PATIENT DOSE ASSESSMENT IN BUSY RADIOLOGY DEPARTMENTS

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INTRODUCTION

- Diagnostic X-rays are used so extensively in medicine by far the largest man-made source of public exposure to ionizing radiation

- Patient dose has become a major issue for increasing awareness of the effects of ionizing radiation.

- To assess patient dose ,measurements have to be limited to most frequent X-ray examinations.

PURPOSE

- survey entrance surface air Kerma (ESAK) for patients in some busy radiology departments as part of establishing national diagnostic reference levels (NDRLs).

MATERIALS & METHODS

➢General survey:

❑ In this study we measured the entrance surface air kerma (ESAK) for patients undergoing selected diagnostic X–ray examinations in 10 busy departments belonged to iranian main health insurance organization.

❑ The study included the examinations of the chest postero-anterior (PA) , chest Lateral(LAT) ,skull antero-posterior (AP), skull Lateral(LAT) , Lumber spine AP/LAT, Thoracic spine AP/LAT, Cervical spine AP/LAT, abdomen and Pelvis AP were chosen for they are largest contributor to the collective dose to the population in the Tehran,

❑ Totally, 4578 adult patients were included in this study.

MATERIALS & METHODS

➢Patient dosimetry

❑ air kerma which was based on the amount of charge released by the radiation per unit mass of air, is used as the basis of directly measured application specific quantities.

❑ in fact, absorbed dose and air kerma are almost equal in the diagnostic energy range but air kerma is easier to measure accurately.

❑ the principal quantities to be measured in patient dosimetry are the incident air kerma and the Entrance surface air kerma (ESAK).

❑ ESAKs were determined on the basis of X-ray tube output measurements and X-ray exposure parameters and body thickness for each technique .

MATERIALS & METHODS

- entrance surface air kerma is air kerma measured in the primary X-ray beam in the entrance plane of the patient and then related to backscatter factor.
- BSF values for X-ray examination range from 1.2 to1.4.

- according equation(1), entrance surface air kerma for each patient was calculated using real examination data.

$$ESAK = Y(d).mAs.\left(\frac{d}{d_{FTD}-t_P}\right)^2.BSF \quad 1$$

- Where d_{FTD} and t_P are the tube focus to patient support distance and the patient thickness, respectively.

$$Y(d) = \frac{K(d)}{mAs}$$

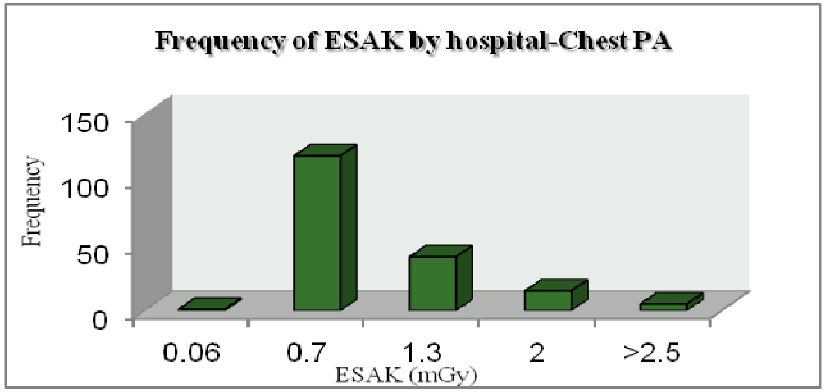
- X-ray tube output, Y_d, (µGy/mAs) was measured at distance 100 cm and voltage range 40 to 120 Kv, in 10 Kv steps.

