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Swedish Radiation Safety Authority

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## National Survey on Justification of CT-examinations in Sweden



Title: National Survey on Justification of CT-examinations in Sweden  
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### **Abstract**

All examinations in diagnostic radiology shall be justified to avoid unnecessary irradiation of the patients. The objective of the study was to investigate the degree of justification for CT-examinations in Sweden. Referrals for all examinations performed during one day were retrospectively evaluated by a group of physicians. The study was designed and conducted by a project group lead by ass. prof. Håkan Jorulf. The authors of this report have derived the results and conclusions on the basis of the data and are responsible for the content of this report.

The principle result was that approximately 20 % of all examinations were not justified. The degree of justification varied strongly with organ examined, moderately with prescriber affiliation and weakly with geographical region. If unjustified examinations could be avoided a large dose reduction for the population would be achieved.

This study shows that there is a need for improvements and the authority will continue to work with this issue.



# Content

<b>1. Summary</b> .....	<b>2</b>
<b>2. Introduction</b> .....	<b>3</b>
<b>3. Data collected</b> .....	<b>4</b>
3.1 Study design .....	4
3.2 Relevance of the examinations in the study.....	6
<b>4. Results</b> .....	<b>8</b>
4.1 Questionnaire.....	8
4.2 Justification .....	8
4.2.1 Quality of the referral .....	8
4.2.2 Prescribers from different organisations.....	9
4.2.3 Anatomical region examined .....	10
4.2.4 Geographical distribution .....	12
4.2.5 Age and gender of patients .....	13
4.2.6 Alternative diagnostic methods.....	15
<b>5. Discussion</b> .....	<b>16</b>
5.1 Questionnaire.....	16
5.2 Referral review.....	16
5.2.1 Method for assessing justification.....	16
5.2.2 Auditors' speciality .....	16
5.2.3 Prescriber's organisation .....	18
5.2.4 Anatomical region examined .....	19
5.2.5 Geographical distribution .....	19
5.2.6 Age and gender of patients .....	20
5.2.7 Alternative diagnostic methods.....	20
<b>6. Future prospects</b> .....	<b>22</b>
<b>7. References</b> .....	<b>23</b>
<b>8. Annex</b> .....	<b>24</b>

# 1. Summary

Even though justification is one of the basic principles in radiation protection the extent to which x-ray examinations are justified is hardly known. Thus the Swedish Radiation Protection Authority (SSI) launched a project concerning for investigating to which degree computed tomography (CT) examinations were justified.

## **Study design**

The degree of justification and the quality of referrals were evaluated for all CT-examinations performed on the 2006-03-22 in all x-ray departments in Sweden. A questionnaire was also sent to all x-ray departments, with questions about equipment and routines concerning referrals and judgment of justification.

## **Main aims of the study**

- To assess the degree of justification CT-examinations in Sweden.
- To get information about the causes for non-justified examinations.
- To investigate how justification is affected by the geographical region, examined organ, age and sex of the patient, quality of the referral and prescriber.
- To assess the quality of referrals.

## **Important findings**

- The setup of the study was adequate although the inter-observer variance was rather high.
- Approximately 80 % of all CT-examinations were justified.
- The number of justified examinations was higher for prescribers affiliated to hospitals than for prescribers from health care centres. The largest difference was for spine examinations (77 % and 29 %, respectively).
- The quality of the referrals was generally high, somewhat poorer for prescribers from healthcare centres (95 % respectively 87 % were satisfactory).
- Justification was depending on the examined organ (between 51 and 98 %).
- The Northern region had a lower degree of justification than the other five regions (75 % vs. 80 %).
- The degree of justification was lower for younger patients

## 2. Introduction

Justification, optimization and dose limits are the three important cornerstones in radiation protection. According to the regulations of the Swedish Radiation Protection Authority (SSI)<sup>1</sup> all medical exposures shall be justified and optimized (1). A medical exposure is justified when the benefit for the patient is larger than the expected harm, and when the effectiveness, advantages and risks for alternative methods with less dose or no dose at all to the patient is duly taken into consideration.

The assessment of justification is a complex task. For the individual patient many factors such as the radiation dose to the patient, the patient's case history, outcome of other investigations, and the radiological resources available must be known and taken into consideration in the justifying process. A justified examination starts with an adequate referral and includes an optimized exposure and a correct diagnosis correspondent to the clinical request. According to regulations of the National Board for Health and Welfare all providers for health are obliged to ensure routines for the design and handling of referrals (2).

