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Assessment of Entrance Surface Dose of X-ray PA examination of patients at Al-Zahra and Al -Hakim Hospitals in Al-Najaf Governorate, Iraq

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Abstract **Original Research Article**

The project is aimed at Al Zahra and Al Hakim Hospitals to focus on patient dosimetry and the establishment of diagnostic reference levels (DRL) for routine X-ray examinations (anteroposterior (abdomen) and (chest) posteroanterior). Ionizing radiation has biological effects that can be harmful, and therefore, it is important to monitor and optimize the radiation dose delivered to patients during medical imaging. The results of the previous studies showed that there are significant differences in radiation dose, so it is important to adopt local DRLs to make the patient safer and improve the radiation practice. Measure radiation doses during anteroposterior (AP) abdomen and posteroanterior (PA) chest radiography exams, set diagnostic reference levels (DRLs) to optimize the practice and improve patient safety. The present study is a prospective study involving 50 cases from Al-Hakim General Hospital and 50 cases from Al-Zahraa Teaching Hospital, with the majority of cases in 1-14 age group (during November 2025). Radiation doses at both hospitals were often higher than international diagnostic reference levels (DRLs) (esd), with Specific findings including higher kVp and mAs values, alluding to increased radiation levels during X-ray exams. It was finally concluded that both Al Zahra and Al Hakim Hospitals have higher ESD than recommended by DRLs. To overcome this, it is important to: Standardize the settings for X-ray exposures. Do periodic quality assurance on X-ray machines. Provide radiographers with training on dose optimization.

Keyword: ESD, radiation dose, X-ray, Al-Zahra Hospital, Al-Hakim Hospital, Al-Najaf Governorate, and Iraq

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1. Introduction

X-ray examinations are essential for diagnosing conditions such as fractures, infections, arthritis, osteoporosis, tumors, birth defects, and bone deformities. In addition to these, doctors may recommend X-rays for various other medical concerns involving both upper and lower extremities. X-ray imaging is crucial in a wide range of diagnostic procedures [1]. Medical ionizing radiation sources are the largest contributors to population radiation exposure from artificial sources, with diagnostic X-rays responsible for over 90% of this exposure. This is largely due to the high volume of

X-ray exams conducted annually [2]. The United Nations Scientific Committee on the Effects of Atomic Radiation estimates that approximately 2.1 billion medical X-ray examinations were conducted globally in 2000, which translates to an annual rate of 360 exams per 1.000 individuals. The estimate of 330 exams per 1,000 people in 1991-1995 was 10% lower than the current rate, showing an increase in the use of X-ray diagnostics. The use of X-ray imaging has a number of benefits, one of which is that images are typically available within minutes, and the cost of the imaging is fairly inexpensive. This has helped maintain the number of X-ray exams that have been performed over the years [3]. Optimizing radiation dose to patients has become a primary objective in the medical field. The main objective of radiation protection is to minimize unnecessary exposure and ensure that the benefits of the examination are greater than any risks. Reducing radiation dose while achieving high image quality is always a challenge for radiologists in order to assure proper diagnosis. Therefore, patient dose measurement is an important aspect in radiation safety and quality assurance programmed [2, 4, 5]. The study aims to assess the radiation doses received by patients undergoing routine anteroposterior (AP) abdomen, and posteroanterior (PA) chest X-ray examinations, and to establish local Diagnostic Reference Levels (DRLs) at Al Zahra and Al Hakim Hospitals, in order to optimize radiographic practices and enhance patient safety.

2. Study area

The cases were collected from two hospitals located in Najaf Governorate, which are government hospitals affiliated with the Najaf Health Department.

3. Sample collection

(100) samples were collected from Al-Hakim General Hospital and Al-Zahraa Teaching Hospital, affiliated with the Najaf Government Health Department, in period from November 2025 to February 2026.

1. (50) samples were taken from Al-Hakim General Hospital, Within the ages (5-14 years) and weight (18.7-46 kg), and (Kvp), (mAs).
2. (50) samples were taken from Al-Zahraa Teaching Hospital, Within the ages (1-10 years) and weight (9-30 kg), and (Kvp), (mAs).

4. Entrance surface dose calculation

Several methods have been developed to determine the Entrance Surface Dose (ESD). Generally, ESD can be determined using two main techniques: the first is direct measurement using Thermoluminescent Dosimeters (TLD), which are typically placed on the patient's skin before X-ray exposure. The second method is mathematical model calculations based on the outputs of the X-ray machine. Additionally, ESD can be determined through measurements performed on a phantom alongside data from the patient's examination [6-8].

Regarding the use of TLD to measure ESD, this method requires a prolonged measurement period and specialized techniques that may not be readily available in most radiology centers. On the other hand, using Ionization Chambers (IC) to measure ESD requires applying conversion factors to translate IC readings into absorbed dose values, which is considered a more complex procedure [9]. Due to the difficulty of accessing TLD or IC instruments, as well as the lack of calibration techniques for these devices, the first models for measuring skin doses were introduced by Birtch et al. In 1974 [10]. In 1984, Edmond published a simplified equation for estimating skin doses [11]. These mathematical models rely on several variables, such as tube voltage (kVp), the distance between the tube and the body (FSD), and exposure (mAs), which is the product of tube current and exposure time in seconds. Based on these mathematical models, this technique is used to estimate the ESD for patients.