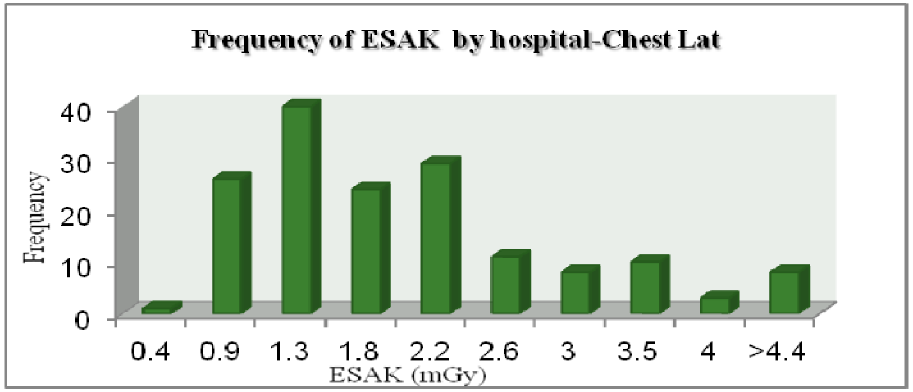
Results

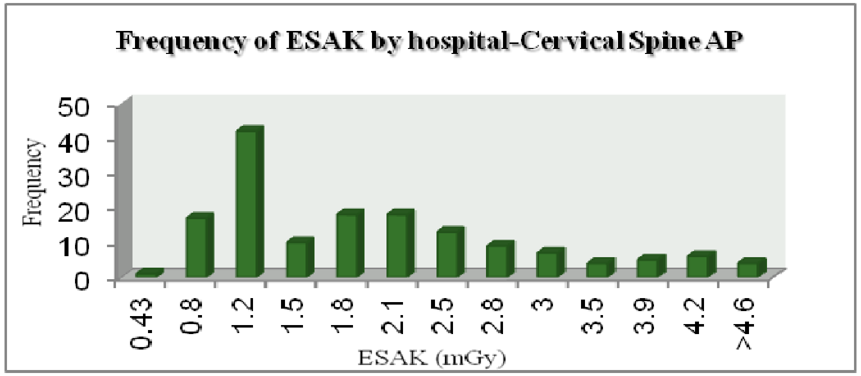
❑ The ESAK of patients varied by a factor of 17 to 51 for cervical spines in anteroposterior (AP) to Pelvis in anteroposterior (AP), respectively.

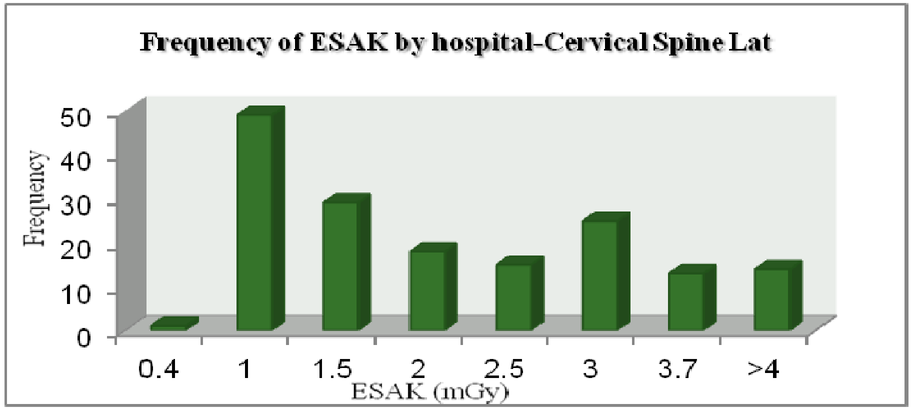
	Chest PA	Chest Lat	Abd. AP	Pelvis AP	Lum. AP	Lum. Lat	Cer. AP	Cer. Lat	Tho. AP	Tho. Lat	Sku. PA	Sku. Lat
Mean	**0.47**	**1.20**	**6.02**	**5.22**	**6.52**	**17.40**	**1.27**	**1.35**	**5.83**	**7.55**	**3.10**	**2.44**
SD	**0.43**	**0.98**	**4.39**	**3.76**	**5.54**	**15.01**	**0.88**	**1.15**	**5.78**	**7.32**	**2.04**	**1.53**
Min	**0.10**	**0.20**	**0.72**	**0.39**	**1.03**	**1.55**	**0.28**	**0.22**	**0.64**	**1.04**	**0.67**	**0.55**
Max	**3.47**	**5.00**	**22.18**	**19.76**	**29.56**	**59.40**	**4.88**	**7.45**	**27.95**	**39.64**	**14.55**	**8.05**

