

6/3020/2018

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Translation. Original text in Finnish.

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Reference levels for the patient's radiation exposure for conventional paediatric X-ray examinations

The responsible party's (party running a radiation practice) duty to introduce reference levels for X-ray examinations is laid down in the Decree of the Ministry of Social Affairs and Health on the medical use of radiation (423/2000). The Decree also prescribes that the reference levels for the most common examinations are issued by the Radiation and Nuclear Safety Authority. The provisions concerning reference levels and introducing them into practice are laid down in Sections 2, 16 and 17 of the Decree.

This decision issues the reference levels for the panoramic tomography examinations of children's teeth and jaws as well as for paediatric chest X-ray examinations. Table 1 shows the reference levels for panoramic tomography examinations of children's teeth and jaws, and Table 2 shows the equations for the reference level curves for paediatric chest X-ray examinations. The reference levels given in Table 2 apply only to examinations carried out in a standing or sitting position.

In addition, Tables 3 and 4 show the dose levels achievable with X-ray equipment with flat panel detectors, illustrating the dose levels that can be achieved through the use of X-ray devices equipped with flat panel detector technology.

Figures 1 and 2 are graphs showing the reference levels of chest X-ray examinations in AP (or PA) and LAT projections as dose-area products (DAP) as a function of the patient's weight.

Responsible parties must introduce into practice either the reference levels given in Tables 1 and 2 or stricter values of their own. A responsible party may also determine reference levels for its own use for examinations for which no reference levels have been provided.

This decision comes into force on 1 May 2018. This decision repeals the decision 26/310/05 by the Radiation and Nuclear Safety Authority on reference levels issued on 28 December 2005.

Director General

Petteri Tiippana

Director

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Appendix

Instructions: Reference levels for the patient's radiation exposure for conventional paediatric X-ray examinations

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Table 1. Reference level as a dose-area product for panoramic tomography of children's teeth and jaws for different age groups.

Examination	Age group [years]	Dose-area product (DAP) ^{*)} [mGy · cm ²]
Panoramic tomography of teeth and jaws	5–9	55
	10–16	75
*) Product of the cross-section dose and area of the radiation beam (DAP).		

Table 2. Reference level curve equations as a function of the patient's weight for paediatric chest X-ray examinations.

Examination	Reference level curve equation ^{*)}
Thorax AP/PA	$y = 4.0196 \cdot e^{0.0382 \cdot x}$
Thorax LAT	$y = 5.002 \cdot e^{0.0430 \cdot x}$
*) where y is the radiation beam cross-section dose-area product DAP [mGy·cm ²] and x is the patient's weight [kg]	

Table 3. Achievable dose levels for panoramic tomography of the teeth and jaws as a dose-area product for different age groups of children.

Examination	Age group [years]	Dose-area product (DAP) ^{*)} [mGy · cm ²]
Panoramic tomography of teeth and jaws	5–9	45
	10–16	55
*) Product of the cross-section dose and area of the radiation beam (DAP).		

Table 4. Equations for the achievable dose level curves as a function of the patient's weight for paediatric chest X-ray examinations.

Examination	Equation for the achievable level curve ^{*)}
Thorax AP/PA	$y = 2.3702 \cdot e^{0.0413 \cdot x}$
Thorax LAT	$y = 2.7869 \cdot e^{0.0467 \cdot x}$
*) where y is the radiation beam cross-section dose-area product DAP [mGy·cm ²] and x is the patient's weight [kg]	