The ESD was then calculated using the following equation [12,13]:

$$ESD = OP \times \left(\frac{KV}{80}\right)^2 \times mAs \times \left(\frac{100}{FSD}\right)^2 \times BSF$$

Where:

- OP: is the tube output per mAs measured at a distance of 180cm from the tube focus along the beam axis at (72-68) kVp. (OP = 0.071 mAs).
- kVp: is the peak of the tube voltage, recorded for any given examination. Where in many cases the output is measured at (72-68) kVp, and therefore this appears in the equation as a quotient to convert the output into an estimate of that which would be expected at the operational kVp. The value of (72-68) kVp should be substituted with whatever kVp the actual output is recorded at in any given instance.
- mAs: is the tube current-time product that is used in any given instant.
- SID: is source-to-image distance.
- FSD: is the focus-to-patient entrance surface distance.

$FSD = SID - Thickness.$

BSF: the Backscatter factor.[14]

5. Result and Discussion

5.1 Descriptive data

The present study is a prospective study including 50 from Al-Hakim General Hospital and 50 from Al-Zahraa Teaching Hospital, the majority of cases were in the 1-14 age group.

5.2 Result and Table of descriptive data analysis

Table (1): for First device (x-ray) of (AHH) for (chest view) (PA) (supine position). We look a result is Kvp; High value (70), Low value (67), mAs; High value (171), Low value (168), SID; 100cm, ESD; High value (18.65), Low value (15.68), age; (9,5), weight; (26,18.7).

No.	Examination	Age (Years)	Weight (Kg)	KVp	mAs	SID (cm)	Thickness (cm)	FSD (cm)	BSF	ESD
1	Chest	5	19	67	168	100	20	80	1.2	15.68695078
2	Chest	5	18.7	68	168	100	20	80	1.2	16.1587125
3	Chest	5	19.8	67	168	100	20	80	1.2	15.68695078
4	Chest	5	20	67	168	100	20	80	1.2	15.68695078
5	Chest	5	20.4	67	168	100	20	80	1.2	15.68695078
6	Chest	6	20.7	69	170	100	22	78	1.2	17.70995747
7	Chest	6	21	70	170	100	22	78	1.2	18.22700937
8	Chest	6	21.3	69	170	100	22	78	1.2	17.70995747
9	Chest	6	21.1	69	171	100	22	78	1.2	17.81413369
10	Chest	6	22	69	170	100	22	78	1.2	17.70995747
11	Chest	7	22.2	69	170	100	23	77	1.2	18.17294337
12	Chest	7	22	69	170	100	23	77	1.2	18.17294337
13	Chest	7	23	68	171	100	23	77	1.2	17.75383201
14	Chest	7	23	69	170	100	23	77	1.2	18.17294337
15	Chest	7	23.9	69	170	100	23	77	1.2	18.17294337
16	Chest	8	24	69	170	100	23	77	1.2	18.17294337

17	Chest	8	23..5	69	171	100	23	77	1.2	18.27984304
18	Chest	8	24	69	170	100	23	77	1.2	18.17294337
19	Chest	8	23.1	69	171	100	23	77	1.2	18.27984304
20	Chest	8	24.3	69	170	100	23	77	1.2	18.17294337
21	Chest	9	24.8	69	170	100	24	76	1.2	18.65432501
22	Chest	9	25	68	170	100	24	76	1.2	18.11753809
23	Chest	9	25	69	170	100	24	76	1.2	18.65432501
24	Chest	9	25.6	68	170	100	24	76	1.2	18.11753809
25	Chest	9	26	69	170	100	24	76	1.2	18.65432501

Table 2: for First device (x-ray) of (AZH) for (chest view) (PA) (supine position). We look a result is Kvp; High value (70), Low value (65), mAs; High value (170), Low value (166), SID; 100cm, ESD; High value (17.12), Low value (11.66), age; (5,1), weight; (22,9).