In 2006 SSI initiated a research project with the aim to gain information about the degree of justification for radiological procedures, *National survey on the use of computed tomography (CT) in Sweden, SSI project P 1539.06*. Computed tomography was chosen because these examinations are giving relatively high patient doses. This report will present results from the study. It will be discussed how further work to solve still open questions could be performed, with the same, a modified or a different approach compared to the present one.

### *Radiology in Sweden*

*Sweden has a population of 9.2 million inhabitants. Healthcare in Sweden is organised on the county level which are grouped in six healthcare regions, with populations between one and two millions each. In the year 2005 the total number of medical radiological examinations in the 140 departments was 5.4 million (3). The number of x-ray equipments is around 2000, 161 of which are computed tomography equipment in 95 of the departments. The collective effective dose to the population from radiological examinations was estimated as 5800 manSv in the year 2005 (3), to which CT-examinations are contributing with 55-60%. This is roughly the same figure as assessed in the year 1996 (4). The increased collective dose from CT-examinations, with a factor of two, was balanced by the decrease of that from conventional examinations with a factor of two.*

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<sup>1</sup> Since 2008-07-01 the authority's name is the Swedish Radiation Safety Authority (SSM)

## 3. Data collected

### 3.1 Study design

The study was composed of two parts. Part one was a questionnaire sent to the 95 x-ray departments in Sweden that were performing CT-examinations. Among the items in the questionnaire were questions about the CT equipment in the department and whether there were documented routines on how referrals and justification were dealt with.

Part two comprised the evaluation of referrals for all CT-examinations that were conducted in Sweden during one day (Wednesday, 22 March 2006). For that purpose copies of all referrals for these examinations were requested from all facilities using CT-equipment. The referrals contained data about the age and gender of the patient, and about the anatomical region to be examined. Information was available on whether the CT-examination was the first radiological examination in the current investigation of the patient, or was a check on the progress of a disease or effect of treatment, or was a further step in an ongoing investigation. The county, the region, the organisation and the level of hospital was given for both the prescriber and the unit performing the examination. Four different organisations were classified: university hospitals, county hospitals, small hospitals and healthcare centres. The referrals collected resulted in 2435 CT-examinations.

Eighteen experienced physicians, both clinicians and radiologists, were engaged as auditors for the evaluation of the quality of the referrals and of the justification of the examinations; the aim was to evaluate all examinations by two auditors, one clinician and one radiologist. Because of practical reasons this couldn't be achieved completely: Out of the 2435 examinations 280 were evaluated by one auditor only, 2176 by two, 50 by three and 1 by four auditors, giving in total 4714 evaluations. The auditors were instructed to base their judgement on justification on the European referral criteria (5), on national guidelines and health care programmes, and on their own experience.

The auditors had to evaluate the quality of the referral as answer to the question "*can the appropriateness and the justification of the examination be assessed?*" in a four-grade scale:

1. adequate referral,
2. relatively adequate,
3. not really adequate and
4. inadequate information.



The auditors evaluated justification as the answer to the question “*is the result of the examination expected to be of importance for further management of the patient or for therapy or is giving reassurance for the diagnosis?*” in a four-grade scale:

1. justified,
2. most likely justified,
3. doubtful whether justified and
4. not justified.

The appropriateness of the CT examination assessed according to 11 alternatives:

1. CT is the correct initial radiological procedure
2. Control with CT is indicated
3. CT is indicated as a further investigation
4. MRT or US should have been chosen
5. Conventional x-rays or scintigraphy, including PET without CT should have been the first choice
6. A different method should be used for the control.
7. A different method should have been used for the continuing investigation
8. Radiological investigation not justified at the time of referral
9. Control is not adequate or repeated examination
10. CT is not needed because investigation with other method(s) is sufficient
11. Can not judge whether choice of method is appropriate.

There are two possibilities for defining justification. One is to use the assessment of the appropriateness where the alternatives 1 through 3 are defined as *justified* (CT there is considered to be indicated) and alternatives 4 through 10 as *not justified* examinations (here another method than CT is preferred). The second is the direct assessment of justification by the auditors in a four-grade scale. In this report the first method is used. The reason for taking this approach is that here the assessment of justification is more coherent and closer to how justification is used in radiation protection. A comparison between the two methods will be carried out and commented.

## 3.2 Relevance of the examinations in the study

For the outcome of the study to be generally valid for the conditions in Sweden, the selected examinations being part of this study must be representative for the praxis in Sweden during an adequate time interval. That applies to both the geographical distribution as the distribution of different types of examinations. The figures for this study can be compared to the results from a frequency study for the year 2005 (3). There the number for all radiological examinations during the year 2005 was assessed, differentiated according to type and location.

