

RESULTS OF A SURVEY ON THE IMPLEMENTATION OF DIAGNOSTIC REFERENCE LEVELS FOR X-RAYS AMONG DUTCH HOSPITALS

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Abstract—Diagnostic reference levels (DRLs) for medical x-ray procedures are being implemented currently in the Netherlands. By order of the Dutch Healthcare Inspectorate, a survey has been conducted among 20 Dutch hospitals to investigate the level of implementation of the Dutch DRLs in current radiological practice. It turns out that hospitals are either well underway in implementing the DRLs or have already done so. However, the DRLs have usually not yet been incorporated in the QA system of the department nor in the treatment protocols. It was shown that the amount of radiation used, as far as it was indicated by the hospitals, usually remains below the DRLs. A procedure for comparing dose levels to the DRLs has been prescribed but is not always followed in practice. This is especially difficult in the case of children, as most general hospitals receive few children.

Health Phys. 108(4):462–464; 2015

Key words: computed tomography; diagnostic radiology; medical radiation; x-rays

INTRODUCTION

THE INTERNATIONAL Commission on Radiological Protection (ICRP) proposed already in its 1991 publication, ICRP 60 (ICRP 1991), the establishment and use of diagnostic reference levels (DRLs). In many countries, these DRLs have since been implemented. In the Netherlands, patient radiation doses are on the rise mainly due to the increasing number of CT examinations (Bijwaard et al. 2014). In order to constrain

patient doses, the National Commission on Radiation Dosimetry (Nederlandse Commissie voor Stralingsdosimetrie, NCS) established DRLs for 11 radiological procedures in 2012 (NCS 2012). Hospitals are not required by law to adhere to these DRLs, but such adherence is considered to be an indication of good practice by the Dutch Healthcare Inspectorate. The NCS publication also contained a procedure for the comparison of administered radiation doses with these DRLs. For most procedures (except for mammography and pediatric radiology), this involves the measurements of patient weights and radiation doses for 20 patients and the interpolation of these radiation doses for a standard patient of 77 kg.

By order of the Dutch Healthcare Inspectorate, a survey was conducted in 2013 among 20 Dutch hospitals to investigate the level of implementation of the DRLs in clinical practice (including their incorporation in the QA system) and whether the procedure for comparison of radiation doses with the DRLs is followed. This paper summarizes the findings of the survey that have been laid down more elaborately in a report of the National Institute for Public Health and the Environment (Bijwaard 2013).

MATERIALS AND METHODS

An electronic questionnaire was developed in portable document format (PDF) that was sent to potential respondents by e-mail. It consisted of five sections. In the first section, contact details were asked; the second section dealt with familiarity with the concept of DRLs; the third section addressed the implementation of DRLs in the QA system; in the fourth section, specific questions were asked about the 11 different DRLs; and the final section was devoted to opinions on DRLs.

From a list of Dutch hospitals and medical centers (N = 132), 20 institutes were selected in a random sample, weighted by the number of yearly patient intakes. The weighting was applied in order to ensure that some of the relatively few university hospitals would also be represented in the sample. The list of selected institutes is

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(Manuscript accepted 16 September 2014)

0017-9078/15/0

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DOI: 10.1097/HP.0000000000000227

Table 1. Hospitals and medical centers that participated in the survey and their location in the Netherlands.

Hospital / Medical Center	Location
Antonius Zorggroep	Sneek
Diaconessenhuis	Leiden
Erasmus MC	Rotterdam
IJsselland Ziekenhuis	Capelle aan den IJssel
Kenemer Gasthuis	Haarlem
Het Lange Land ziekenhuis	Zoetermeer
Medisch Spectrum Twente	Enschede
Ommelander Ziekenhuis Groep	Delfzijl en Winschoten
Maasziekenhuis Pantein	Beugen
Refaja Ziekenhuis Stadskanaal	Stadskanaal
Rijnstate	Arnhem
Slotervaartziekenhuis	Amsterdam
St. Elisabeth Ziekenhuis	Tilburg
Sint Franciscus Gasthuis	Rotterdam
Tergooi	Hilversum/Blaricum
UMCG	Groningen
VU Medisch Centrum	Amsterdam
Westfries Gasthuis	Hoorn
Wilhelmina Ziekenhuis	Assen
Zaans Medisch Centrum	Zaandam

shown in Table 1. In the rest of this paper and in the corresponding report (Bijwaard 2013), the responses of the institutes are treated anonymously because the objective of this study is to investigate a general trend among all participating institutes and not to point out possibly flawed practices in individual hospitals.

The final electronic questionnaire was sent to the board and the radiation protection officers of the 20 selected institutes by e-mail. Within two months, all questionnaires had been completed and returned.

RESULTS

The completed questionnaires were returned by email as XML-files, and these have been analyzed jointly in Microsoft Excel. The first section, dealing with contact details, is not discussed here. The answers to all questions in the second section are all affirmative. This means that all institutes are familiar with the Dutch DRLs as laid down in the NCS report (NCS 2012). In the third section, 14 hospitals indicate that they used a QA system. Only five of these indicate that the DRLs have been incorporated in the QA system (as was recommended in the NCS report). Apart from this, all 20 institutes perform radiation dose measurements, and 18 institutes measure dose at routine QC tests, the frequency of which varies from monthly to yearly. The dose measurements are in most cases (75%) carried out by a radiographer, a technician, a radiation protection officer, or a supplier, and in 25% of the cases by a medical physicist.