	Examination	Age (Years)	Weight (Kg)	KVp	mAs	SID (cm)	Thickness (cm)	FSD (cm)	BSF	ESD
1	Chest	1	9.5	67	168	100	10	90	1.2	12.39462778
2	Chest	1	10	66	168	100	10	90	1.2	12.0274
3	Chest	1	9	67	167	100	10	90	1.2	12.32085023
4	Chest	1	9.3	67	168	100	10	90	1.2	12.39462778
5	Chest	1	10.2	65	168	100	10	90	1.2	11.66569444
6	Chest	2	12	67	168	100	15	85	1.2	13.89570727
7	Chest	2	11.9	68	168	100	15	85	1.2	14.3136
8	Chest	2	13.7	67	168	100	15	85	1.2	13.89570727
9	Chest	2	14.2	67	169	100	15	85	1.2	13.97841981
10	Chest	2	14.8	67	168	100	15	85	1.2	13.89570727
11	Chest	3	15	67	168	100	20	80	1.2	15.68695078
12	Chest	3	15.7	67	168	100	20	80	1.2	15.68695078
13	Chest	3	16.1	67	168	100	20	80	1.2	15.68695078
14	Chest	3	17	67	168	100	20	80	1.2	15.68695078
15	Chest	3	17	67	168	100	20	80	1.2	15.68695078
16	Chest	4	18	67	168	100	20	80	1.2	15.68695078
17	Chest	4	17.5	70	168	100	20	80	1.2	17.12320313
18	Chest	4	18.3	67	168	100	20	80	1.2	15.68695078
19	Chest	4	20	67	169	100	20	80	1.2	15.78032549
20	Chest	4	19	67	168	100	20	80	1.2	15.68695078
21	Chest	5	19.4	67	168	100	20	80	1.2	15.68695078
22	Chest	5	19.8	68	166	100	20	80	1.2	15.96634688
23	Chest	5	20.3	67	168	100	20	80	1.2	15.68695078
24	Chest	5	22	67	170	100	20	80	1.2	15.8737002
25	Chest	5	21	67	168	100	20	80	1.2	15.68695078

Table 3: The result of (AZH) For (Chest view) (PA) (Erect and Supine Position), sample from 1st device Kvp; High value (70), Low value (65), mAs; High value (170), Low value (166), ESD; High value (17.12), Low value (11.66), sample from 2nd device Kvp; High value (72), Low value (69), mAs; High value (172), Low value (168), ESD; High value (4.84), Low value (4.19).

	Examination	Age (Years)	Weight(Kg)	KVp	mAs	SID (cm)	Thickness (cm)	FSD (cm)	BSF	ESD
1	Chest	1	9.5	67	168	100	10	90	1.2	12.39
2	Chest	1	10	66	168	100	10	90	1.2	12.0274
3	Chest	1	9	67	167	100	10	90	1.2	12.32085023
4	Chest	1	9.3	67	168	100	10	90	1.2	12.39462778
5	Chest	1	10.2	65	168	100	10	90	1.2	11.66569444
6	Chest	2	12	67	168	100	15	85	1.2	13.89570727
7	Chest	2	11.9	68	168	100	15	85	1.2	14.3136
8	Chest	2	13.7	67	168	100	15	85	1.2	13.89570727
9	Chest	2	14.2	67	169	100	15	85	1.2	13.97841981
10	Chest	2	14.8	67	168	100	15	85	1.2	13.89570727
11	Chest	3	15	67	168	100	20	80	1.2	15.68695078
12	Chest	3	15.7	67	168	100	20	80	1.2	15.68695078
13	Chest	3	16.1	67	168	100	20	80	1.2	15.68695078
14	Chest	3	17	67	168	100	20	80	1.2	15.68695078
15	Chest	3	17	67	168	100	20	80	1.2	15.68695078
16	Chest	4	18	67	168	100	20	80	1.2	15.68695078
17	Chest	4	17.5	70	168	100	20	80	1.2	17.12320313
18	Chest	4	18.3	67	168	100	20	80	1.2	15.68695078
19	Chest	4	20	67	169	100	20	80	1.2	15.78032549
20	Chest	4	19	67	168	100	20	80	1.2	15.68695078
21	Chest	5	19.4	67	168	100	20	80	1.2	15.68695078
22	Chest	5	19.8	68	166	100	20	80	1.2	15.96634688
23	Chest	5	20.3	67	168	100	20	80	1.2	15.68695078
24	Chest	5	22	67	170	100	20	80	1.2	15.8737002
25	Chest	5	21	67	168	100	20	80	1.2	15.68695078
1	Chest	6	21.3	69	171	180	22	158	1.2	4.341499334
2	Chest	6	22	69	170	180	22	158	1.2	4.316110449
3	Chest	6	20.9	69	172	180	22	158	1.2	4.366888219
4	Chest	6	21.6	70	170	180	22	158	1.2	4.442121655
5	Chest	6	22	69	170	180	22	158	1.2	4.316110449
6	Chest	7	21	69	170	180	23	157	1.2	4.371267851
7	Chest	7	21.7	69	170	180	23	157	1.2	4.371267851
8	Chest	7	22	70	168	180	23	157	1.2	4.445961297
9	Chest	7	23	69	170	180	23	157	1.2	4.371267851
10	Chest	7	22.6	69	169	180	23	157	1.2	4.34555451
11	Chest	8	23	69	170	180	23	157	1.2	4.371267851
12	Chest	8	22.9	69	170	180	23	157	1.2	4.371267851
13	Chest	8	24	69	170	180	23	157	1.2	4.371267851
14	Chest	8	23.7	69	170	180	23	157	1.2	4.371267851
15	Chest	8	24.1	69	170	180	23	157	1.2	4.371267851
16	Chest	9	25	69	170	180	24	156	1.2	4.427489368
17	Chest	9	24.9	69	170	180	24	156	1.2	4.427489368
18	Chest	9	26	69	171	180	24	156	1.2	4.453533423
19	Chest	9	25.7	67	171	180	24	156	1.2	4.199099251
20	Chest	9	26.8	69	170	180	24	156	1.2	4.427489368
21	Chest	10	27	71	170	180	24	156	1.2	4.687875216