The number of examinations included in this study was 2435, performed during the selected day 22 March 2006. Assuming the production of CT examinations during one Saturday, Sunday or other public holiday is corresponding to 25 % of the production during one weekday will give a yearly production equivalent to 288 weekdays. Hence, the number of CT examinations during one weekday is the number for the whole year 2005 divided by 288. The result is presented in Table 1.

**Table 1 Comparison between the numbers of examinations per working day included in this study and a survey carried out in 2005 for the six healthcare regions in Sweden.**

	This study	Survey 2005	Difference(%)
<b>Northern</b>	250	240	4
<b>Stockholm</b>	540	497	8
<b>South-eastern</b>	282	250	11
<b>Southern</b>	426	413	3
<b>Uppsala/Örebro</b>	563	493	12
<b>Western</b>	374	371	1
<b>Total</b>	2435	2264	7

The numbers are not differing more than 12% for any region. Approximately 7% more examinations were included in this study compared with the survey of 2005.

The relative number of the various types of examinations included could also influence the outcome. For example if the study comprises an unrepresentative number of examinations of a specific type that is almost always justified, the study will show a too high frequency of justified examinations. Table 2 shows the relative numbers of examinations of various parts of the body compared to the survey for 2005 (3). The definition and grouping of the examinations were somewhat different in the two studies; therefore all

pelvis and abdomen examinations were put together into a new group “other”.

**Table 2 Comparison between regions of the body examined in this study and the survey 2005, the numbers express the percentage relatively to all examinations in the respective study.**

	Skull and neck	Brain	Spine	Thorax	Extremities	Multiregion	Other
This study	9 %	42 %	3 %	11 %	2 %	11 %	21 %
Survey 2005	13 %	40 %	2 %	16 %	2 %	2 %	25 %

The agreement between the two studies is relatively good for the examinations of the brain, spine and extremities but poor for multiregion. This disagreement might be attributed to differences in the classification of examinations in the two studies.

As radiological protection for children is especially important a separate evaluation for children would be desirable. However, the number of examinations of children (0-15 years) was low, and it could also be expected that the types of examinations were different compared to adults. In table 3, the relative distribution of different types of paediatric examinations for this study and the 2005 survey is shown.

**Table 3. Comparison between regions of the body examined for children (0-15 years), percentage relatively to all examinations in the respective study.**

	Skull and neck	Brain	Spine	Thorax	Extremities	Multiregion	Other
This study	23 %	39 %	4 %	12 %	7 %	9 %	7 %
Survey 2005	22 %	44 %	2 %	7 %	6 %	3 %	17 %

The distributions of examinations for the two studies were quite similar. Compared to the figures for adults there were differences, the largest for the skull and neck region where the figures for children were two times higher than those for adults. However, the total number of paediatric examinations in this study was only 58, thus evaluations of these data have large statistical uncertainties, and it will be difficult to do any specific evaluations for children.

## 4. Results

### 4.1 Questionnaire

Out of the 95 questionnaires 93 were returned. It was stated by

- 84% of the departments that they had documented procedures for referral handling.
- 36% of the departments that they had documented procedures for the assessment of justification.
- 65% of the departments that assessment of justification was performed for all patients and on medical grounds, and by the remaining departments that justification was assessed for more than 50% of the referrals.
- 82% of the departments that the setting of priorities for when an examination is scheduled is always based on medical grounds, and for the remaining departments for more than half of all examinations.

### 4.2 Justification

In the following chapters data for the level of justification together with a number of parameters are presented, such as the prescribers' organisational and geographical residence, the anatomical region examined, the age of the patient, the quality of the referral, and the auditors' speciality. As stated in chapter 2, last paragraph, the terms *justification* and *justified* (unless specified differently) are relating to the assessment of the appropriateness of the examination by the auditors. Most of the findings will be expressed as numbers of evaluations by the auditors rather than as numbers of examinations.

#### 4.2.1 Quality of the referral

The level of adequate information in the referrals was assessed by the auditors in a four-grade scale, from adequate to inadequate. Here this four-grade scale was reduced to a two-grade scale, where "adequate" "and relatively adequate" was regarded as "satisfactory" and "not really" and "inadequate" as "not satisfactory". Table 3 is showing to what extent the quality of the referrals was correlated to the assessment of justification.

