

UNNECESSARY X-RAY EXPOSURES: SPOILT FILMS AND THEIR CONTRIBUTION TO ANNUAL COLLECTIVE DOSE

Cornelia Diaconescu¹, O. Iacob¹, T. Bostaca², C. Cobzaru³,
L. Munteanu⁴

1-Institute of Public Health and Medical Research, Iasi,
RO-6600

2-University of Medicine and Pharmacy Iasi, Radiology Dept.

3-St. Spiridon's Hospital Iasi, Outpatient Radiology Dept.

4-Romanian Railways Hospital Iasi, Radiology Dept.

INTRODUCTION

Medical X-ray examinations in Romania give rise to a large annual collective dose equivalent of about 14,200 man Sv (90% of all manmade sources) [1]. The extent to which the unnecessary medical radiation contributes to this collective dose was not investigated and on a national scale the response is very difficult to obtain. This work is an attempt to estimate, even rough, the current extent of unnecessary exposures due to repeated examinations and of those with poor image quality.

METHODOLOGY

Twelve X-ray diagnostic departments from seven medical centers were selected on their annual workload basis for the audit. Because the rejected radiographs are not recorded separately, we have chosen a four month period (the middle month of every quarter) during 1993, to make an analysis of these spoilt films. The annual repeat rates of radiographic examinations were calculated on this basis, for each hospital. A random sample of 800 films from all X-ray departments was separately viewed by three radiologists. According to their own opinion, the examinations divided between the following categories of a three step scale: **VERY GOOD** for films having no errors of exposure, positioning or processing; **good or diagnostic acceptable** for films with some errors of exposure, positioning or processing but which do not detract from the diagnostic utility of the radiograph and **unacceptable** for films having such errors that made them unsuitable to diagnostic. We used this last category of radiographs or spoilt films to make an evidence of clinically unhelpful X-ray examinations because the probability of obtaining an useful information for patient management is extremely low.

RESULTS

The four month sample involved 11819 patients which had a X-ray examination; the overall number of films used was 21330 and the percentage of patients with a repeated exposure ranged from 0.53 to 5.70. The main causes of a repeated film which form part of a X-ray examination are divided into the following categories (A-D) :

- A - faults due to personnel (radiographer) : positioning or processing ;
- B - machine faults : overexposure, underexposure (errors of exposure) ;
- C - films with faults of manufacture : stains and traces revealed by development ;

D - consultant's request.

The annual frequency of repeated examinations with their causes in each medical center is presented in Table 1.

Table 1. Annual frequencies of repeats with their causes

Hospital	Main causes for a repeated film (%)			
	A	B	C	D
1	6.2	79.3	6.2	8.3
2	41.6	41.6	-	16.8
3	100.0	-	-	-
4	5.9	29.4	64.7	-
5	14.8	59.3	25.9	-
6	16.6	16.6	66.8	-
7	23.1	61.5	15.4	-

The exposure errors seem to be the major fault accomplishing the higher percentage of repeated films (up to 79%) in almost all hospitals. Radiographic films with faults such as stains and traces which appeared by processing the film are another cause for a repeated examination.

The faults in positioning included also the selection of wrong beam limiting cone or diaphragm. Except one hospital (for lung diseases) where all repeated examinations were due to this kind of error, the radiographers' faults had a lesser effect on repeat rates. From the eighteen common X-ray examinations observed, only five had relevant repeated rates : lung, heart (21.2%); lumbosacral spine (16.9%); i.v. urography (21.1%); gastric series (21.2%) and extremities (8.5%). The frequency of rejects by cause and type of examination is present in Table 2.

Table 2. Frequencies of repeats for some examinations

Examination	Categories of repeats causes (%)			
	A	B	C	D
Lung, heart	22.9	54.2	20.0	2.9
Lumbosacral spine	7.1	78.6	14.3	0
I.V. Urography	30.0	25.0	35.0	10.0
Gastric series	0	80.0	0	20.0
Extremities	14.3	35.7	50.0	0

These data reveal that the examinations with higher patient exposure such as lumbosacral spine or urographies, having an important contribution to collective dose, have been repeated mainly due to machine faults, a kind of systematic error which cannot be avoided, because the radiological equipment is very old. On the other hand, the repeated examinations by cause C are easiest to eliminate. But apart the repeats, the most unnecessary medical irradiation arises from clinically unhelpful examinations [2,3]. In this category we have included the examinations appreciated by radiologists as unacceptable having such errors that cannot contribute to diagnostic decisions. Radiologist's impressions are summarized in Table 3.

Table 3. The radiologists' impressions on the radiographs (%)

	Image quality		
	Very good	Good	Unacceptable
% of the original sample	19.7±5.4	49.6± 3.2	30.7± 2.7
Type of examination			
Lung+heart	24.2±7.2	48.0± 5.5	27.8± 5.4
Lumbosacral spine	16.0±5.4	35.8±10.2	48.2±13.4
I.V.Urography	12.5±4.0	47.8±13.8	39.7±13.0
Gastric series	20.0±5.1	50.4± 7.8	29.6± 5.2
Extremities	28.9±8.3	53.4± 9.3	17.7± 5.9

There is an evident discrepancy between the percentage of repeats, as nowadays registered in radiology and the percentage of daily performed radiographs of poor quality, never recorded like that, but in fact as unhelpful to diagnosis as the former ones. Our results make an evidence for the need and the importance of a register of reject radiographs, a very simple and useful mean to control the radioprotection standards [4]. Estimates of the extent of the unnecessary component of the collective dose due solely to clinically unhelpful X-ray examinations and the repeated ones, are given in Table 4.

Table 4. Annual collective dose and potential dose savings

Type of examination	Effective dose/film	Annual collective dose	Potential annual collective dose savings from :		
			Poor quality exams	Repeats	%
	mSv	manSv	manSv	manSv	
Lung, Heart	0.25	17.0	5	0.13	30.2
Lumbosacral spine	2.0	50.0	24	0.90	49.8
I.V.Urography	2.5	40.3	16	0.35	40.6
Gastric series	4.8	80.0	27	1.01	35.0
Extremities	0.1	6.1	1	0.02	16.7

Our results testify the potential for a significant reduction in the collective dose to patients (up to 49%) and a significant benefit to society as a whole by bettering the diagnostic quality and value of radiographs.

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