ 4.4% (n = 116).

![Figure 4. Breakdown of RTE main themes by classification level reported, December 2017 to March 2018 (n = 1171/2621 subset of RTE)](image)

**Classification of radiotherapy errors**

Each of the 2621 RTE reports was classified as ‘other non-conformance’, ‘near miss’, ‘minor radiation incident’, ‘non-reportable radiation incident’ or ‘reportable radiation incident’ (Figure 5). Of the RTE reports, 98.3% (n = 2576) were minor radiation, near miss or other non-conformities with little or no impact on patient outcome. Of the remaining 1.7% (n = 45) RTE reports, only 0.8% (n = 20) were reportable under IR(ME)R8 to the appropriate authority. It was reported in a national survey that providers are more likely to submit RTE reports of higher classification levels (levels 1–3) to the national voluntary reporting system than reports of a lower classification RTE reports of lower classification are less likely to be shared due to resource constraints and inefficient reporting and learning systems.
Reportable radiation incidents as defined in *Towards Safer Radiotherapy* fall into the category of reportable under one of two statutory instruments – IR(ME)R or IRR2017. These incidents will generally be clinically significant, although they may be correctable within the course of treatment. The majority of these higher level incident reports affected a single exposure. This meant that corrective action could be taken over the remaining treatment fractions so the incident did not have a significant impact on the patient or the outcome of their treatment.

There were 20 reportable radiation incidents submitted to the voluntary system from December 2017 to March 2018 (Figure 5), comprising 0.8% of the RTE reviewed; this is a slight decrease from 27 (1.0%) reportable radiation incidents in the previous four-monthly analysis.

Further analysis of the reports indicates the points in the pathway at which the reportable incidents occurred (Figure 6). ‘Verification of diagnosis/extent/stage’ comprised 25.0% (n = 5) of these reportable radiation incidents and was the most frequently occurring process subcodes of all reportable radiation incidents reported for this time period. An example of the type of RTE associated with ‘verification of diagnosis/extent/stage’ included pretreatment exposures being authorised and performed on a patient who did not have confirmed diagnosis. The second most frequently occurring event within this subset was ‘on-set imaging: approval process’ comprising 20.0% (n = 4) of all reportable radiation incidents for this time period. This was also one of the most commonly occurring subcode in the previous four month analyses (11.1%, n = 3). ‘On-set imaging: production process’ comprised 10.0% (n = 2) of reportable radiation incidents for this time period. An example of the type of RTE...
associated with ‘on-set imaging: production process’ includes multiple additional repeat exposures required for a single fraction due to human error including imaging in the incorrect area then repeating further multiple images. The remaining reports were singular events spread across 9 different subcodes.

Figure 6. Breakdown of reportable radiation incidents (level 1) by process subcode reported, December 2017 to March 2018 (n = 20)

Non-reportable radiation incident

Radiation incident not reportable, but of potential or actual clinical significance

Non-reportable radiation incidents comprised 1.0% (n = 25) of the RTE reported from December 2017 to March 2018 (Figure 5); this is consistent with the previous four-monthly analysis.

Further analysis indicates the points in the pathway at which non-reportable radiation incidents occurred (Figure 7). The reports were spread across 20 different subcodes. ‘On-set imaging: approval process comprised 12.0% (n = 3) and was the most frequently occurring event within the non-reportable radiation incidents. In contrast in the previous 4 month analyses ‘patient positioning’ was the most common non-reportable radiation incident (14.3%, n = 4). An example of a RTE associated with ‘on-set imaging: approval process’ includes the mismatch of imaging. Singular events reported are spread across 16 different subcodes and grouped in Figure 7 as miscellaneous.
Breakdown of non-reportable radiation incidents (level 2) by process subcode reported, December 2017 to March 2018 (n = 25)

**Minor radiation incident**

*Radiation incident in the technical sense, but of no potential or actual clinical significance*²

Minor radiation incidents comprised 37.5% (n = 982) of the RTE reported from December 2017 to March 2018 (Figure 5); this is a slight increase from 937 (33.7%) minor radiation incidents in the previous four-monthly analysis⁵.

