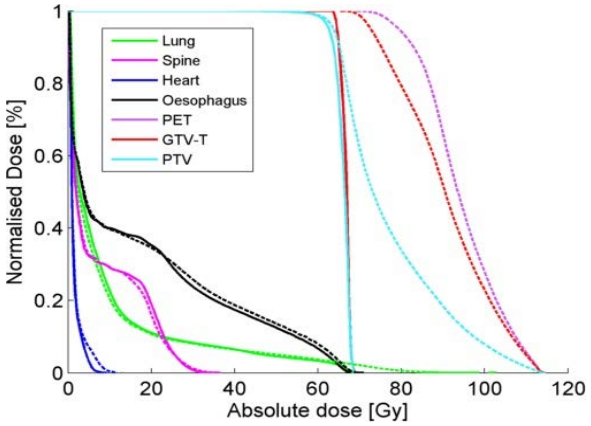
Results: Dose-volume-histogram data for the standard (solid) and escalated (dashed) arms for one patient is presented (Figure 1). Centres entering the NARLAL2 trial must successfully pass a workshop evaluation on delineation, PET determination, treatment planning, and IGRT strategy. Additionally, all participating centres should expect to enrol ≥5 patients/year, use 4D-CT and PET, inverse treatment planning, daily online match on soft tissue, and have an adaptive treatment strategy. Planning and treatment of the initial two patients within each centre are thoroughly investigated by a small QA work group consisting of 2 clinical oncologists and 4 physicists. Furthermore, every six month each centre will be visited by an external oncologist in order to ensure that guidelines are still followed throughout the duration of the trial.



Conclusion: The NARLAL2 trial started patient accrual in January 2015 based on this extensive QA work.

EP-1933

End-to-end dosimetric audit – comparison of TLD and lithium formate EPR dosimetry

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Purpose or Objective: The purpose of the study was to compare a lithium formate dosimetry system with a lithium fluoride TL dosimetry system as used in a solid phantom developed for remote end-to-end audits of advanced radiotherapy treatments, such as IMRT and VMAT. This type of inter-dosimeter comparison is of benefit for better understanding of advantages and limitations in the use of these dosimeters in remote audit programs for radiotherapy.

Material and Methods: A phantom was designed by a multinational coordinated research group (Coordinated Research Project E24018) with the intention to be used for remote end-to-end audits of advanced radiotherapy treatment (IMRT and VMAT). The phantom is made of polystyrene and includes solid water volumes representing a target region (PTV) and an organ at risk (OAR) with two measurement points in each. For an audit, the phantom is to be loaded with either TLD or EPR dosimeters and sent to external clinics to be treated using their local procedure for IMRT or VMAT. Dimensions of the active volume of the dosimeters used were: 20 mm length and 3 mm diameter for TLD, 5 mm height and 4.5 mm diameter for the EPR dosimeter. In addition, gafchromic film is used in the audit but this is not a subject of the current study. Irradiations were performed using VMAT technique and the doses determined by the TLDs and EPR dosimeters were compared with the TPS calculated doses.

Results: The absorbed dose determined by the EPR and TL dosimeters agreed within 2% with the TPS calculated doses in the PTV. In the OAR the discrepancy was larger; the dose determined by the EPR system was 3% lower compared to the TPS dose while the dose determined by the TLD was 5% higher than the TPS dose. The dose difference in the OAR was expected to be larger due to the steep dose gradients in this region over the dosimeter volume and the phantom positioning uncertainties involved.

Conclusion: Both dosimetry systems agree with the TPS calculated doses within 2% in the PTV and 5% in the OAR. This study shows that both dosimetry systems give results acceptable for this application and can be used for remote dosimetry audits of IMRT or VMAT. The EPR dosimeters have higher resolution due to their smaller size. This is an advantage of the EPRs over the TLDs since it is possible to resolve dose gradients to a higher extent.

EP-1934

Event reporting and learning in radiotherapy: evaluation over 4 years

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Purpose or Objective: Radiotherapy is one of the primary treatment options in cancer management. Radiotherapy is recognised as one of the safest areas of modern medicine; however, when errors occur, the consequences for the patient can be significant.

The rapid development of new technology has significantly changed the way in which radiotherapy is planned and delivered. Quality and safety programs in radiotherapy have been recommended by international bodies, such ESTRO and AAPM.

The purpose of this work is twofold: to report on the long-term use of an event reporting and learning system in an RT department to record and classify events, and to compare a restricted access system to an open-access system

Material and Methods: A voluntary web-based safety information database for RT was designed for reporting individual events in RT and was clinically implemented in 2011. An event was defined as any occurrence that could have, or had, resulted in a deviation in the intended delivery of cancer care. The aim of the reporting systemm was to encourage process improvement in patient care and safety.

During the RT process, when something goes wrong and results in event, it is initially recorded and reported within the RT Department. Initially only the management group registered events. From June 2012 all team at RT Department (radiation oncologist, radiation therapists, medical physicists, nurses, technicians, dosimetrists, medical secretary) can directly register events. All events were analyzed inside a management group who selected and proposed actions to be taken.

Results: We analyzed events from 2011 to 2014 for 6108 patients who have undergone radiation treatment at our hospital. Over this period of time 298 events were reported. After the event reporting system became open access (June 2012), the registered number of events increased significally: from 22 in 2011 to 44 in 2012, 120 in 2013 and 112 in 2014. The spectrum of reported deviations extendent from minor workflow issues to errors in treatment delivery.