22	Chest	10	27.9	71	172	180	24	156	1.2	4.743026689
23	Chest	10	29	72	171	180	24	156	1.2	4.849215976
24	Chest	10	30	71	172	180	24	156	1.2	4.743026689
25	Chest	10	28.8	70	172	180	24	156	1.2	4.610361193

Table 4: The result of (AHH) For (Chest view) (PA) (Erect and Supine Position). sample from 1st device Kvp; High value (70), Low value (67), mAs; High value (171), Low value (168), ESD; High value (18.65), Low value (15.68), sample from 2nd device Kvp; High value (73), Low value (70), mAs; High value (173), Low value (170), ESD; High value (5.04), Low value (4.64).

	Examination	Age (Years)	Weight(Kg)	KVp	mAs	SID (cm)	Thickness (cm)	FSD (cm)	BSF	ESD
1	Chest	5	19	67	168	100	20	80	1.2	15.68695
2	Chest	5	18.7	68	168	100	20	80	1.2	16.15871
3	Chest	5	19.8	67	168	100	20	80	1.2	15.68695
4	Chest	5	20	67	168	100	20	80	1.2	15.68695
5	Chest	5	20.4	67	168	100	20	80	1.2	15.68695
6	Chest	6	20.7	69	170	100	22	78	1.2	17.70996
7	Chest	6	21	70	170	100	22	78	1.2	18.22701
8	Chest	6	21.3	69	170	100	22	78	1.2	17.70996
9	Chest	6	21.1	69	171	100	22	78	1.2	17.81413
10	Chest	6	22	69	170	100	22	78	1.2	17.70996
11	Chest	7	22.2	69	170	100	23	77	1.2	18.17294
12	Chest	7	22	69	170	100	23	77	1.2	18.17294
13	Chest	7	23	68	171	100	23	77	1.2	17.75383
14	Chest	7	23	69	170	100	23	77	1.2	18.17294
15	Chest	7	23.9	69	170	100	23	77	1.2	18.17294
16	Chest	8	24	69	170	100	23	77	1.2	18.17294
17	Chest	8	23..5	69	171	100	23	77	1.2	18.27984
18	Chest	8	24	69	170	100	23	77	1.2	18.17294
19	Chest	8	23.1	69	171	100	23	77	1.2	18.27984
20	Chest	8	24.3	69	170	100	23	77	1.2	18.17294
21	Chest	9	24.8	69	170	100	24	76	1.2	18.65433
22	Chest	9	25	68	170	100	24	76	1.2	18.11754
23	Chest	9	25	69	170	100	24	76	1.2	18.65433
24	Chest	9	25.6	68	170	100	24	76	1.2	18.11754
25	Chest	9	26	69	170	100	24	76	1.2	18.65433
1	Chest	10	26.8	71	172	180	24	156	1.2	4.743027
2	Chest	10	27	72	171	180	24	156	1.2	4.849216
3	Chest	10	27.5	71	172	180	24	156	1.2	4.743027
4	Chest	10	29	71	173	180	24	156	1.2	4.770602
5	Chest	10	28.3	72	172	180	24	156	1.2	4.877574
6	Chest	11	29	71	172	180	25	155	1.2	4.804424
7	Chest	11	30	70	172	180	25	155	1.2	4.670042
8	Chest	11	29.8	71	170	180	25	155	1.2	4.748559
9	Chest	11	30.4	71	172	180	25	155	1.2	4.804424
10	Chest	11	31	71	173	180	25	155	1.2	4.832357
11	Chest	12	33	71	172	180	25	155	1.2	4.804424
12	Chest	12	33	72	173	180	25	155	1.2	4.969439
13	Chest	12	35	71	172	180	25	155	1.2	4.804424

14	Chest	12	35.8	71	173	180	25	155	1.2	4.832357
15	Chest	12	36	70	172	180	25	155	1.2	4.670042
16	Chest	13	38	71	172	180	25	155	1.2	4.804424
17	Chest	13	38.9	72	172	180	25	155	1.2	4.940713
18	Chest	13	40	71	173	180	25	155	1.2	4.832357
19	Chest	13	39.6	70	171	180	25	155	1.2	4.64289
20	Chest	13	40.5	71	172	180	25	155	1.2	4.804424
21	Chest	14	41	71	172	180	25	155	1.2	4.804424
22	Chest	14	43	72	173	180	25	155	1.2	4.969439
23	Chest	14	42	71	172	180	25	155	1.2	4.804424
24	Chest	14	44	73	171	180	25	155	1.2	5.04938
25	Chest	14	46	71	172	180	25	155	1.2	4.804424

Table 5: Compare between (AHH) and (AZH), (Chest View), (PA) (Supine Position). (AHH) sample from 1st device Kvp; High value (70), Low value (67), mAs; High value (171), Low value (168), ESD; High value (18.65), Low value (15.68), (AZH) sample from 1st device Kvp; High value (70), Low value (65), mAs; High value (170), Low value (166), ESD; High value (17.12), Low value (11.66).