The most frequently occurring level 3 process subcodes (Figure 8) consisted mainly of treatment unit processes 81.3% (n = 798). ‘On-set imaging: production process’ was the most frequently occurring event (30.2%, n = 297) within this subset. Examples of this type of minor radiation incident included using the incorrect filter for a CBCT. The second most frequently occurring event within this classification was ‘movements from reference marks’ (7.4%, n = 73), followed by ‘on-set imaging: approval process’ (6.3%, n = 62).

A large proportion of the reports in this classification were related to on-set imaging, these included ‘use of on-set imaging’, ‘on-set imaging: production process’, ‘on-set imaging: approval process’ and ‘on-set imaging: recording process’ (48.0%, n = 471). Which is consistent with the previous four-monthly analysis⁵ when 45.8% (n = 429) of minor radiation incidents were associated with on-set imaging. A number of minor radiation incidents with the primary code ‘on-set imaging: production process’ were attributed to equipment malfunction, (44.8%, n = 133), examples of this type of RTE includes CBCT faults during acquisition. Malfunction of equipment and on-set imaging: production process are discussed further in issue 18 of *Safer Radiotherapy*⁴.
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Figure 8. Breakdown of most frequently occurring minor radiation incidents (level 3) by process subcode reported, December 2017 to March 2018 (n = 714/982 subset of RTE)

Near miss

_Potential radiation incident that was detected and prevented before treatment delivery_²

Near misses comprised 24.5% (n = 643) of the RTE reported from December 2017 to March 2018 (Figure 5). Figure 9 shows the most frequently occurring process subcodes across this level of RTE. ‘Documentation of instructions’ comprised of 8.1% (n = 52) followed by ‘accuracy of data entry’ 7.2% (n = 46), these were also the most frequently occurring subcodes within the previous four month period⁵. Further details on the error ‘accuracy of data entry’ can be found in issue 2 of _Safer Radiotherapy_⁴ and issue 8 contained further details on ‘documentation of instruction’.

Figure 9. Breakdown of the most frequently occurring near misses (level 4) by process subcode reported, December 2017 to March 2018 (n = 290/643 subset of RTE)
Other non-conformance

Non-compliance with some other aspect of a documented procedure, but not directly affecting radiotherapy delivery²

Other non-conformance comprised 36.3% (n = 951) of the RTE reported from December 2017 to March 2018 (Figure 5). The most frequently occurring subcode was ‘accuracy of data entry’ (4.7%, n = 45), (Figure 10) within this classification. This was followed by ‘communication of appointments to patient’ (4.5%, n = 43) and ‘consent process and documentation’ (4.3%, n = 41). Both ‘accuracy of data entry’ (5.0%, n = 55) and ‘communication of appointments to patient’ (2.9%, n = 32) were included in the most frequently occurring non-conformance subcode in the previous four-monthly analysis⁵. However ‘consent process and documentation’ did not feature in the most frequently occurring non-conformances in the previous four-monthly analysis.

![Figure 10. Breakdown of the most frequently occurring non-conformances (level 5) by process subcode reported, December 2017 to March 2018 (n = 340/951 subset of RTE)](image)

Safety barriers

Critical control points, detection methods or defence in depth, are any process steps whose primary function is to prevent errors occurring or propagating through the RT workflow¹⁰

Up to 4 individual pathway codes can be allocated to each RTE report to identify all points in the pathway where the error was not picked up. All subcodes were analysed across the 2621 RTE reports for the reporting period December 2017 to March 2018, a total of 2036 subcodes were identified as failed safety barriers (SB). Only 2.3% (n = 47) of failed SBs led to a Level 1 or 2 RTE. Treatment unit processes were attributed to 44.2% (n = 899) of all failed SBs. The most common failed SBs are represented in Figure 11. Treatment unit process ‘end of process checks’ was the most commonly reported failed SB (16.7%, n = 339). ‘End of process checks’ across the pathway account for 38.8% (n = 790) of all reported failed SBs. Issue 4 of Safer Radiotherapy⁴ includes guidance on minimising the occurrence of RTE associated with ‘end of process checks’.
Effective safety barriers or methods of detection (MD) can now be identified utilising the safety barrier taxonomy. For the reporting period December 2017 to March 2018 nine providers indicated MD in 66 reports. A further 11 RTE contained the letters MD; however it was unclear which process code indicated the MD therefore they have not been included in this analysis. Issue 24 of Safer Radiotherapy includes guidance on the application of MD coding. The most commonly reported effective safety barrier for this reporting period was treatment unit ‘end of process checks’ (33.3%, n = 22).