**Table 3 Quality of referral versus degree of justification (in % relative to the total number of evaluations).**

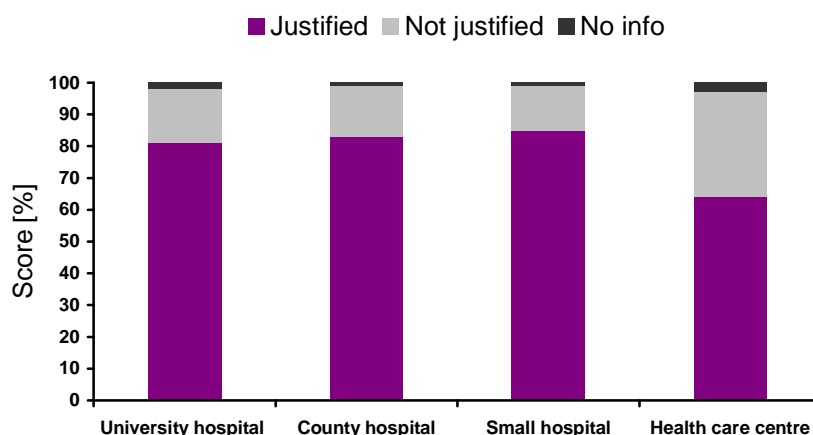
Quality of the referral	Justified	Not justified	Don't know	Sum
Satisfactory	76.7	15.4	0.7	92.8
Not satisfactory	2.1	3.7	0.5	6.3
Don't know	0.3	0.1	0.4	0.8
Sum	79.1	19.3	1.6	100.0

Table 3 is showing that about 93 % of the referrals had adequate or relatively adequate information, i.e. were satisfactory. It is also indicating that 15.4 % of the referrals were for not justified examinations. Not satisfactory referrals are obviously not the major reason for the examinations to be assessed as not justified because of the 19.3 % evaluations that were found to be not justified only 3.7 % had not satisfactory referrals.

Prescribers from each of the three categories of hospitals (university hospitals, county hospitals and small hospitals) had approximately the same level of quality of the referrals; 94-95 % were judged as “satisfactory” whereas this figure was reduced to 87 % for prescribers from healthcare centres.

#### 4.2.2 Prescribers from different organisations

Prescribers from the four different categories of organisations had roughly the same number of referrals each. Figure 1 shows the degree of justification for the four different categories. The three from hospitals are showing similar values (82 – 84 % justified) whereas prescribers from healthcare centres have a significantly lower value (64 % justified).



**Figure 1 Judgement of justification for prescribers from different types of organisations.**

### 4.2.3 Anatomical region examined

In this study the examinations were originally characterised as 38 different types. These were later regrouped into 12 broader defined anatomical regions. The assessment of justification for these 12 anatomical regions from all auditors is given in table 4 in absolute numbers and in table 5 in relative numbers.

**Table 4 Justification for the 12 anatomical regions given as numbers of evaluations**

	Justification	Not justified	Do not know /no answer	Total number
<b>Angiography</b>	80	8	1	89
<b>Abdomen/Pelvis</b>	537	225	6	768
<b>Colon</b>	26	25	0	51
<b>Extremities</b>	69	21	0	90
<b>Neck</b>	70	17	5	92
<b>Brain</b>	1545	334	31	1910
<b>Multiregion</b>	405	36	9	450
<b>Spine</b>	112	82	3	197
<b>Skull</b>	272	51	4	327
<b>Thorax</b>	431	54	13	498
<b>Trauma</b>	54	1	0	55
<b>Urinary tract</b>	103	48	4	155
<b>Total</b>	3704	902	76	4682

**Table 5 Justification for the 12 anatomical regions given as percentage of the evaluations for the respective region**

<b>Degree of justification</b>	<b>Justified</b>	<b>Not justified</b>	<b>Do not know/ no answer</b>
<b>Angiography</b>	90	9	1
<b>Abdomen/Pelvis</b>	70	29	1
<b>Colon</b>	51	49	0
<b>Extremities</b>	77	23	0
<b>Neck</b>	76	18	5
<b>Brain</b>	81	17	2
<b>Multiregion</b>	90	8	2
<b>Spine</b>	57	42	2
<b>Skull</b>	83	16	1
<b>Thorax</b>	87	11	3
<b>Trauma</b>	98	2	0
<b>Urinary tract</b>	66	31	3
<b>Total</b>	79	19	2

The overall degree of justification was lower for prescribers from healthcare centres. For further analysis justification was derived for different anatomical regions, for prescribers from hospital and from healthcare centres. Only the five most frequent anatomical regions were taken into consideration – the remainders are of such low frequency that no reliable results could be expected.