(AHH)				(AZH)		
First device x-ray				First device x-ray		
supine				supine		
	low value	high value			low value	high value
Kvp	67	70		Kvp	65	70
mAs	168	171		mAs	166	170
SID	100	100		SID	100	100
ESD	15.68	18.65		ESD	11,66	17.12
age	5	9		age	1	5
weight	18.7	26		weight	9	22

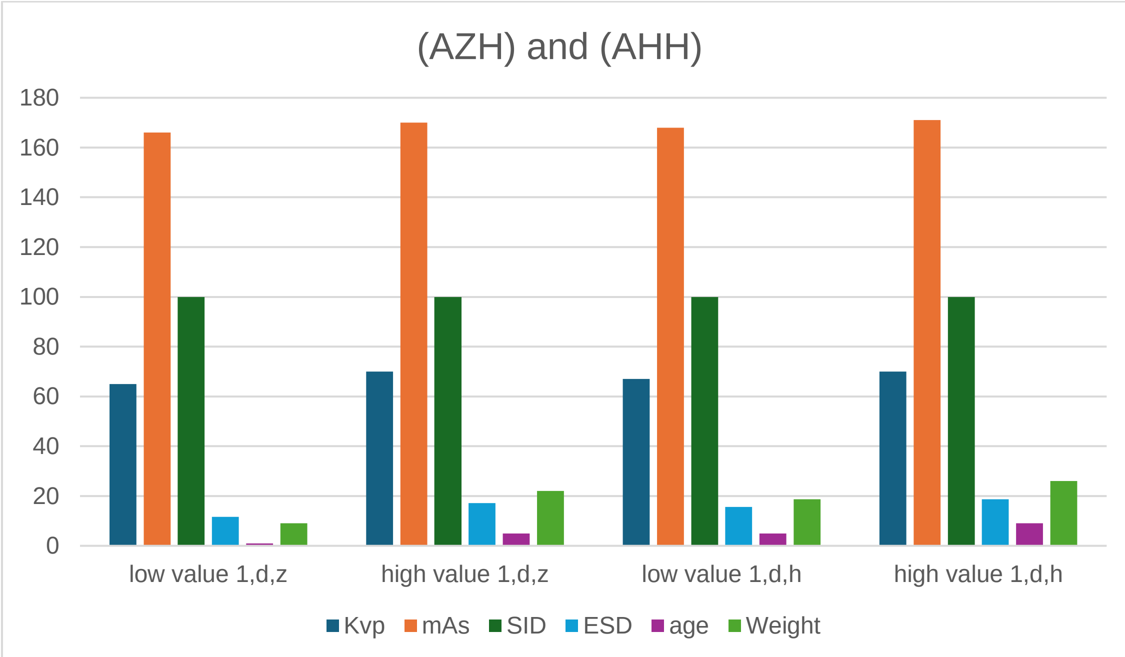

Figure (1): Compare between 1st x-ray device (AZH) and 1st x-ray device (AHH) for Supine position.