The distribution of the professional who registered the event was:

	2011	2012	2013	2014
Radiation Oncologist	59%	18%	6%	4%
Medical Physicists	4.5%	7%	2%	2%
Dosimetrists	-	5%	-	7%
Radiation Therapists	32%	70%	91%	87%
Nurses	4.5%	-	-	-
Medical Secretary	-	-	-	1%
Nº of Events	22	44	120	112

Dose errors were detected in 29 patients. In 9 patients afected more than 1 session (5 patients in 2011, 3 patients in 2012, 1 patient in 2013 and no patients in 2014).
The number of corrective actions has increased because of the increasing number of registered events: 2 in 2011, 4 in 2012, 7 in 2013 and 9 in 2014.

Conclusion: Event reporting and learning systems in radiotherapy can provide valuable data for patient safety treatment. An open acces event reporting improved identification of areas which needed process and safety improvements. The major indication of the effectiveness is the reduction in dose errors.

EP-1935

Impact of standardised codes of practice and related audit on radiotherapy dosimetry over 20 years

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Purpose or Objective: Reference dosimetry audit measurements in UK radiotherapy centres have been carried out over the last 20 years. This work examines the variation in local dosimetry calibration in a network of radiotherapy centres, draws conclusions on the implementation of an absorbed dose based protocol for MV photon beams and includes the measured effect of a change in the nationally recommended electron code of practice (CoP) from an air kerma based to an absorbed dose based protocol.

Material and Methods: Data from reference dosimetry audits conducted in radiotherapy centres by the National Measurement Institute (NMI) for photon, electron and kV x-rays have been collated, recording the NMI:Centre ratio for reference output measurements, beam quality, and field chamber comparison. A total of 81 MV photon, 98 electron and 30 kV photon beams were measured during 68 visits between June 1994 and February 2015. The change in the national standard deviation has been assessed over time, and differences due to the change between the two electron CoPs during this period has been quantified. The improvement in consistency for MV beams since the adoption of a CoP traceable to a primary standard of absorbed dose is assessed.

Results: The mean NMI:Centre difference for radiation output calibration was less than 0.25% for all modalities. A total of 7 measurements were reported to be outside the +/- 2% tolerance.There was a statistically significant difference (p=0.008) in the mean result for the respective air kerma based electron CoP, +0.75% (n=14) with the absorbed dose based protocol giving +0.20% (n=84).
The variation in MV results has decreased steadily over time (see Figure 1). The standard deviation has halved when comparing the first and last 20 results, being 0.85% (2000) and 0.35% (2015). This trend has also been noted within regional audit groups. A linear correlation was observed between the 'NMI:Centre output ratio' and the 'NMI:Centre field chamber comparison ratio'.
There has been no significant difference observed between regional audit and national audit for the measured NMI:Centre ratios, but some regions have had many more NMI audits than others, some having no beams audited for a particular modality, and others having more than 20.

Conclusion: Data has been collated from 20 years of NMI reference dosimetry audits, and key trends and changes have been noted. The introduction of the 2003 absorbed dose-based electron CoP has decreased the difference between NMI and centre measured outputs. The use of a single absorbed dose based MV CoP, introduced just prior to the start of these audits, has contributed to the improved consistency demonstrated in these results. This not only shows the impact of a rigorous traceability chain developed by close collaboration between NMI and end users but also demonstrates that the NMI audit programme is likely to be a contributing factor to this improvement in consistency in dosimetry nationally.

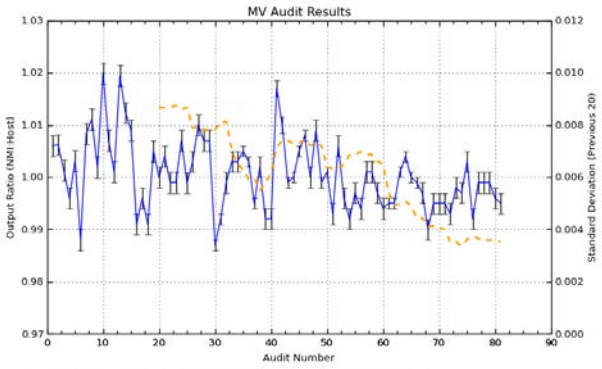

Figure 1: MV photon audit results plotted in order of completion (solid blue line). The running standard deviation of the previous 20 results shows a steady reduction in variation (dashed orange line).

EP-1936

Dose plan quality in the DBCG HYPO trial: an evaluation based on all treatment plans in the study

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Purpose or Objective: In the DBCG HYPO trial a number of radiation therapy (RT) parameters were prospectively determined for each individual treatment plan. These parameters were reported to a database and analyzed to determine the plan quality in the trial.

Material and Methods: Patients (pts) for breast-only RT after surgery for early node-negative breast cancer from 8 RT centre in 3 countries were included in the trial between May 2009 and March 2014. They were randomized to either 40 Gy/15 fx or 50 Gy/25 fx. A number of plan-quality parameters such as doses to CTV-breast and organs at risk were determined for each plan. The use of respiratory gating during treatment was reported. Definitions on compliance to protocol guidelines, as well as minor and major deviations (Table 1) were agreed upon before trial start. After closing the trial, the QA parameters were analyzed and scored.