Table 6 is showing the figures for these five anatomical regions, for prescribers from hospitals and from healthcare centres.

**Table 6:** Justification (%) for five anatomical regions, prescribers from hospitals (A) and health care centres (B)

	Jusitified	Not justified	No answer
<b>Abdomen/ Pelvis</b>			
A	73	27	1
B	58	41	1
<b>Brain</b>			
A	83	15	2
B	72	27	1
<b>Spine</b>			
A	77	23	1
B	29	68	2
<b>Skull</b>			
A	86	12	2
B	73	27	0
<b>Thorax</b>			
A	88	10	2
B	78	16	6

#### 4.2.4 Geographical distribution

Table 7 shows the degree of justification in percentage for the various healthcare regions. Five of the regions are showing quite similar results whereas the Northern region has slightly lower values.

**Table 7 Judgement of justification (in %) in the six healthcare regions in relative values**

Justification	Southern	South-eastern	Western	Stockholm	Uppsala/ Örebro	Northern
Justified	81	79	79	79	79	75
Not justified	17	20	20	18	20	23
No answer	1	1	1	3	1	2



#### 4.2.5 Age and gender of patients

The distribution of evaluations in ten-years age-intervals is shown in figure 2, for males and females from 0 to 100 years.

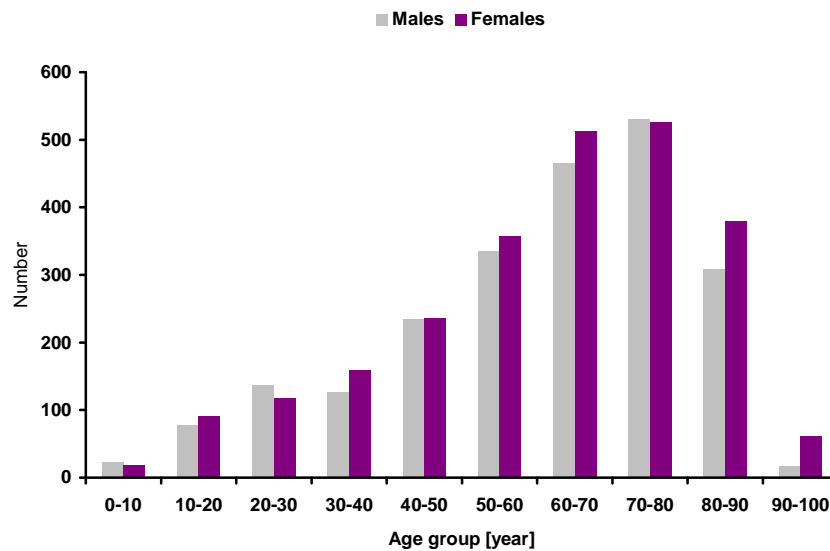


Figure 2 Number of evaluations for males and females in different age groups.

Figure 3 shows the degree of justification (expressed as percentage of the number of evaluations judged as justified) in ten-year age-intervals for both males and females for all examinations, and figure 4 shows data for the 3 most frequent examination groups. The youngest and oldest patients' age-groups were summed to cover 20 years because the number of examinations was very low for these patients.

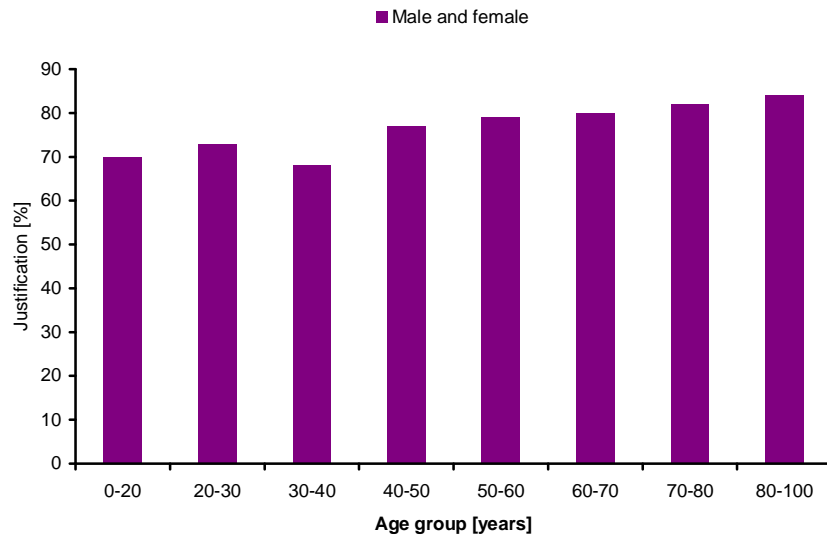


Figure 3 Justification for different age groups (all examinations)

Figure 4 shows the degree of justification as a function of age for the three most frequent examinations. The figure indicates that justification increases with increasing age, at least to the age of 70.