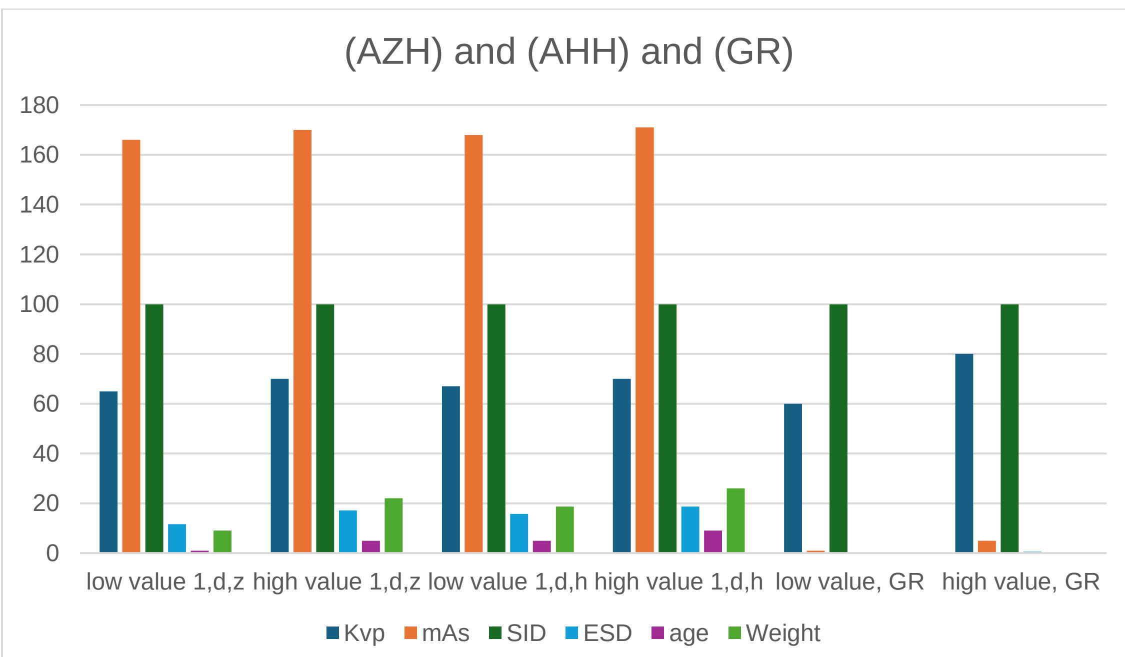

Figure (2): Compare between 1st x-ray device (AZH) and 1st x-ray device (AHH) for Supine position with Global range (GR).

Table 6: for First device (x-ray) of (AHH) for (abdomen view) (AP) (supine position). We look a result is Kvp; High value (81), Low value (77), mAs; High value (182), Low value (178), SID; 100cm, ESD; High value (27.5), Low value (21.9), age; (9,5), weight; (26,18.7).

	Examination	Age (Years)	Weight (Kg)	KVp	mAs	SID (cm)	Thickness (cm)	FSD (cm)	BSF	ESD
1	Abdomen	5	19	77	178	100	20	80	1.2	21.9523541
2	Abdomen	5	18.7	78	178	100	20	80	1.2	22.52624766
3	Abdomen	5	19.8	77	178	100	20	80	1.2	21.9523541
4	Abdomen	5	20	77	178	100	20	80	1.2	21.9523541
5	Abdomen	5	20.4	77	178	100	20	80	1.2	21.9523541
6	Abdomen	6	20.7	79	180	100	22	78	1.2	24.58086169
7	Abdomen	6	21	80	180	100	22	78	1.2	25.20710059
8	Abdomen	6	21.3	79	180	100	22	78	1.2	24.58086169
9	Abdomen	6	21.1	79	181	100	22	78	1.2	24.71742203
10	Abdomen	6	22	79	181	100	22	78	1.2	24.71742203
11	Abdomen	7	22.2	79	180	100	23	77	1.2	25.2234715
12	Abdomen	7	22	79	180	100	23	77	1.2	25.2234715
13	Abdomen	7	23	79	182	100	23	77	1.2	25.50373229
14	Abdomen	7	23	80	181	100	23	77	1.2	26.00978243
15	Abdomen	7	23.9	80	181	100	23	77	1.2	26.00978243
16	Abdomen	8	24	80	181	100	23	77	1.2	26.00978243
17	Abdomen	8	23..5	80	182	100	23	77	1.2	26.15348288
18	Abdomen	8	24	80	181	100	23	77	1.2	26.00978243
19	Abdomen	8	23.1	80	182	100	23	77	1.2	26.15348288
20	Abdomen	8	24.3	80	181	100	23	77	1.2	26.00978243
21	Abdomen	9	24.8	80	181	100	24	76	1.2	26.69875346
22	Abdomen	9	25	79	181	100	24	76	1.2	26.03545631
23	Abdomen	9	25	80	181	100	24	76	1.2	26.69875346
24	Abdomen	9	25.6	80	181	100	24	76	1.2	26.69875346
25	Abdomen	9	26	81	182	100	24	76	1.2	27.52161163

Table 7: for First device (x-ray) of (AZH) for (abdomen view) (AP) (supine position). We look a result is Kvp; High value (81), Low value (75), mAs; High value (181), Low value (177), SID; 100cm, ESD; High value (24.4), Low value (16.4), age; (5,1), weight; (22,9).

	Examination	Age (Years)	Weight(Kg)	KVp	mAs	SID (cm)	Thickness (cm)	FSD (cm)	BSF	ESD
1	Abdomen	1	9.5	77	178	100	10	90	1.2	17.34506991
2	Abdomen	1	10	76	178	100	10	90	1.2	16.89747407
3	Abdomen	1	9	77	178	100	10	90	1.2	17.34506991
4	Abdomen	1	9.3	77	178	100	10	90	1.2	17.34506991