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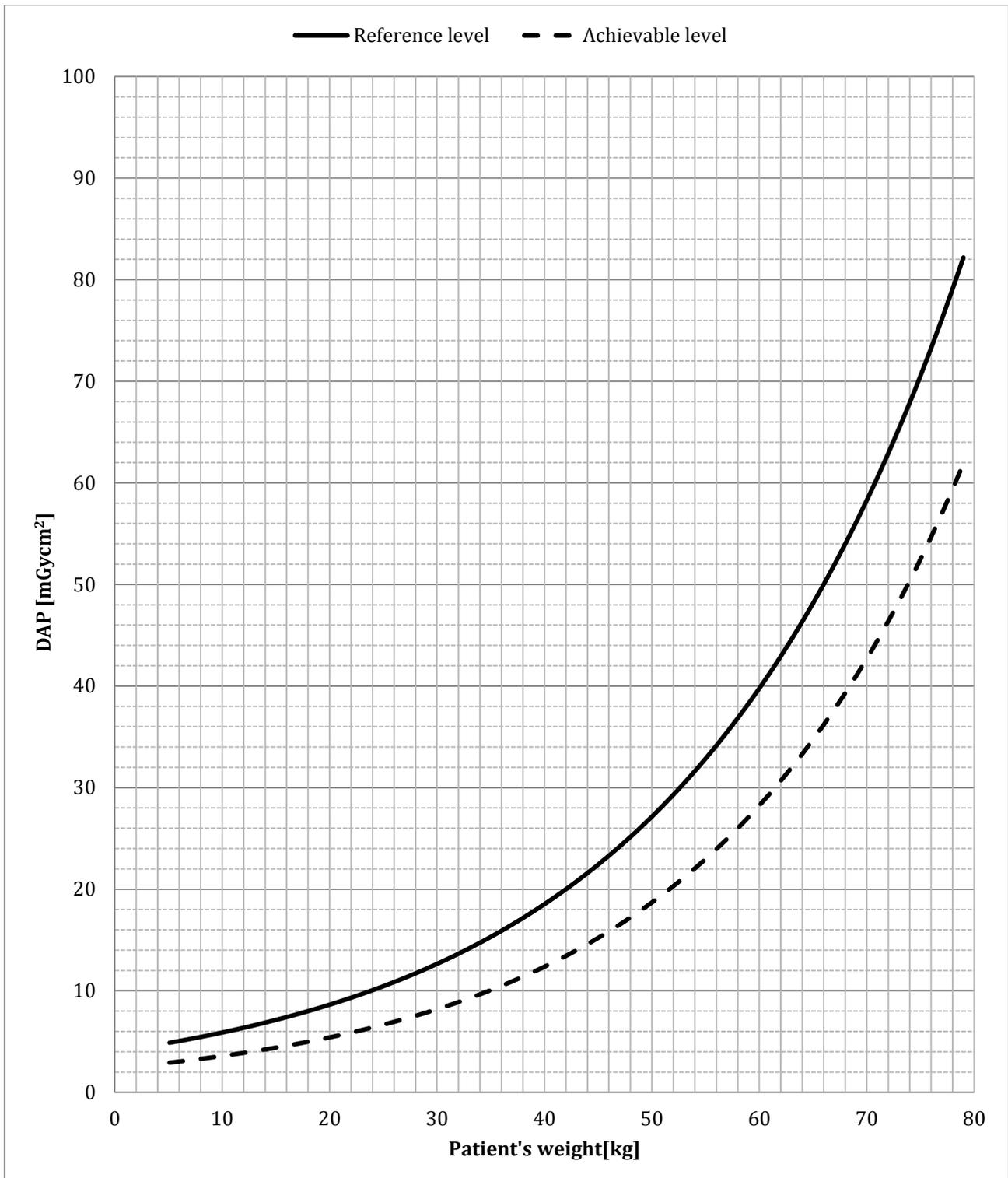


Figure 1: Reference level curve for chest X-ray examination and achievable dose level curve in the AP/PA projection as a dose-area product (DAP) as a function of the patient's weight. The equation for the reference level curve is $y = 4.0196 \cdot e^{0.0382 \cdot x}$ and for the achievable dose level curve $y = 2.3702 \cdot e^{0.0413 \cdot x}$.

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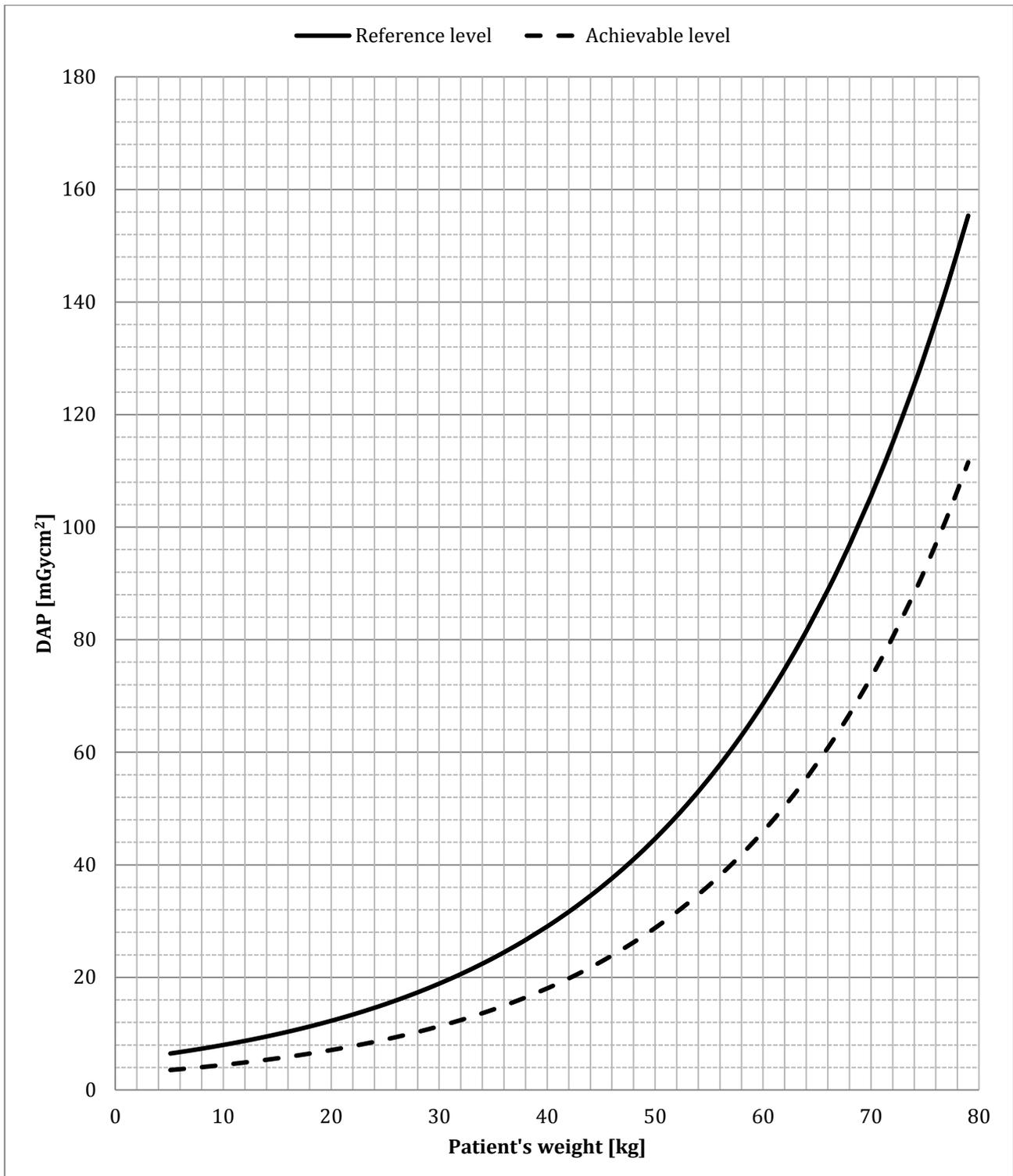


