Dose Tracking Software: the experience of Pisa University Hospital

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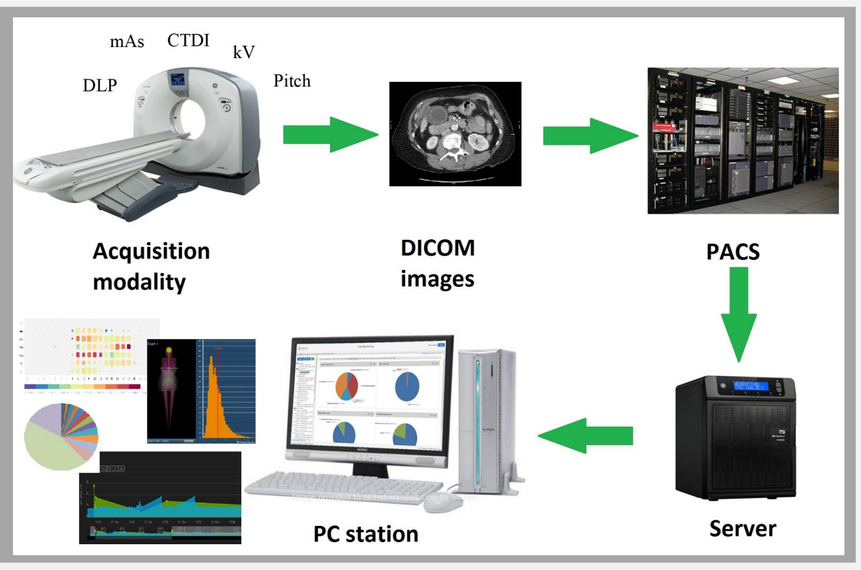
INTRODUCTION

Medical imaging with ionizing radiation is the non-invasive technique most widely used to identify internal injuries and lesions and effective doses given in a single medical imaging exposure are universally within the low-dose range (<100 mSv). Risks associated to ionizing radiation from medical imaging techniques have focused the attention of medical society and general population and some recent epidemiological studies showed an increased incidence of cancer in patients who underwent to radiological examinations [1]. Therefore, it is necessary to balance the benefit/detriment relationship of such examinations in order to establish the conditions under which its use is justified. Constant and systematic monitoring of radiation dose is indispensable in order to increase the quality of radiological services to patients.

Dose Monitoring Software

The purpose of dose tracking is to strengthen the process of justification and optimization with the intent to achieve better protection of patient [2]. Constant and systematic monitoring of radiation dose is indispensable in order to reduce the dose given to patients in every examination without impairing its diagnostic quality, according to the ALARA (As Low As Reasonably Achievable) principle. Dose monitoring can lead to performance control, protocol optimization and rapid correction of wrong practices. Lawmakers are interested in monitoring and reducing radiation doses, as shown by the newly published European Directive EURATOM/59/2013 that contains more stringent radiation protection rules, especially concerning patients' protection. In particular, the European Directive requires that patients are informed about the risk associated with ionizing radiation, and that detailed information about radiation dose is included in every procedure's report. In the last few years, most vendors already provide means to track patient exposure history with new software tools that can automatically retrieve, store and analyze dosimetric data stored in a Picture Archiving and Communication System (PACS). These software can be installed on hospital networks, and are in most cases web-based, ensuring easy access to all authorized users.

