Diagnostic Reference Levels (DRL's) and Target Dose Levels in The Netherlands

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Introduction

Diagnostic X-ray imaging plays an increasingly important role in the current healthcare system. The number of X-ray examinations is steadily increasing, and there is increasing use of advanced techniques such as computed tomography. This makes it possible to improve quality of care, but as a consequence radiation exposure to patients increases and radiation protection for patients who undergo X-rays must be sufficiently secured.

Materials and Methods

A task group was initiated to define DRL's and target dose levels (TDL's) and to verify these in a field study.
The examinations are mammography, radiography, computed tomography and diagnostic fluoroscopy, it includes diagnostic imaging of adults and children, and covers practices within the radiology and cardiology departments. The studies are a good reflection of current clinical diagnostic practice. During the field study dose area product (DAP) was measured for chest PA, abdomen AP, pelvis AP radiography and computed tomography dose index and dose length product was measured for chest and abdomen CT (respectively pulmonary embolism and abdomen general). Data collection took place using written forms or extraction of dose values from PACS-Dicom databases. DAP meters in the field were compared with a factory calibrated Diamentor M4 to trace their deviation.

Results

DRL's and target dose levels were established for 22 examinations. 39 Institutions participated in the validation study. During the validation study none of the institutions exceeded the DRL's. Furthermore some appeared to perform well below target values, and many complied with the Target Dose Levels. In some cases a significant variation in the accuracy of DAP meters was encountered.

Table 1: DRL's and Target Dose levels (TDL) with summarized results of the field study

			Results field study			
Examination	***DRL***	***TDL***	***Median***	***minimum***	***maximum***	***# locations***
Radiography, Dose Area Product, unit μGy x m^2						
Chest PA-DR	12	6	4,7	1,9	8,9	34
Chest PA-CR	12	6	9,1	5,8	11,2	5
Abdomen AP-DR	300	150	78	34	151	22
Abdomen AP-CR	300	150	195	86	215	5
Pelvis AP-DR	300	150	73	52	108	7
Comp. Tomography, $CTDI_{vol}$ - DLP, units mGy and mGy x cm respectively						
CT Pulmonary embolism	10 - 350	6 - 200	8 - 241	5 - 169	64 - 340	15
CT Abdomen single run	15 - 700	8 - 400	10 - 452	3 - 20	16 - 800	20

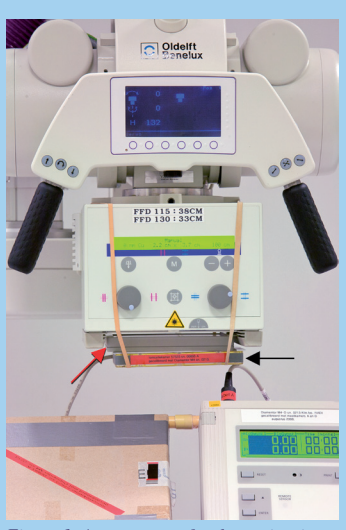

*Figure 1: Arrangement for determination of the deviation / correction factor of a hospitail's DAP meter.
Red arrow: hospital's flat ion chamber,
Black arrow: reference flat ion chamber*