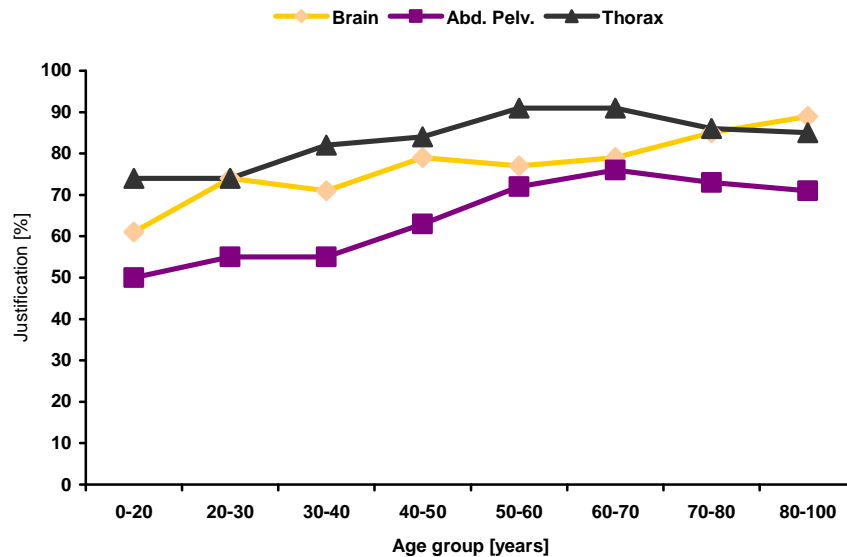


Figure 4 Justification for different age groups and examined anatomical regions.

#### 4.2.6 Alternative diagnostic methods

Of special interest are those examinations for which the auditors suggested alternative methods not using ionising radiation, i.e. magnetic resonance imaging (MR) or ultra sound (US). For 384 evaluations (8 % of all) the auditors made this assessment. Table 8 shows more detailed results for the six healthcare regions and for the three examination for which this judgement was given most frequently.

**Table 8 CT-examinations that should have been performed with MR or US according to the auditors' judgement, for the six healthcare regions and three examination types. The total numbers of evaluations (N) for the examination in the respective healthcare region are given together with the absolute ( $N_{MR+US}$ ) and relative values for those that should have been performed with MR or US ( $RN_{MR+US}$ ).**

	Spine			Brain			Abdomen		
	N	$N_{MR+US}$	$RN_{MR+US}$ %	N	$N_{MR+US}$	$RN_{MR+US}$ %	N	$N_{MR+US}$	$RN_{MR+US}$ %
<b>Southern</b>	23	2	9	337	27	8	122	27	22
<b>South</b>	28	7	25	215	9	4	102	17	17
<b>Eastern</b>									
<b>Western</b>	54	33	61	280	19	7	98	5	5
<b>Stockholm</b>	14	1	7	414	12	3	186	32	17
Uppsala/ Örebro	43	1	2	444	19	4	192	35	18
<b>Northern</b>	35	17	49	220	21	10	68	8	12
<b>Total</b>	197	61	31	1910	107	6	768	124	16

N = total number of evaluations in the respective healthcare region for the indicated anatomical region

$N_{MR+US}$  = Number of evaluations for examinations that according to the auditors should have been performed with MR or US

$RN_{MR+US}$  = Relative number of evaluations for examinations that according to the auditors should have been performed with MR or US

## 5. Discussion

The main aim of the study was to investigate to which degree CT-examinations were justified and to find out reasons why unjustified examinations are performed. This analysis will focus on the identification of these factors and will try to find measures for improvements. The findings in the previous chapter will be analysed and, when feasible. Suggestions for actions will be given.

### 5.1 Questionnaire

For a number of facilities, documented procedures for referral handling and for assessment of justification were missing. A prerequisite for the assessment of justification is an adequate referral. A written guideline on what the referral must contain is needed in order to ensure that everyone involved knows what is required. Written guidelines are also needed for justification assessments to be consistent, independent of who is making the assessment. Without documented routines it is difficult to systematically improve the referral handling and justification assessment.