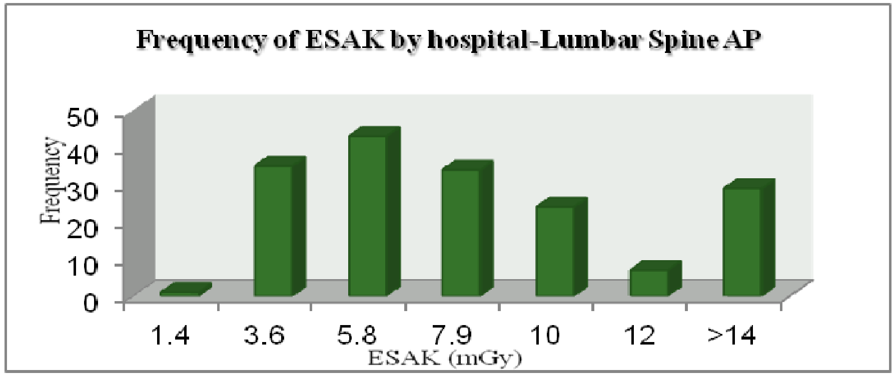
Table1- The mean, Standard Deviation (SD), minimum and maximum ESAK values in mGy for different techniques .

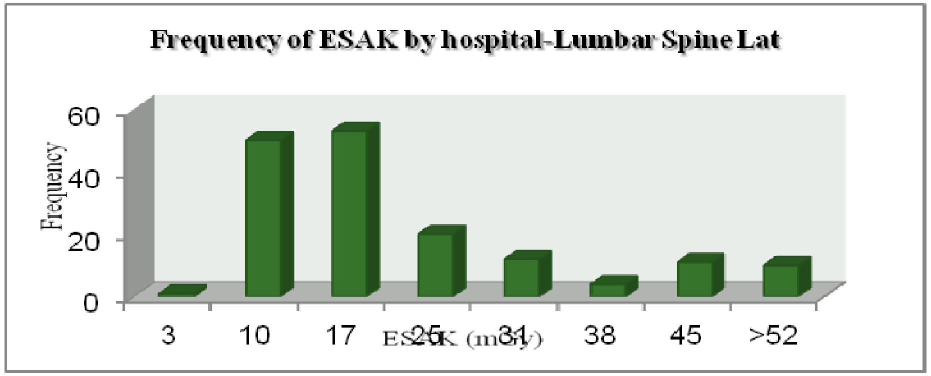

Frequency of ESAK by hospital-Chest PA
Frequency
150
100
50
0
0.06
0.7
1.3
2
>2.5
ESAK (mGy)

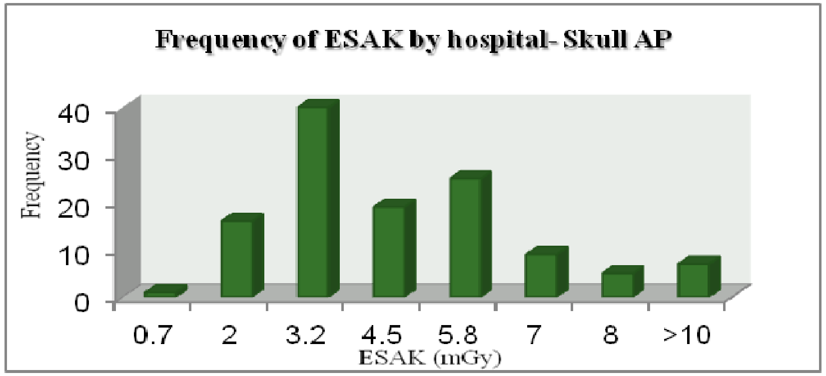

Frequency of ESAK by hospital-Chest Lat
Frequency
40
30
20
10
0
0.4
0.9
1.3
1.8
2.2
2.6
3
3.5
4
>4.4
ESAK (mGy)