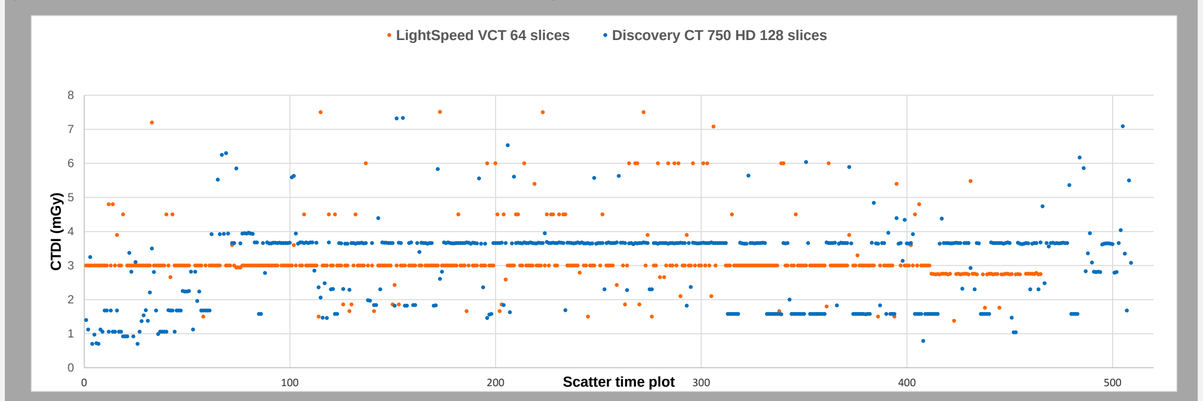


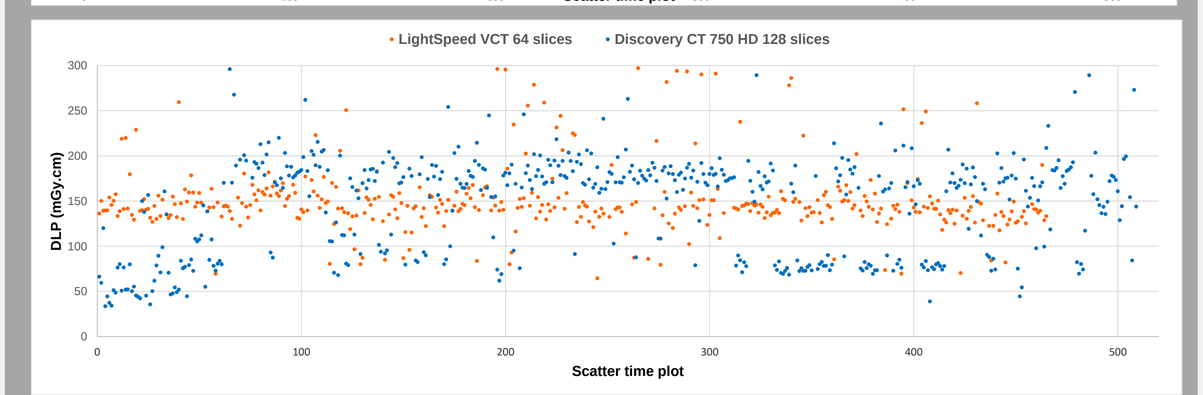
METHODS

In Pisa University Hospital we established a multidisciplinary dose team composed of radiologists, technologists, engineers and physicists, and recently started to evaluate some commercially available dose management systems. Thanks to dose monitoring software, our dose team recovered and analyzed from 1st January 2014 up to now more than 130,000 TC scans, about 7,000 mammography procedures and nearly 123,000 traditional radiography exams.

TC Colonography

In particular, the first dataset we analyzed concerned CT colonography. CT colonography or virtual colonoscopy is a low dose CT procedure that can be used as a screening test for colon cancer. Two different scanners were employed for virtual colonoscopy, a GE Discovery CT 750 HD 128 slices with iterative reconstruction algorithms and a GE LightSpeed VCT 64 slices. We conducted a retrospective analysis of TC colonography executed between 1st April 2012 and 9th April 2014 in order to compare the performances of this two devices. Were collected CTDIvol and DLP values from 974 exams, 465 of which from TC LightSpeed VCT 64 slices and 509 from Discovery CT 750 HD 128 slices. As shown below, despite what we expected the CTDIvol and DLP values are higher in exams performed with the well-performance 128 slices device with respect to 64 slices device.





In this table is possible to see median, 25th percentile and 75th percentile values of CTDIvol and DLP for two modalities. This difference in radiation dose is due to technical parameters used for the acquisition.

		LightSpeed VCT 64 slices	Discovery CT 750 HD 128 slices
CTDIvol (mGy)	25° perc	3,00	1,82
	median	3,00	3,65
	75° perc	3,00	3,66
DLP (mGy.cm	25° perc	137	89
	median	146	169
	75° perc	166	185

TC colonography protocols BMI<30:

- GE Discovery CT 750 HD 128 slices 120 kV tube voltage, 50 mA tube current, 0.7 ms tube rotation time;
-GE LightSpeed VCT 64 slices 120 kV tube voltage, 50 mA tube current, 0.5 ms tube rotation time.

The result of this audit was submitted to the attention of the radiological team and it emerged from discussion that was needed to optimize CT colonography protocols in effort to limit radiation dose in 128 slices TC.