### 5.2 Referral review

#### 5.2.1 Method for assessing justification

As pointed out there were two options in this study to assess “justification”. In this report the assessment of the appropriateness of the examination was chosen. The differences between the two choices are small. A comparison between these two methods is shown in Table 9. The four-grade scale for the direct assessment of justification was reduced to a two-grade scale (yes or no) where it was assumed that “justified” and “probably justified” is *justified*, and “justified with doubt” and “not justified” is *not justified*. The two methods are giving the same results for 94 % of all evaluations.

**Table 9 Justification according to assessment of appropriateness and to a direct assessment, respectively, in % of the total number of evaluations.**

Direct assessment \ Appropriateness	Justified and probably justified	Justified with doubt or not justified	Cannot be judged or data missing
Justified	74.0	5.0	0.2
Not justified	0.0	19.1	0.1
Cannot be judged or data missing	0.3	0.8	0.6

#### 5.2.2 Auditors' speciality

This study showed a relatively high inter-observer variance that varied with the examined anatomical region. To a large extent these differences in

judgements could be attributed to the speciality of the auditors. Two categories of auditors were involved in this study: Physicians working in clinics referring patients for CT examinations (here called “clinicians”) and radiologists. Preferably one radiologist and one clinician should evaluate each examination. This was achieved for all examination except for extremity, spine and trauma, which to 95 % were evaluated by radiologists only because for these examinations there were no relevant clinicians in the group of auditors.

Table 10 shows the justification evaluated by clinicians and radiologists for those examinations where clinicians and radiologists carried out approximately the same number of evaluations each. For some examinations the differences regarding assessment of justification between clinicians and radiologists are remarkably high. The percentage of justified examinations of the abdomen/pelvis, colon, and urinary tract are lower when assessed by clinicians and the opposite holds for neck, skull and thorax. It cannot be determined whether these findings are generally valid in Sweden because only a small number of auditors were engaged. But, some possible explanations can be given which could be checked in a follow-up study.

**Table 10:** Judgement of justification by (a) clinicians and (b) radiologists. The figures are given as percentage of the total number of evaluation by the respective group of observers for the examination type in question

**(a) Clinicians**

	Justified	Not justified	No answer
Angiography	93	5	2
Abdomen/pelvis	59	40	1
Colon	28	72	0
Neck	86	7	7
Brain	80	18	1
Multiregion	90	8	3
Skull	91	7	2
Thorax	91	7	1
Urinary tract	38	59	3

**(b) Radiologists**

	Justified	Not justified	No answer
Angiography	88	13	0
Abdomen/pelvis	80	19	1
Colon	73	27	0
Neck	68	26	6
Brain	81	17	2
Multiregion	90	8	1
Skull	80	19	1
Thorax	82	14	4
Urinary tract	93	5	2

Radiologists and clinicians have a different role in the management of patients which might lead to a different view on what is the best radiological procedure for a given patient history. It might be that clinicians are not familiar with the newest examination methods and their possibilities, or that the radiologist is not aware of all details in the investigation schemes for certain diseases or suspects for disease. A closer cooperation between clinicians and radiologists would improve the mutual understanding.

All auditors, both clinicians and radiologists are certainly influenced in their judgement by how the situation is at their own clinics. For instance it is likely that new radiological methods will not be introduced simultaneously in the whole country so there will be different practices in different clinics. That is one of the reasons why the study cannot unconditionally give the true answer to the questions about justification. But that does not mean that the study is not conclusive: when doubts on justification for a certain radiological procedure are brought forward from either side this is reason enough for a critical review.

### **5.2.3 Prescriber's organisation**

Examinations referred to by prescribers from the three types of hospitals had all similar degree of justification, between 82 and 84 %. However, the corresponding figure for prescribers from healthcare centres was only 64 %, and it was shown that for all types of examinations the degree of justification was lower for these prescribers. The quality of request forms showed a similar pattern: all the three types of hospitals provided 94-95 % "sufficient" referrals whereas prescribers from healthcare centres achieved 87 %.

