



## Health Staff Perceptions on Ongoing Dose Management Project

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## Background/introduction

Modern medical imaging requires a benefit to risk balance between the diagnostic capabilities of Computerized Tomography (CT) and the ionizing radiation potential risks associated with it. Due to its advantages of ease of access, speed and consistency of results, CT use has been increasing, and as such, also radiation exposure (1,2). With the objective of patient safety and an adequate benefit to risk assessment, an approach based on Justification, Standardization and Optimization of examinations is to be implemented (1) and has been promoted by radiology societies, namely through programs such as EuroSafe imaging. Furthermore, a more systemic approach to radiation exposure monitoring has been developed with the use of automated solutions (radiation Tracking Software) that register, monitor and evaluate big data related to radiation exposure (2,3). This is critical for the reduction of radiation dose, wherever required, through the standardization of practice and optimization of protocols (1-3). These systems also allow the tracking of patient cumulative radiation dose and alerts for high dose levels of radiation through the setting of thresholds (2,3). The organization and coordination of activities to implement such a dose management program and the routine use of an automated software, require considerable resources and are dependent on the collaboration between health professionals, with radiographers being the main users of the systems in their daily practice. It is therefore important to understand the perception of radiographers on dose management programs, specifically on perceived impact of the automated dose management software on daily workflow and potential advantages of its use.

## Description of activity and work performed

The goal of this study was the preliminary evaluation of the perception of radiographers, engaged in a dose management program, on the impact of an automated dose management software on the daily workflow and whether the perception of the potential advantages of the dose management program and software correlated with the perceived impact on daily workflow.

A survey for radiographers working in CT departments in 6 different outpatient radiology facilities implementing a common dose management program (Dose Excellence Project - DEP), for at least two years, using an automated software (DoseWatch, GE Healthcare, Milwaukee Wis. USA). The DEP team has a national project leader and each radiology facility has a radiographer appointed as the DEP contact person. DEP was implemented using a centrally-defined basic framework adapted to local circumstances and practices. The average number of CT examinations in the radiology facilities in 2018 was 8605 (SD: 3835; Median: 7609). 6 CT scanners were used, a GE Revolution EVO 128SLC (GE Healthcare, Milwaukee Wis. USA), a GE BrightSpeed 16SLC (GE Healthcare), a Siemens Somatom Sensation 64 SLC (Siemens Healthineers, Erlangen, Germany), a GE Optima 660 64 SLC (GE Healthcare), a Philips Brilliance 64 SLC (Philips Medical Systems, Amsterdam, Netherlands) and a Philips Ingenuity Core 64SLC (Philips Medical Systems).

An online questionnaire was sent to the 28 radiographers working in CT department and participating in the DEP team. The participation to the survey was anonymous and voluntary. The final received responses were 25. The characteristics of the sample, including relevant working experience, are described in **table 1 Fig. 1 on page 5** .

### Methods and measurements

This survey was developed for this study by the authors and based on the authors knowledge, this is a unique study and, to our knowledge, the first publication on the perception of radiographers on the use of a dose management software and the potential advantages of a dose management program. Two of the authors are radiographers participating in DEP, who were involved in the questionnaire preparation, and did not take part in the survey. The survey included a questionnaire with demographic questions such as gender and age group, as well as relevant working experience and workload (**table 1) Fig. 1 on page 5**. It was also composed by a set of questions on the potential advantages of an automated dose tracking software in a dose management program and on the perceived impact of the software in daily workflow (**table 2) Fig. 2 on page**

5 . Apart from a descriptive analysis, a statistical analysis (Spearman's Rho bilateral correlation) was performed between perceived impact on workflow, perceived benefit to patients and workload (number of patients per CT shift).

## Results:

Almost all radiographers (24/25) considered to have at minimum a reasonable knowledge of what DoseWatch is, used it at least a moderate number of times and considered its use to have only minimal or no impact on daily workflow, thus being able to perform all CT duties in a safely and timely manner. Also, all 25 respondents answered that time spent on each patient for DEP 'activities' (such as Alert Justification) was under 5 minutes, with 23 answering less than 2 minutes. When estimating the benefit of the use of DoseWatch to patients, 23 respondents considered it to have at least a moderate benefit. No respondent answered its use to be harmful. A greater variability was observed when considering the advantages of the use of DoseWatch in a well justified and individually tailored optimized CT examination (question 7). 12 out of 25 respondents answered that it is fundamental, 7 out of 25 that there is of a moderate benefit, 2 out of 25 that there are slight advantages and 4 out of 25 that the use of DoseWatch is neutral in this setting. In addition, almost all of the respondents (23 out of 25) perception was that radiation dose of the majority of CT examinations performed in their facilities were within national Dose Reference Levels (DRLs) (**table 3**) [Fig. 3](#) on page 6 (4).

For a 0.05 significance level, a statistically significant ( $r=-0.441$ ;  $p=0.027$ ) negative correlation was found between perceived impact on workflow and perceived benefit for patients. This means that the impact on workflow is negatively associated to higher benefit for patients (**table 4**) [Fig. 4](#) on page 6 . Other analyzed correlations did not have statistical significance. The negative correlation between perceived benefit to patients and workload, was approaching the significance level ( $r=-0.381$ ;  $p=0.06$ ). It is possible that a larger sample might corroborate this correlation, especially if a unilateral assumption (higher benefit correlates with lower workload) is considered. The positive correlation between perceived impact in workload and number of patients per shift was not significant ( $r=0.249$ ;  $p=0.23$ ), although it is possible that the latter is associated with the small sample and the relatively small proportion (7/25) of very high-volume (more than 30 patients per shift) workloads. Further studies with larger samples would be useful to evaluate this correlation.