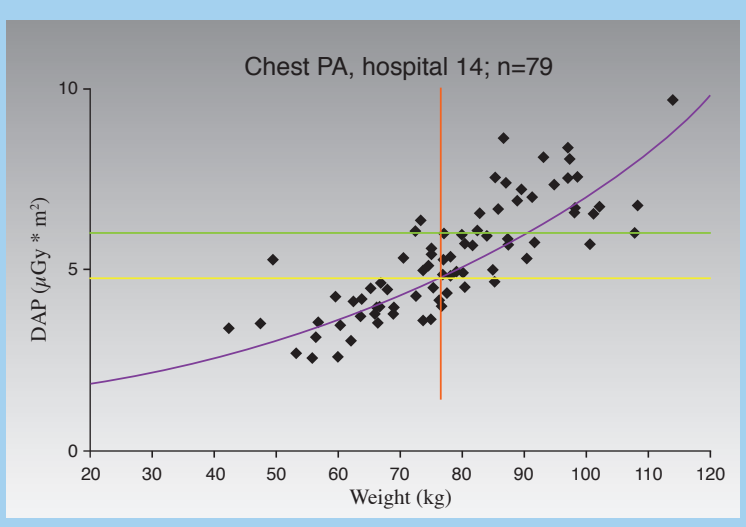

*Figure 2. Example of intrapolation of the DAP value which matches a defined standard patient of 76.4 kg., represented by the orange line. The intersection of this line with the best fit through the data points (purple line) indicates an intrapolated DAP value of 4.7 µGy*m2 (Yellow line), well below the Target Dose Level of 6 µGy*m2 (green line).*

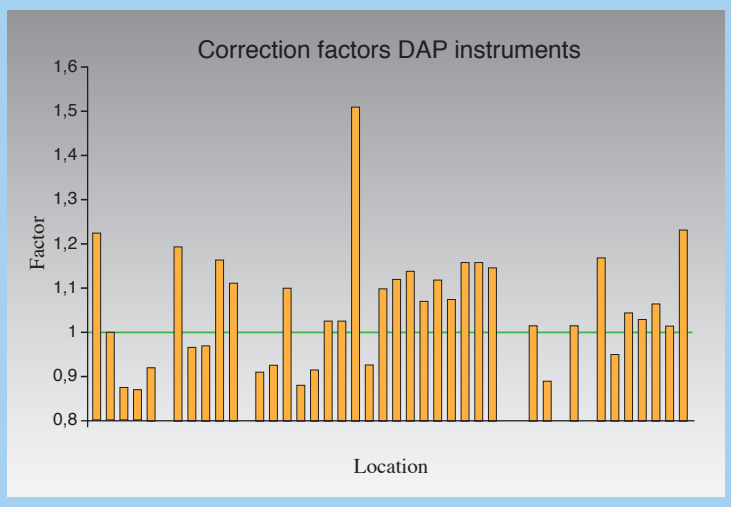

Figure 3. Correction factors from DAP meters in use for Chest PA examinations.

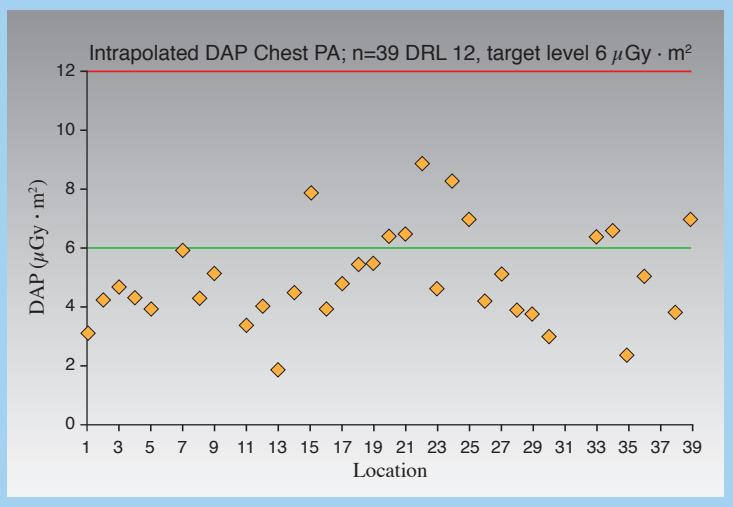

Fig. 4. Scatter plot of intrapolated DAP values from 39 hospitals Chest PA examination using DR techniques. All hospitals perform well below DRL, 76 % even below target level.

Conclusion

The introduction of diagnostic reference levels (DRL) in the Netherlands aims at avoiding practices with unnecessary high patient dose. The DRL is an upper limit for patient exposure that still can be considered as 'good medical practice'. But, even more important, the simultaneous introduction of target dose levels in the Netherlands aims at stimulating the optimization of practices. A target dose level is much lower than the DRL and is achievable with modern imaging equipment and optimized acquisition protocols.

A field study revealed that all institutions complied with the DRL's although the Dutch DRL's are among the lowest in Europe. The introduction of target dose levels, that are much lower compared to DRL's is recommended.

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Additional documentation on Dutch DRL's: www.referentieniveau.nl

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