It is to be expected that different categories of prescribers will have different categories of patients, and that might cause the differences observed for justification. A possible reason could be that they have on average more pa-

tients with diffuse symptoms. The first examination in the current investigation of the patient is more likely to fail in justification compared to a follow-up check which often is a part of a well elaborated program to be followed for certain patients, whereas for the first hand examination the knowledge about the patient's possible disease might be more vague. The relative number of such first hand examinations for prescribers from healthcare centres is only 10 % higher than for prescribers from hospitals, but the number of unjustified examinations is, relatively, twice for prescribers from healthcare centres.

Another possible explanation for the findings could be that there is less contact between those prescribers and the radiological departments indicating that these prescribers are not fully familiar with all the radiological options available. The lower quality of referrals could also contribute to the lower degree of justification for prescribers from healthcare centres. As shown before, the total of "insufficient" referrals could theoretically cause at most 3.7 % of all examinations to be not justified; for examinations with referrals from healthcare centres this figure is 8 %. The quality of the referral is important, but poor quality is not the main reason examinations to be unjustified.

Only those referrals that lead to a CT-examination were part of this study. Referrals for CT-examinations that were not performed were excluded. It would be of value to investigate also these referrals which could give additional information on the quality of referrals and on how justification is assessed in clinical practice.

#### **5.2.4 Anatomical region examined**

As could be expected the degree of justification was varying with the type of examination, between 50 and 98 %. Colon, spine and urinary tract were at the low end of justification. Common for these three examinations is that they belonged in the past to rather frequent conventional x-ray examinations, and that there seem to be large differences about which modality is to be preferred, both among the prescribers and the auditors.

For example spine examinations referred to by prescribers from healthcare centres had a degree of justification with 50 % units lower than those from other prescribers. Similar differences in the degree of justification can be seen between radiologists and clinicians for examinations of the colon and urinary tract.

#### **5.2.5 Geographical distribution**

Differences in the level of justification in different parts of the country were obviously small. The Northern region was the only region with slightly lower figures. As seen in table 11 this was not because of a larger contribu-

tion of referrals from healthcare centres which have been shown to have less degree of justification. In fact, the Northern region had the lowest percentage of prescribers from health care centres, only half of that for the Stockholm region.

The reason for the lower figures for justification in the Northern region needs further evaluation. A possible explanation might be that this region is sparsely populated, often with long distances to the nearest hospital. Examinations might be prescribed and performed on weaker indications when the patient is anyhow present at the hospital.

**Table 11 Percentage of examinations referred to by prescribers from healthcare centres for the six healthcare regions**

Region	Southern	South-eastern	Western	Stockholm	Uppsala/Örebro	Northern
Percentage of referrals	15 %	20 %	22 %	28 %	19 %	14 %

### 5.2.6 Age and gender of patients

As could be expected the frequency of examinations was varying and becomes more common with increasing age. It has been shown that 50 % of all examinations are performed on patients of age 65 years and older. The distribution of the examination amongst the two genders is rather even: 52 % females and 48 % males.

The degree of justification is lower for younger patients. The reason for this is not quite clear. It could be that when evaluating the examinations the auditors had taken into special consideration the increased radiation risk for young patients. This might have resulted in more rigorous requirements for the justification of the procedures, possibly more strict than the judgement of the prescriber and the radiologist in charge for the actual patient.

### 5.2.7 Alternative diagnostic methods

In 8 % of all evaluations the auditors concluded that MR or US should be the preferred examination. Out of all examinations of the spine 30 % should have been replaced with MR or US according to the auditors. There were large variations of this figure between the regions, from 2 % (Uppsala region) to 61 % (Western region). Likewise remarkable is the low number of spine examinations performed in Stockholm (14) compared to the Northern and Western regions (35 and 54, respectively). For brain examinations the differences between the regions are less pronounced, between 3 and 10 % with an average of 6 %. For examination of the abdomen the corresponding figures are 5 and 22 % with an average of 16 %.

These findings indicate that there were large differences in what modality was preferred for specific clinical requests. These differences were mostly



pronounced for examinations of the spine. It would be worth while to investigate the reasons for these differences, which might be: different access to examination modalities in question, tradition, good or poor routines for assessment of justification, availability/lack of certain expertise.

## 6. Future prospects

The study has shown that there is a need for improvements concerning justification of CT-examinations. This could be achieved by

- Education and training, both the prescribers and the radiologists in matters concerning justification.
- Information to the prescribers, especially those from healthcare centres, about requirements and criteria for referrals.
- Promotion of the use of referral criteria e.g. RP 118 (5) for both prescribers and radiologists.
- Improved communication between radiologists and prescribers.
- QA documents on the content and the format of good referrals.
- QA documents on the justification process.

## 7. References

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## 8. Annex

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