## Images for this section:

Sample characteristics (N=25)		
Characteristics	Responses	
	Percentage	Number
<b>Gender</b>		
female	64%	16
male	36%	9
<b>Age Group (y)</b>		
20-30y	24%	6
31-40y	56%	14
41-50y	12%	3
51-60y	8%	2
>60y	0%	0
<b>Working experience as a qualified radiographer (y)</b>		
<5y	8%	2
5-10y	24%	6
>10y	68%	17
<b>Working experience on CT</b>		
<5y	36%	9
5-10y	28%	7
>10y	36%	9
<b>Number of CT shifts per week (independently of employer or location)</b>		
<1 shift	8%	2
1-3 shifts	32%	8
4-6 shifts	44%	11
>6 shifts	16%	4
<b>Average duration of a CT shift</b>		
<4h	0%	0
4-6h	44%	11
>6h	56%	14
<b>Number of patients per CT shift</b>		
<10	0%	0
10-20	32%	8
21-30	40%	10
>30	28%	7

Fig 1: Table 1. Samples's characteristics and summary working experience.

N=number of participants. Y=years. CT= computer tomography

**Fig. 1:** Fig 1: sample's characteristics and summary working experience

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**Fig 2: table 2. Questions in the survey related to Dose watch and workflow**

- Q1: How do you consider your knowledge of Radiation Protection?
- Q2: Do you know what Dosewatch software is (from the user perspective)?
- Q3: As a Radiology Technologist in CT, are you a User of a Dosewatch software in any Affidea Clinic?
- Q4: Which are, in your opinion, the major advantages of the DoseWatch software (select all that apply)?
- Q5: Which is, in your opinion, the major negative impact or limitations in your workflow in a CT shift that come from the use of a Dosewatch software?
- Q6: Does the use of a DoseWatch software benefits patients in your practice?
- Q7: In a well justified examination, where the patient is correctly centered and pitch, dose modulation and iterative reconstruct are appropriately set, are there any advantages in the use of DoseWatch software?
- Q8: Do you believe that radiation exposure in CT examinations in your practice are on average within recommended values (DRL)?
- Q9: For how many years are you participating in the DEP project?
- Q10: How much time do you spend in each patient with DEP activities (such as Alert justification)?
- Q11: In your opinion, a Dose management program is more important to (choose all that apply)?

**Fig. 2:** Fig 2:questions in the survey related to DoseWatch<sup>TM</sup> and workflow

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Dose descriptor: CT DIvol (mGy)				
Body region	Affidea centers in study		Portuguese CT DRL's *	
	75th percentile	standard deviation	Mean	75th percentile
Lumbar	23.8	8.0	34.6	38.4
Head	47.6	8.4	69.9	75.0
Chest	7.3	2.1	12.4	13.6
Abdomen	12.5	2.4	13.9	18.3

Fig 3:Table 3. 75th percentil CT DIvol (mGy) with Standard deviation in 6 clinical centers involved in DEP and Portuguese CT DIvol in adults. Values are for descriptive purpose only, using 75th percentile, considering scanner variation and non stratification of patient characteristics

\* Adapted with permission from Santos et al. The establishment of computed tomography diagnostic reference levels in Portugal. Radiation protection Dosimetry (2014).

**Fig. 3:** Fig 3: 75th percentil CT DIvol (mGy) with Standard deviation in 6 clinical centers involved in DEP and Portuguese CT DIvol in adults. Values are for descriptive purpose only, using 75th percentile, due to scanner variation and non stratification of patient characteristics

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Spearman's Rho		Which are, in your opinion, the major negative impact or limitations in your workflow in a CT shift that come from the use of a DoseWatch software?	Does the use of a DoseWatch software benefits patients in your practice?	How many patients per shift do you perform CT?
Which are, in your opinion, the major negative impact or limitations in your workflow in a CT shift that come from the use of a DoseWatch software?	Correlation Coefficient	1	-0,441	0,249
	Significance (bilateral)		0,027	0,23
	N	25	25	25
Does the use of a DoseWatch software benefits patients in your practice?	Correlation Coefficient	-0,441	1	-0,381
	Significance (bilateral)	0,027		0,06
	N	25	25	25
How many patients per shift do you perform CT?	Correlation Coefficient	0,249	-0,381	1
	Significance (bilateral)	0,23	0,06	
	N	25	25	25

Figure 4: table 4. Spearman's correlation rank coefficient between perceived impact on workflow, perceived benefit for patients from Dosewatch and workload per shift in number of patients. Correlation is significant at 0,05 (bilateral).

**Fig. 4:** Fig 4: Spearman's correlation rank coefficient between perceived impact on workflow, perceived benefit for patients from Dosewatch™ and workload per shift in number of patients. Correlation is significant at 0,05 (bilateral).

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## Conclusion and recommendations

Radiographers considered the dose management program and use of DoseWatch of significant benefit for patients, and that average DRLs were within national levels. Impact on workflow was considered minimal or non-existent. The results suggest that the negative correlation between the perception of benefit to patients from DoseWatch use and perceived impact on workflow should be considered when implementing and evaluating dose management programs.

Time spent for DoseWatch 'activities' (such as Alert Justification) per patient was considered by most radiographers to be less than 5 minutes, with the majority to be less than 2 minutes. This may be considered as an adequate time spent for such activities, when introducing such programs. Time needed to allocate for this activity will nevertheless depend on the workload of the CT department and ratio of examinations with high dose level alerts and need for justification.

Considering the limitations resulting from the small sample, further studies could investigate related topics addressed in more depth.

## Personal/organisational information

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