Qualifying the use of RIS data for patient dose audit by comparison with DICOM header data

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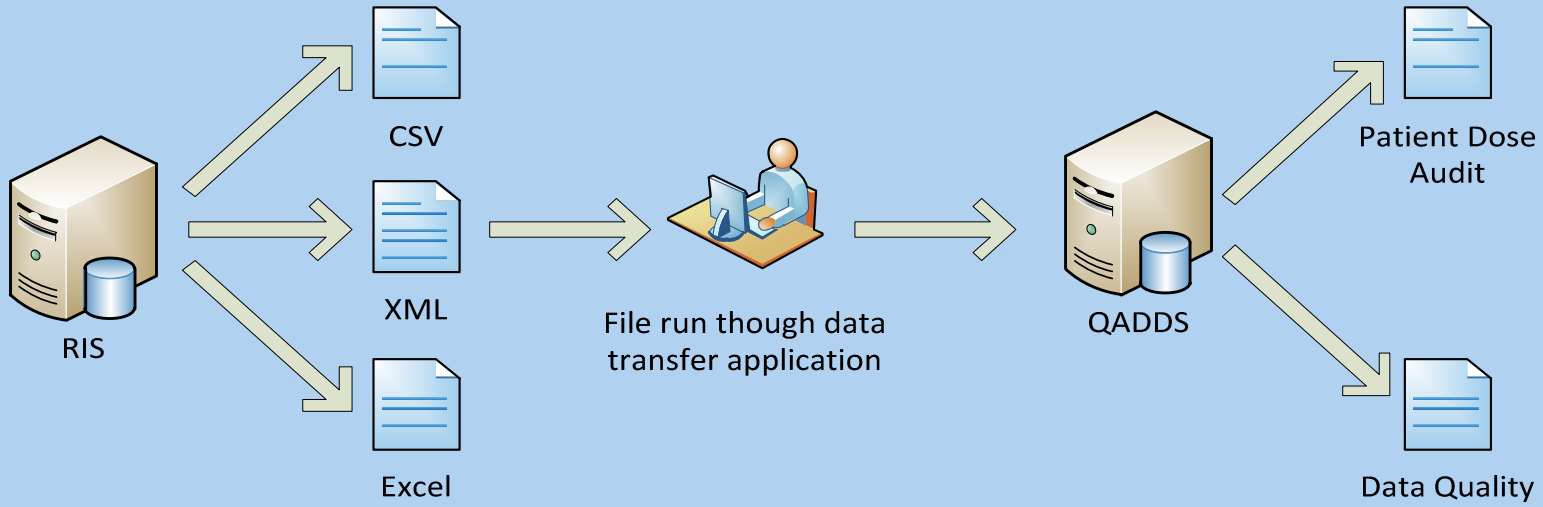
Introduction

A system was developed in 2008 to calculate patient doses using Radiology Information System (RIS) data and present this data as a patient dose audit. The results of this project were presented at meetings in 2008 and 2009. A file containing the RIS data was exported from RIS and sent to IRS. Here, it was run through a bespoke system and entered into QADDS: IRS's system for storing patient dose and QA data (www.qadds.co.uk) before being audited. A report on the quality of the data is produced in conjunction with the dose audit.



Data flow with current dose audit procedure

Introduction

One of the issues with this system was the quality of user entered data, as highlighted by the data quality reports produced by the system (which used departmental guidelines and the bounds of individual equipment as a basis for deciding whether an entry was suspect or impossible and therefore erroneous).

Also, IRS work towards a 'Gold-Standard' for patient dose records which would include the following data fields

- **Date**
- Patient ID
- **Gender**
- **Age**
- Size
- Height
- Weight
- **Examination**
- **Projection**
- **kV**
- **mAs**
- Focus
- FSD
- **Tube Room**
- Operator

However it is often the case that some of these fields will not be present in RIS, or may not be filled in routinely. Therefore the absolute minimum set of fields required to include a record as part of an audit was defined (shown in bold)

Purpose

Missing or erroneous data entry is one of the issues that will always be present when human input to a system is required. Does this missing or erroneous data have an impact upon the audits carried out using RIS data?

It has been shown that DICOM header data can be used to perform dose audits with a high level of data accuracy where dose data is taken directly from the detector automatically.

This study aims to show that using RIS data for dose audits is not only a viable alternative to using DICOM header data, but that it has advantages.

Method

A new system was developed to pull header data from DICOM images easily.

One of the initial hurdles was getting access to the DICOM images before they were stored in PACS. The images could have been pulled from PACS onto a CD/DVD, but for the size of study required, this was impractical. The manufacturer of the CR solution at a local hospital site was reluctant to have 3rd party software installed on the modality workstation but stated that a legacy machine still had DICOM images sent to it and that they would be happy to have the software installed on there.

Data was recovered for a common set of examinations using both RIS and DICOM header data. The data was compared on a result-by-result basis to check for consistency of common fields between RIS and DICOM, as well as assessing the value of data fields uncommon to both systems. (For instance, could any of the 'Gold Standard' fields missing in RIS be found in DICOM?).

Ease of access to the data was also taken into consideration.

The data comprised of 1470 records and was from a single room and contains the examinations that are included within a standard dose audit.

Results

Presented here are the findings of the comparison between the RIS & DICOM data. The table shows the comparison of the different factors needed to perform a dose audit focusing kV, mAs & DAP. The data shows how many of each parameter were present in RIS & DICOM, the percentage in both RIS & DICOM, the accuracy of RIS data compared to DICOM and the mean difference between RIS & DICOM where one existed.