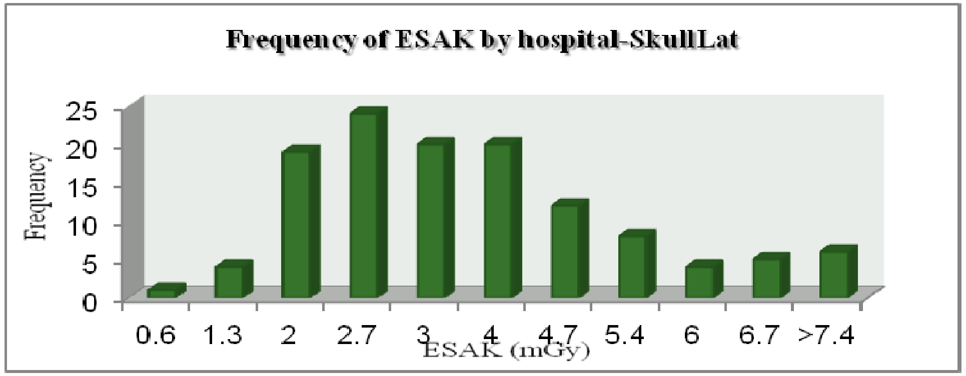

Frequency of ESAK by hospital-Cervical Spine AP
Frequency
50
40
30
20
10
0
0.43
0.8
1.2
1.5
1.8
2.1
2.5
2.8
3
3.5
3.9
4.2
>4.6
ESAK (mGy)

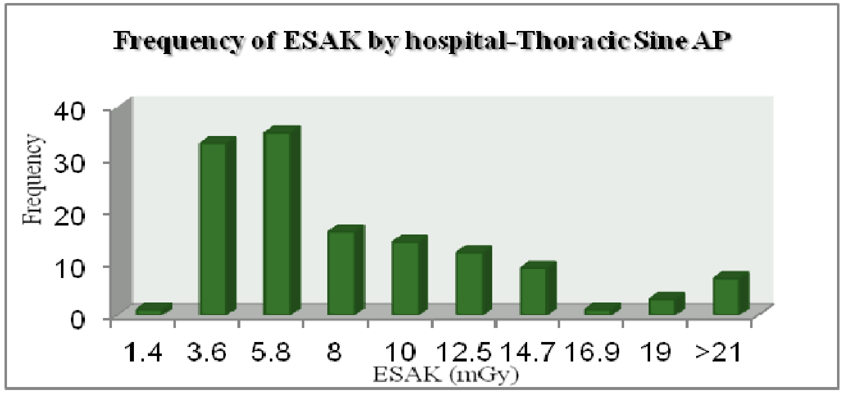

Frequency of ESAK by hospital-Cervical Spine Lat
Frequency
50
40
30
20
10
0
0.4
1
1.5
2
2.5
3
3.7
>4
ESAK (mGy)

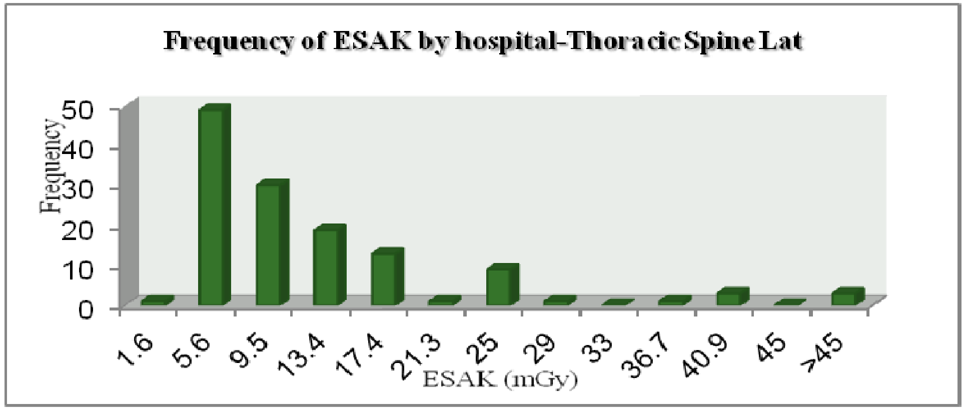

Frequency of ESAK by hospital-Lumbar Spine AP
Frequency
50
40
30
20
10
0
1.4
3.6
5.8
7.9
10
12
>14
ESAK (mGy)