5	Abdomen	1	10.2	75	178	100	10	90	1.2	16.45572917
6	Abdomen	2	12	76	178	100	15	85	1.2	18.94388097
7	Abdomen	2	11.9	78	178	100	15	85	1.2	19.95404637
8	Abdomen	2	13.7	77	178	100	15	85	1.2	19.44568391
9	Abdomen	2	14.2	77	179	100	15	85	1.2	19.55492933
10	Abdomen	2	14.8	77	178	100	15	85	1.2	19.44568391
11	Abdomen	3	15	77	178	100	20	80	1.2	21.9523541
12	Abdomen	3	15.7	77	178	100	20	80	1.2	21.9523541
13	Abdomen	3	16.1	78	179	100	20	80	1.2	22.65279961
14	Abdomen	3	17	78	179	100	20	80	1.2	22.65279961
15	Abdomen	3	17	78	179	100	20	80	1.2	22.65279961
16	Abdomen	4	18	78	179	100	20	80	1.2	22.65279961
17	Abdomen	4	17.5	81	179	100	20	80	1.2	24.42883271
18	Abdomen	4	18.3	78	179	100	20	80	1.2	22.65279961
19	Abdomen	4	20	78	180	100	20	80	1.2	22.77935156
20	Abdomen	4	19	78	179	100	20	80	1.2	22.65279961
21	Abdomen	5	19.4	78	179	100	20	80	1.2	22.65279961
22	Abdomen	5	19.8	79	177	100	20	80	1.2	22.97772861
23	Abdomen	5	20.3	78	179	100	20	80	1.2	22.65279961
24	Abdomen	5	22	78	181	100	20	80	1.2	22.90590352
25	Abdomen	5	21	78	180	100	20	80	1.2	22.77935156

Table 8: Compare between (AHH) and (AZH), (Abdomen View), (AP) (Supine Position), (AHH) sample from 1st device Kvp; High value (81), Low value (77), mAs; High value (182), Low value (178), ESD; High value (27.5), Low value (21.9), (AZH) sample from 1st device Kvp; High value (81), Low value (75), mAs; High value (181), Low value (177), ESD; High value (24.4), Low value (16.4).

Al hakim hospital				Al Zahra hospital		
First device x-ray				First device x-ray		
supine				supine		
	low value	high value			low value	high value
Kvp	77	81		Kvp	75	81
mAs	178	182		mAs	177	181
SID	100	100		SID	100	100
ESD	21.9	27.5		ESD	16.4	24.4
age	5	9		age	1	5
weight	18.7	26		weight	9	22

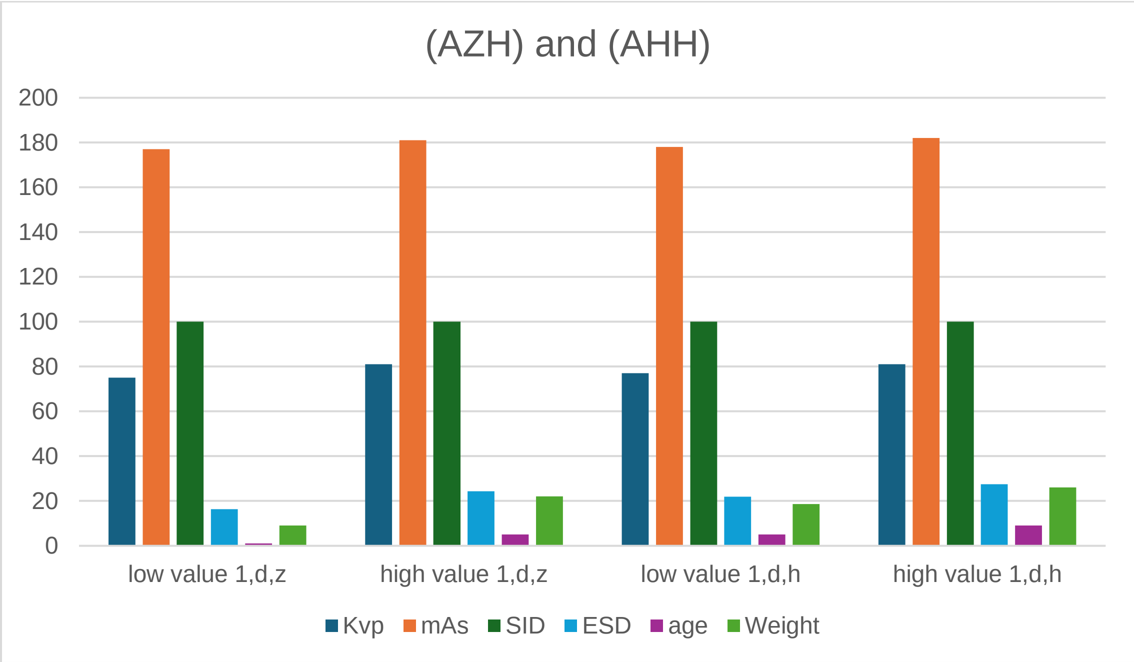

Figure (3): Compare between 1st x-ray device (AZH) and 1st x-ray device (AHH) for Supine position.