Parameter	Present in RIS	Present in DICOM	% in DICOM & RIS	Accuracy	Mean Difference
kV	1210	1470	82.3	95.2	18.5
mAs	1209	1470	82.2	91.5	24
DAP	252	1338	18.8	98	0.8

Obviously the first thing that stands out about the results is the poor percentage of DAP values recorded in the RIS. It could be argued however, that 252 records is still a good amount to audit against, especially when guidelines suggest a minimum of 10 records per examination is required. Also worthy of note is that not all DAPs were recorded in the DICOM data. This was due to a technical fault that required an engineer to fix.

Numbers for kV & mAs are high and would provide plenty of data to audit against.

Results

The next thing to consider is the accuracy of the data. kV was 95% accurate with a mean difference between RIS & DICOM of 18.5 where a difference existed (0.8 across all values). Most of the differences seem to have been caused by mistyping (e.g. Entering 25 instead of 125). Where instances like this occur, the errors can be easily spotted and omitted from the audit.

mAs accuracy was 91.5 % with a mean difference of 24 (2.2 across all values) and again any obvious rogue values could be easily caught.

DAP has a very high level of accuracy with 98% and a mean difference of 0.8 (0.04 across all values)

When considering the length of this study and that dose audits are only required to be carried out every 3 years, we can see that RIS would provide more than enough data, even on sites where DAP is not being logged as routinely as kV & mAs. The high levels of data accuracy show that we can have confidence in the data contained within RIS (whilst bearing in mind that mistakes are bound to happen, and spotting them wherever possible)

The logging of and accuracy of the data in RIS could be greatly improved by using Modality Performed Procedure Step (MPPS) which would take DICOM data and send it to a corresponding record in RIS.

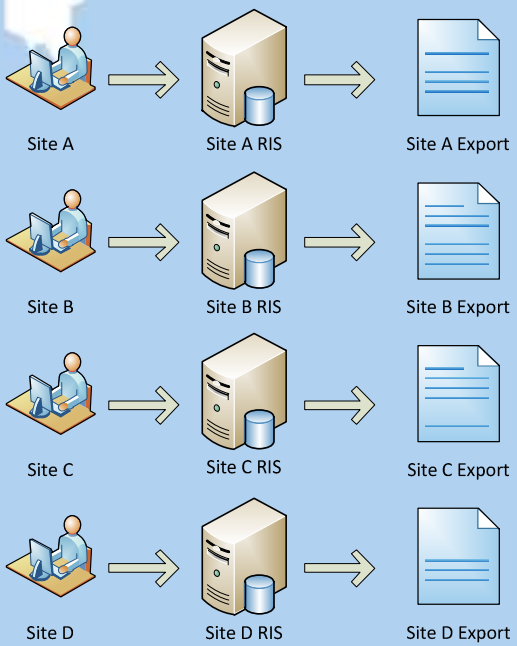
Results

Accuracy of the data is not the only thing to take into consideration. No additional fields from the 'Gold Standard' were found within DICOM. It was shown that RIS can provide fields that allow for clinical audit (Are exposures being justified? Are pregnancies being checked for before exposure? etc.) Whilst the DICOM specification does provide a tag for a pregnancy check, for instance, it was not present in the files from this study.

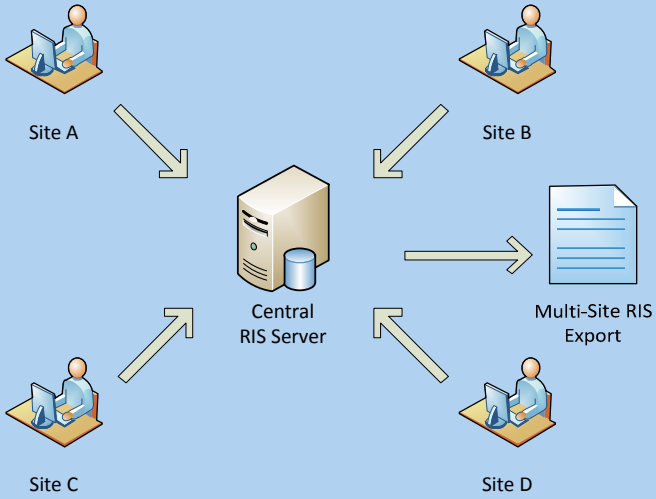
As well as this, the ease of access to the data is a very big concern when looking to roll out a patient dose audit program. In general RIS data has been much easier to gain access to. By their very nature, DICOM headers are stored inside a flat file rather than in individual data fields within a database. In order to gain access to the header data, the individual files themselves need to be interrogated. This means either having a system like the one used in this study, which would not be possible in every location, or retrieving images from PACS and putting them on media such as CD/DVD for interrogation. For an audit that may contain 100,000+ records (as is currently the case using RIS) this would be very impractical.

Results

Conversely, RIS data is held within a relational database structure meaning that it is much easier to export the data. Indeed, it is possible to collect data for many sites in a single export from a RIS database with certain RIS manufacturers moving their data storage off-site from hospitals to a centrally managed location.



Sites with on-site RIS



Sites with off-site RIS

Conclusions

This study shows that using RIS is a useful tool for carrying out patient dose audits and that it is an alternative to using DICOM header data. Access to RIS data was much easier and with manufacturers looking to centralize data storage, multiple sites' data can be accessed simultaneously. Problems with data accuracy could be mostly solved by using Modality Performed Procedure Step (MPPS) which would share accurate DICOM exposure data with RIS.

This would in essence provide a 'best of both worlds' solution where the greater data accuracy of 'straight from the detector' DICOM data meets the ease of access of RIS to provide access to millions of accurate patient dose records.

Even without MPPS, the shear weight of numbers means that there will be adequate records available from RIS to produce a dose audit once erroneous data has been filtered.