Figure 2: Reference level curve for chest X-ray examination and achievable dose level curve in the LAT projection as a dose-area product (DAP) as a function of the patient's weight. The equation for the reference level curve is $y = 5.002 \cdot e^{0.0430 \cdot x}$ and for the achievable dose level curve $y = 2.7869 \cdot e^{0.0467 \cdot x}$.

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Reference levels for the patient's radiation exposure for conventional paediatric X-ray examinations

Definition of the reference level

Reference level refers to a predetermined X-ray examination radiation dose level that is not presumed to be exceeded in a procedure performed according to the standards of good practice upon a patient of normal size. For paediatric X-ray examinations, "normal size" refers to a patient belonging to a particular age or weight group.

Use of reference levels

Reference levels can be used for detecting X-ray devices and practices that cause exceptionally high radiation exposures. Reference levels are not intended for limiting the radiation exposure of any individual patients but for comparing the average radiation exposure of a group of patients, selected as explained below, to the exposure caused by standard good practice.

If reference levels are exceeded, this does not necessarily mean that the examination has been improperly conducted. Exposures exceeding the reference levels may be expedient in order to, for example, achieve an image quality which is better than usual. On the other hand, the fact that no reference levels are exceeded does not necessarily mean that the examination has been optimised for radiation safety. It is still necessary to ensure that image quality is sufficient for a reliable diagnosis and that the radiation exposure is not excessive.

Determining radiation exposure

Radiation exposure is measured or analytically estimated at least every three years in accordance with instructions issued by the Radiation and Nuclear Safety Authority. Exposure is determined for the most common examination types performed with each examination stand, using at least one imaging projection, for which a good practice reference level has been provided. The radiation exposure is measured or analytically estimated on the basis of the imaging values used for a group of at least ten patients. A radiation exposure median is calculated for this group and compared to the reference level. The radiation exposure shall be redetermined and compared anew to the reference level, if any changes or repairs that affect the radiation exposure are made to the examination procedure or equipment.

For the intermediary years, it is enough to ensure that radiation exposure has not changed and the image quality has not deteriorated. This shall be done at each examination stand and at least with one imaging projection of one examination type that is performed with the examination stand in question and for which a reference level has been provided.

Chest X-ray examination

The reference levels for paediatric chest X-ray examinations are provided as a reference level curve where the reference levels are shown as a function of the patient's weight. When carrying out dose collection, the patient's weight is determined in addition to the

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radiation exposure in chest X-ray examination. The reference level curve can be used e.g. as a print-out so that the radiation doses are marked in the image according to the patient's weight and compared to the reference level curve. If there are more dots above the reference level curve than below it, this indicates that the reference level has been exceeded and the deviations from the reference level curve must be examined in more detail. If, on the other hand, there are more dots below the reference level curve than above it, this indicates that the radiation exposure has remained below the reference level.

The comparison to the reference level curve can also be performed computationally (using a spreadsheet, for example) by comparing the curve fitted to the patient doses determined by the responsible party (exponential curve in the form $y = A \cdot e^{B \cdot x}$) to the reference level curve. If the fitted curve is above the reference level curve, this indicates that the reference level has been exceeded. STUK's website has a table available for download that shows the reference level as a function of the patient's weight. The table can be used in the computational application of the reference level curve.

Panoramic tomography of the teeth and jaws

The reference level of panoramic tomography of the teeth and jaws has been determined for the age groups 5–9-year-olds and 10–16-year-olds. The radiation exposure should be determined for a group of ten patients at least in each age group. A radiation exposure median is calculated for this group and compared to the reference level of the age group.

Assessment of results and corrective action

The radiation exposure data must be recorded and systematically compared to the reference levels. If reference levels are exceeded, the reason for this must be investigated and all necessary measures must be taken in order to reduce the radiation exposures of patients.