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CT Scanners – Mapping sensitive functions and alarms

In March 2018, inappropriate use of the "1 more" function of a General Electric computed tomography (CT) scanner resulted in extremely significant overexposure (> 1 Gy) of a pregnant patient and her future child during a diagnostic CT examination.

To prevent the recurrence of this type of incident, ASN set up a working group (WG) with the radiology professionals to inventory the sensitive functions available on the CT scanners installed in France and their available alarm modes.

Increasing vigilance with regard to sensitive functions, such as the "1 more" feature

In order to enhance user's vigilance, the WG decided to draw up a list of the available CT scanner functions that are sensitive in terms of the radiation exposure risk. By "sensitive" we mean the CT scanner utilisation's modes that induce **multiple** acquisitions on a **given anatomical area** of the patient and can therefore potentially lead to **high doses to the skin** and the subjacent organs. This initial inventory was drawn up by the physicists of the WG representing IRSN (French Institute for Radiation Protection and Nuclear Safety) and the SFPM (French Society of Medical Physics). Table 1 below summarises the four main functions identified, their area of use and the commercial names specific to each CT scanner manufacturer.

Table 1: Sensitive functions

Function	Area of use	Commercial name by manufacturer			
		GE	Siemens	Philips	Toshiba/Canon
Acquisition extension over a given anatomical area	All	<i>One more</i>	<i>Function not available</i>	<i>Extend</i>	<i>Confirm</i>
Detection and tracking of bolus of contrast agent to trigger automatic acquisition	Examinations injected with arterial and/or portal phase	<i>SmartPrep</i>	<i>Bolus Tracking/ Test Bolus</i>	<i>Bolus Tracking</i>	<i>SURE Start</i>
Acquisition in cine/shuttle mode	Dynamic imaging (perfusion, etc.)	<i>Volume Shuttle/ Volume Helical Shuttle/ Cine</i>	<i>Perfusion/ Adaptive 4D spiral</i>	<i>Perfusion/ Mode Jog</i>	<i>Perfusion 2D/ Wide Volume/ Shuttle Helical</i>
Guidance acquisition	Interventional CT scanner	<i>SmartStep/ SmartView/ SmartView 2D&3D</i>	<i>i-sequence/ i-fluoro/ i-spiral/ CareVision...</i>	<i>CT Fluoroscopy</i>	<i>SURE Fluoro</i>

Two types of alarm parameters to set

As part of its contribution to the WG, the SFPM also conducted an internal survey to determine how the professionals use the alarms available on the CT scanners. The results indicate that further to the above mentioned significant radiation protection event (ESR), the alarm parameters are used to a greater extent (by 75% of the teams compared with 47% beforehand). The physicists of the WG drew up an initial inventory, in the same way as for the sensitive functions. The various manufacturers were then contacted in order to find out the maximum setting values for these alarms (generic term), which are set out in the table below.

NV (Notification Value): Relates to an acquisition and is not blocking.

AV (Alert Value): Relates to the entire dose received during an examination and can be blocking on certain manufacturers' machines (GE for example). In this case, a password must be entered to override the blocking.

With other manufacturers, the alert is not necessarily blocking; prior alert windows are displayed and require user identification to override the alert and track the user.

Table 2: Great variability in maximum alarm thresholds between manufacturers

		GE	SIEMENS	PHILIPS	TOSHIBA/CANON
NV	CTDI [mGy]	2 000	2 000	no limit	999 999
	DLP [mGy.cm]	400 000	99 999	no limit	999 999
AV	CTDI [mGy]	2 000	2 000	9 999	2 000
	DLP [mGy.cm]	400 000	99 999	9 999	999 999
	Paediatrics avail.	yes	yes	No	yes
	Log file export	yes	yes, monthly	yes, monthly	yes, daily
	Password	obligatory	possible	possible	possible

Conclusion: barriers need to be reinforced

✚ The WG found that the data obtained from the manufacturers on the conditions of setting sensitive function parameters are heterogeneous and too imprecise to help the users "render safe" their utilisation.

Furthermore, the increased utilisation of the alarms observed since the ESR is not an effective defence barrier because the maximum thresholds are too high and they differ from one manufacturer to another. In addition, there is a lack of data in the literature to use as a basis for defining notification and alert values that are appropriate for the practices and protocols.

✚ **The WG recommends that users of "sensitive" functions as defined herein check the parameter settings on each CT scanner and do so in consultation with their supplier, in order to use them as safely as possible.**

✚ **To take things further, the WG recommends raising the awareness of manufacturers across Europe, notably in collaboration with HERCA and the European Medicines Agency. The aim is to bring additional barriers by providing users with precise and comprehensive information for an appropriate use of the parameters of sensitive functions and of the notification and alert conditions and values.**