The largest part of the questionnaire is devoted to Section 4, which consists of a series of questions for each individual DRL (and is therefore repeated 11 times, once for every DRL). The main results of this section are summarized in Table 2. Table 2 shows that for the common radiological procedures [mammography, CT abdomen, CT pulmonary angiography (CTPA) thorax, X-thorax PA and X-pelvis AP], comparison of radiation doses with the DRLs usually takes place (in approximately 75% of all institutes). This is less common for the pediatric and more complex procedures. With an exception for coronary angiography (CAG), only 5–7 institutes (25–35%) report comparisons with the DRLs. For the pediatric procedures, this is caused by the small number of children that undergo these procedures in general hospitals; they are usually referred to specialized children's hospitals. Note that the fact that a DRL is used for comparison does

Table 2. Summary of responses given to the main questions of section 4 of the questionnaire regarding DRLs and their implementation. Note that the numbers represent the number of hospitals out of a sample of 20. CTPA stands for CT pulmonary angiography, X-thorax PA means thorax x-ray posterior-anterior, X-pelvis AP means pelvis x-ray anterior-posterior, MCUG is micturating cystourethrography, CTCA stands for CT coronary angiography, and CAG means coronary angiography.

Procedure	# reporting use of DRL	# correct dose to DRL comparisons	# reporting doses	# reporting doses < DRL
Mammography	11	6	5	4
CT abdomen	15	2	13	13
CTPA thorax	14	1	13	12
X-thorax PA	16	3	14	13 or 14 ^a
X-pelvis AP	14	3	13	13
X-thorax child	6	1	5	5
X-abdomen child	5	1	3	3
CT head child	5	1	4	3
MCUG child	5	1	3	3
CTCA	7	1	6	6
CAG	11	3	9	9

^aThis is unclear from the response of one hospital.

not mean that it is incorporated into the QA system and/or the protocol for the procedure. This is very often not the case: depending on the procedure, only 2–7 institutes report this.

Remarkably few hospitals perform the comparison of radiation dose with the DRLs according to the procedure prescribed by the NCS (Table 2, third column). In some instances, individual doses are used for comparison instead of interpolated doses, but more often an interpolation of dose values cannot be performed because weights of patients were not measured. Except for some of the more common procedures, doses are often not reported. It is unclear whether this means that these are not collected on a regular basis (18 institutes do measure doses in QC tests). Where doses are reported, these usually remain below the DRL (with only three or four exceptions). When doses are structurally higher than the DRL, this is reported to be caused by the weights of the patients or the complexity of the procedure.

The answers in the last section of the survey regarding opinions on the DRLs indicate a generally positive attitude toward the introduction of the DRLs and their values. Only one hospital opposes the use of DRLs, and very few institutes find their values either too low or too high. For the common radiological procedures, approximately half of the respondents agree with the DRLs and the other half have no opinion. For the other procedures, approximately 75% of the institutes have no opinion. Six hospitals note that comparing doses to the DRLs is a lot of work, and another three report that it is a difficult procedure. Seven respondents indicate that they would like to receive some form of education on the subject. Six hospitals remark that they do not receive enough children to compare their doses to the DRLs.

CONCLUSION

The survey results show that approximately 1 y after the establishment of the Dutch DRLs, all 20 hospitals in the sample are familiar with their concept and values. However, up to now, only 25% of them have incorporated the DRLs in the QA system (as was recommended). For radiological procedures involving adults, the DRLs are often used, even though these are not incorporated in the protocols. For pediatric radiology, it appears to be difficult to use the DRLs because many general hospitals do not receive enough children. Therefore, they are not able to follow the requested form of comparison of doses to the DRLs. In general, few hospitals follow this comparison procedure exactly. Often the required weights of patients are not measured. When radiation doses are reported, these are usually below the DRLs. When the doses are above the DRLs, this is either caused by the high weights of patients or the complexity of the radiological procedure.

Acknowledgments—This work was supported by the Dutch Healthcare Inspectorate, which is part of the Dutch Ministry of Health, Welfare and Sport.

REFERENCES

- Bijwaard H. Inventory of the use of diagnostic reference levels for x-rays in the Netherlands. Bilthoven: RIVM; RIVM report 080129001; 2013 (in Dutch).
- Bijwaard H, Pruppers M, de Waard-Schalkx I. The influence of population aging and size on the number of CT examinations in the Netherlands. *Health Phys* 107(1):80–82; 2014.
- International Commission on Radiological Protection 1990 recommendations of the International Commission on Radiological Protection. Oxford: Pergamon Press; Publication 60, *Annals ICRP* 21, 1–3; 1991.
- Nederlandse Commissie voor Stralingsdosimetrie. Diagnostic reference levels in the Netherlands. Delft: NCS; Report 21; 2012 (in Dutch).