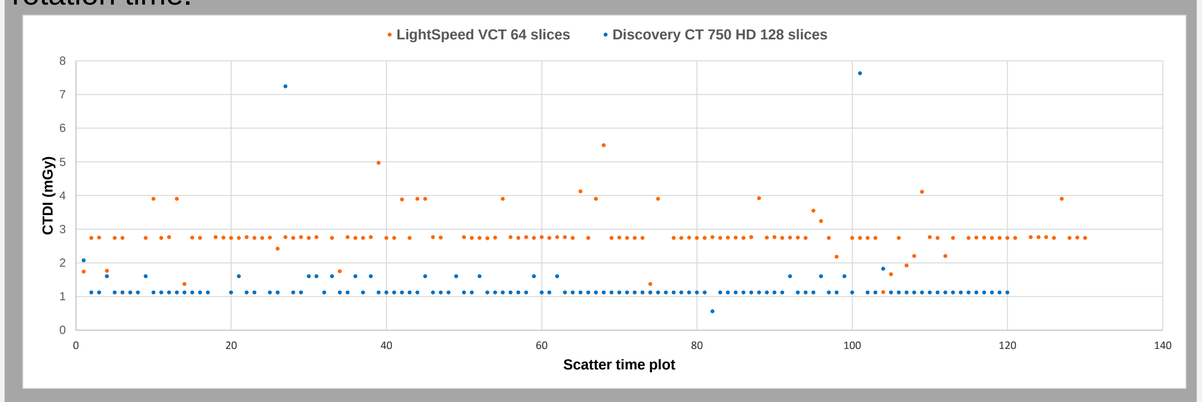
RESULTS

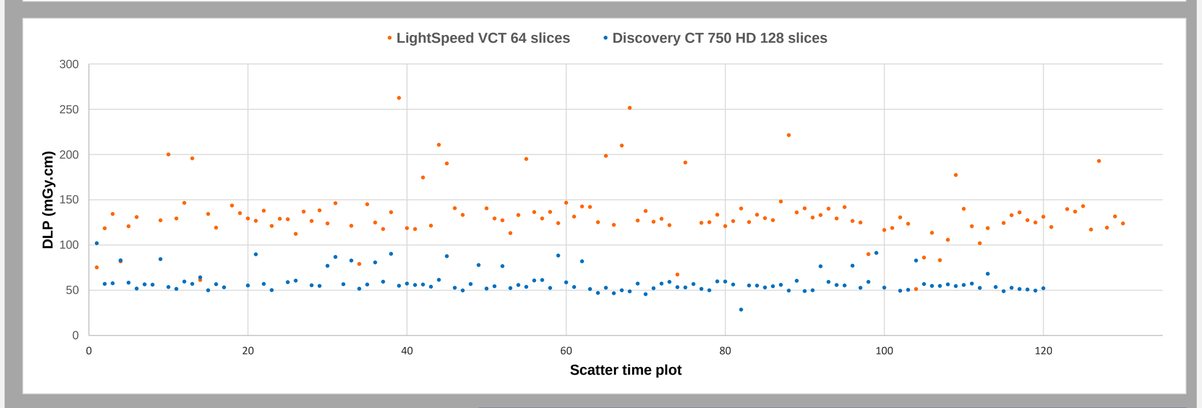
CT colonography protocols were progressively revised through continuous feedback among all involved staff technologists and radiologists by keeping track of radiation dose and image quality for every CT examination.

After six months were collected TC colonography data executed between 10th April 2014 and 24th October 2014 to a total of 250 exams, 130 from LightSpeed VCT 64-MDCT and 120 from Discovery 750 HD 128-MDCT. After protocol optimization, dose values significantly decreased: the reduction in radiation dose was associated with a reduction in tube current and tube rotation time settings used for CT examinations.

TC colonography protocols BMI<30:

- GE Discovery CT 750 HD 128 slices 120 kV tube voltage, 20 mA tube current, 0.5 ms tube rotation time;
-GE LightSpeed VCT 64 slices 120 kV tube voltage, 50 mA tube current, 0.5 ms tube rotation time.





It is clear a reversal of radiation dose tendency and now the whole of exams performed by GE Discovery CT 750 HD supply a minor quantity of radiation dose than GE LightSpeed VCT 64. In 128-MDCT there was a significant Reduction in median CTDIvol and DLP values of respectively 69% and 67%. Dose monitoring software represents an essential part of radiologic quality management by allowing the systematic control of dose performances, by contributing to the reduction of wrong practices, and by supporting protocol optimization. Radiological staff training and protocol optimization were used to ensure a better homogeneity of dosimetric values in TC exams and to minimize the variability which is clinically not justified.

		LightSpeed VCT 64 slices	Discovery CT 750 HD 128 slices
CTDIvol (mGy)	25° perc	2,74	1,12
	median	2,74	1,12
	75° perc	2,76	1,12
DLP (mGy.cm)	25° perc	123	73
	median	130	56
	75° perc	142	60

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