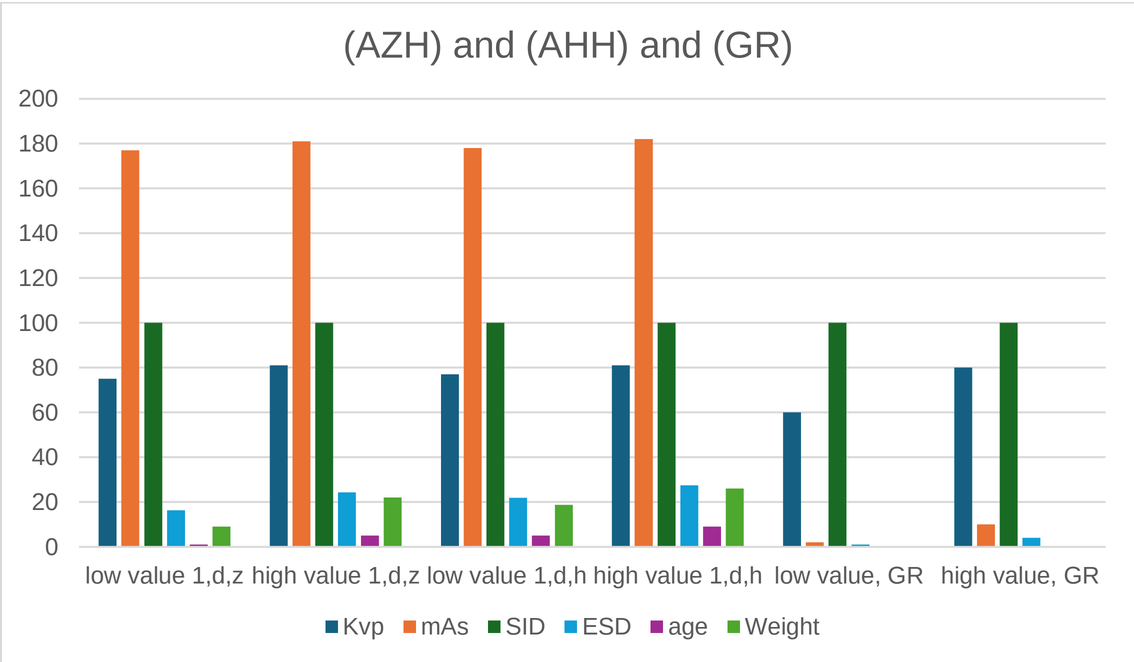

Figure (4): Compare between 1st x-ray device (AZH) and 1st x-ray device (AHH) for Supine position with Global range (GR).

5.3 Results: for PA (Chest) and AP (Abdomen)

Data collected from patient examinations, including age, weight, peak kilovolt (kVp), milliampere-second (mAs), and electrostatic discharge (ESD) values, were collected from 100 patients (50 patients from each hospital). The results between the two hospitals were compared to international diagnostic reference levels (DRLs). ESD measurements showed that radiation doses at both hospitals frequently exceeded international DRL guidelines, and Specific findings included elevated kVp and mAs values, indicating higher exposure levels during X-ray examinations.

5.4 Discussion

The analysis of data collected from 100 patients across two hospitals revealed significant findings related to radiation exposure during X-ray examinations. Various key parameters, including age, weight, peak kilovolt (kVp), milliampere-second (mAs), and electrostatic discharge (ESD) were assessed and compared to internationally accepted diagnostic reference levels (DRLs).

One of the important findings from the study was that ESD levels in both hospitals were often above the DRLs recommended by the international standards. This indicates that patients are getting more radiation than is deemed optimal for diagnostic imaging. High ESDs directly signal the potential for overexposure during radiography procedures and may raise the risk for stochastic effects like radiation-induced conditions in the future.

When further analysis of exposure parameters was performed, the consistently high kVp and mAs values were observed for both facilities. Therefore, high kVp values will increase the energy (penetrability) of the X-ray beam, and high mAs will increase the amount of radiation produced, leading to a higher patient dose. The results suggest that there is a need to standardize the radiographic protocols and check the equipment used at both hospitals so that they are optimized and conform to international standards of best practice.

A consistent deviation from the DRLs indicates a systematic problem and not individual deviations. Some factors that may contribute to this include antiquated equipment, failure to follow dose optimization principles, inadequate training of radiologic technologists or lack of regular quality assurance programs. Solving these root causes is crucial for keeping patients safe and avoiding exposure to unnecessary radiation.

6. Conclusions

The present study found that the Entrance Surface Dose (ESD), tube voltage (kVp), and tube current–time product (mAs) obtained at Al Zahra Hospital and Al Hakim Hospital were greater than the internationally recommended values. The results of this study suggest that there is a need to enhance the management of radiation dose and optimize the parameters of a radiograph examination in both hospitals. The study also highlights the need for standardization of the exposure protocols for consistent image quality whilst minimizing unnecessary radiation exposure to the patient. Further, periodic quality control and quality assurance of the radiographic equipment should be followed to ensure equipment reliability and performance accuracy. Regular annual dose checks are suggested in hospitals and healthcare centers to monitor radiation exposure and follow the international radiation safety standards. Also, ongoing training and education programs need to be undertaken for further improvement of dose optimization, and to establish better patient radiation protection.

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