Figure 11. Breakdown of failed safety barriers by classification level reported, December 2017 to March 2018 (n = 1403/2036 subset of RTE data)

Figure 12. Breakdown of effective safety barriers by classification level reported, December 2017 to March 2018 (n = 43/66 subset of RTE data)
Causative factors

Use of causative factor taxonomy enables identification of system problems or root causes that could precipitate a range of different incidents.\(^\text{11}\)

The new causative factor (CF) taxonomy has been adopted by 46 (85.1%) out of 54 RT departments and has been applied to 2051 (78.3%) RTE reports for this reporting period. Following consistency checking, PHE coded a further 70 reports with CF taxonomy, resulting in 2121 reports containing CF taxonomy for the analysis. This is a marked increase since the last reporting period when 47 (85.4%) out of 55 RT providers applied the CF taxonomy to 1322 (47.5%) RTE.

Figure 13 shows the most commonly occurring primary CFs which are seen as the root cause of an incident. Consistent with the previous analysis, the most commonly occurring primary CF was individual ‘slips and lapses’ (37.9%, n = 805), closely followed by ‘adherence to procedures/protocols’ (15.4%, n= 326). ‘Slips and lapses’ were most frequently attributed to ‘on-set imaging: production process’ (14.7%, n = 118), and ‘adherence to procedures/protocols’ were most frequently attributed to ‘on-set imaging: recording process’ (8.0%, n = 26). Issue 22 of *Safer Radiotherapy*\(^4\) includes guidance on minimising the occurrence of RTE caused by a slip or lapse of an individual.

Currently up to three CF codes can be attributed to each individual RTE. A review of the second and third CF codes indicate the contributory factors associated with an incident. Contributory factors were indicated across 832 reports, 167 of these contained multiple CF leading to 999 contributory factors. Figure 14 shows the most commonly occurring

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**Figure 13. Breakdown of most common primary causative factors by classification level, December 2017 to March 2018 (n = 1990/2121 subset of data)**

Currently up to three CF codes can be attributed to each individual RTE. A review of the second and third CF codes indicate the contributory factors associated with an incident. Contributory factors were indicated across 832 reports, 167 of these contained multiple CF leading to 999 contributory factors. Figure 14 shows the most commonly occurring
contributory factors. The most commonly occurring was ‘adherence to procedures/protocols’ (43.0%, n = 430), these were most frequently attributed to ‘on-set imaging: recording process’ (11.6%, n = 50).

![Diagram showing breakdown of contributory factors by classification level, December 2017 to March 2018 (n = 900/999 subset of data)](image)

**Figure 14. Breakdown of most common contributory factors by classification level, December 2017 to March 2018 (n = 900/999 subset of data)**

Brachytherapy errors

Errors coded with brachytherapy process codes as the primary code account for 0.8% (n = 21) of radiotherapy errors for the reporting period December 2017 to March 2018 this is consistency with the previous four-monthly report (0.9%, n = 25). Brachytherapy is a small specialised practice within radiotherapy, therefore the number of brachytherapy associated RTE would be expected to be low. The majority of the brachytherapy errors reported were near misses or non-conformances (76.2%, n = 16) and none were classified as a reportable radiation incident (Figure 15).

‘Correct applicators/sources’, ‘planning of treatment’ and ‘management of variations’ each comprised 14.3% (n = 3) of all brachytherapy incidents. An example of a RTE associated with the ‘correct applicator/sources’ includes the incorrect applicator being prepared for a procedure but not used. An example of a RTE associated with the ‘planning for treatment’ includes the incorrect data being used for planning. Issue 20 of *Safer Radiotherapy* includes further guidance on brachytherapy RTE. The CF were reviewed within this dataset, only 9 reports were attributed to 7 different CF, it is recommended that CF are included when...
reporting RTE. Future supplementary analysis will include analysis of CF for brachytherapy reports.

![Bar chart showing breakdown of brachytherapy errors coded '15' by classification level, December 2017 to March 2018 (n = 21)](chart)

**Figure 15. Breakdown of brachytherapy errors coded ‘15’ by classification level, December 2017 to March 2018 (n = 21)**

**References**


2. Towards Safer Radiotherapy. Available at [www.rcr.ac.uk/towards-safer-radiotherapy](http://www.rcr.ac.uk/towards-safer-radiotherapy)