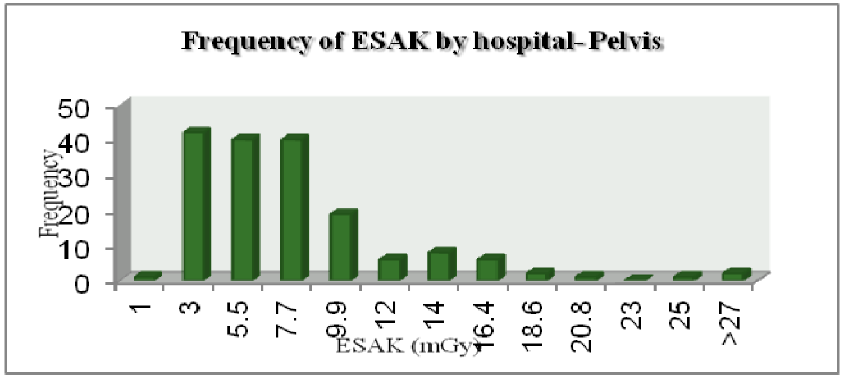

Frequency of ESAK by hospital-Lumbar Spine Lat
Frequency
60
40
20
0
3
10
17
25
31
38
45
>52
ESAK (mGy)

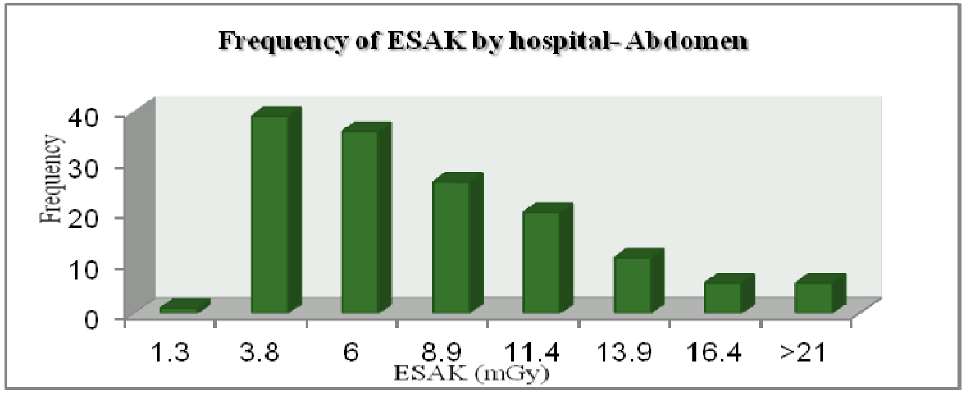

Frequency of ESAK by hospital- Skull AP
Frequency
0 10 20 30 40
0.7 2 3.2 4.5 5.8 7 8 >10
ESAK (mGy)


Frequency of ESAK by hospital-SkullLat
Frequency
0 5 10 15 20 25
0.6 1.3 2 2.7 3 4 4.7 5.4 6 6.7 >7.4
ESAK (mGy)


Frequency of ESAK by hospital-Thoracic Sine AP
Frequency
0 10 20 30 40
1.4 3.6 5.8 8 10 12.5 14.7 16.9 19 >21
ESAK (mGy)


Frequency of ESAK by hospital-Thoracic Spine Lat
Frequency
0 10 20 30 40 50
1.6 5.6 9.5 13.4 17.4 21.3 25 29 33 36.7 40.9 45 >45
ESAK (mGy)


Frequency of ESAK by hospital- Pelvis
Frequency
0 10 20 30 40 50
1 3 5.5 7.7 9.9 12 14 16.4 18.6 20.8 23 25 >27
ESAK (mGy)


Frequency of ESAK by hospital- Abdomen
Frequency
0 10 20 30 40
1.3 3.8 6 8.9 11.4 13.9 16.4 >21
ESAK (mGy)

Conclusions

- Patient doses were found to be similar to doses in developed countries but there are large differences between ESAKs for similar techniques which could be optimized by using technical parameters charts and optimized exposure parameters .

- Except the posterior aspect (PA)of the chest, that average patient ESAK resulted in these study are not higher than those in developed countries.