film analysis and quality control from x-rays examinations in some hospitals in Baghdad

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Abstract
There were significant correlation between breathing effects in chest x-ray examination and rejected film.
While the techniques and skills employed contribute to about 50% nearly equally of the rejected films.
The study samples included (300) patients divided males and females.
The mean age of subjects was (35±10years) and their mean height was (170±5 cm), and the mean weight was (70±5Kgm)

Introduction
The first phase of the national project in diagnostic radiology concentrate on the film reject rate analysis, quality control for x-ray diagnostic instruments and measurement of patient dose, which was completed within four weeks.
The observed reject rates were found to be nearly independent of the type of x-ray examination, also they reflected an equally 50% by both the nature of technique and skills employed.
Where as the results of measurement of patient dose, which were taken through the first phase of the project, were found to be nearly within the range of the international recommendations given IAEA

Materials and methods
The study was performed with two months, the patients from both sexes were referred to the x-ray sections in (institute of x-ray, specialist surgeries, al-yarmook and Dar - altamreedh hospitals) by various physicians, and they were either inpatients or outpatients
Chest/PA, abdomen/AP, lumber spine /AP, lumber spine /LAT, and pelvis/AP, X-ray examinations were chosen to be studies; they were investigated with general x-ray machine.
Each x-ray room was provided with a daily form for wasted films to be taken .The rejected films were counted according to the x-ray room location and cause of rejection
Results and Discussion

Rejected film rate analysis:

The overall reject rates by hospitals as a percentage of total films used at institute of x-ray, specialist surgeries, al-yarmook and Dar-altamreedh hospitals, were found to be 6.12%, 4.35%, 4.17% and 4.17%, respectively.

Other results in table (2) and (3) indicate that the techniques and skills employed contribute to about 50% nearly equally of the rejected films.

Further be observed that the film reject rates are similar across the studies hospitals as shown in figure (1).

Figure (1): Rejected Rate by Examination For each Hospital as percentage of Film Used in the Examination
| hospitals                      | rejected rates by causes% |
|-------------------------------|---------------------------|
|                              | Too dark | Too light | Positioning | Patient movement | other |
| institute of x-ray Room 1    | 55.00    | 25.00     | 5.00        | 5.00              | 10.00 |
| institute of x-ray Room 2    | 33.33    | 33.33     | 0.00        | 33.33             | 0.00  |
| institute of x-ray Room 3    | 12.50    | 37.50     | 25.00       | 12.50             | 12.50 |
| institute of x-ray Room 4    | 0.00     | 55.565    | 22.22       | 22.22             | 0.00  |
| specialist surgeries Room 1  | 100.00   | 0.00      | 0.00        | 0.00              | 0.00  |
| specialist surgeries Room 2  | 25.00    | 25.00     | 33.33       | 0.00              | 16.67 |
| al-yarmook Room 1             | 53.00    | 27.00     | 5.00        | 5.00              | 10.00 |
| al-yarmook Room 2             | 12.50    | 37.00     | 25.00       | 12.50             | 12.50 |
| al-yarmook Room 3             | 12.50    | 25.00     | 36.00       | 0.00              | 26.00 |
| Dar altamreedh Room 1         | 4.00     | 4.00      | 11.00       | 25.00             | 20.00 |
| Dar altamreedh Room 2         | 37.00    | 23.00     | 12.00       | 0.00              | 28.00 |
| Dar altamreedh Room 3         | 0.00     | 0.00      | 16.67       | 25.00             | 28.00 |
TABLE (2): rejected rates by reason and room as a percentage of other causes at hospitals.

| hospitals          | rejected rates by causes% |   |   |   |   |
|--------------------|---------------------------|--|--|--|--|
|                    | Too dark | Too light | Positioning | Patient movement | other  |
| institute of x-ray | 26.32    | 14.22     | 13.51       | 9.11             | 36.84  |
| specialist surgeries | 12.52   | 13.79     | 15.79       | 31.58            | 26.32  |
| al-yarmook         | 20.00    | 30.00     | 30.00       | 5.00             | 15.00  |
| Dar altamreedh     | 36.93    | 34.48     | 11.34       | 10.34            | 6.90   |

The patient reflections on film rejection were observed significantly on chest x-ray examinations and apparently, it is an evidence of breathing effect, as shown in figure (3).

Most of films were used for chest /AP examination (50%) due to the fact that most not all hospitals involved in this project stated to use digital units instead of conventional units like institute of x-ray and Dar – altamreedh as shown in figure (4).

The provision of batter quality films and fresh processing chemicals would improve the results. regular training in related radiation protection matter of the radiology staff would also be useful, for instance, the difficulty in selecting appropriate exposure parameters was observed to be a source of majority avoidably waste films, as shown in figure (5).
Figure (2): statistical Analysis for Total Rejected Films

| Part            | Percentage |
|-----------------|------------|
| Chest/PA        | 46%        |
| Lumber spine / Ap | 13%       |
| Lumber spine / LAT | 11%      |
| abdomen         | 21%        |
| pelvis          | 4%         |
| skull/AP        | 2.4%       |
| skull/LAT       | 2.6%       |
Figure (3): statistical Analysis for Total Films used

| Part         | Percentage |
|--------------|------------|
| chest/AP     | 50%        |
| abdomen/AP   | 13%        |
| lumber spine/AP | 11%     |
| lumber spine/LAT | 11%   |
| pelvis/AP    | 6%         |
| skull/AP     | 5%         |
| skull/LAT    | 4%         |
Elevated reject rate in abdomen/ AP are evidence of this deficiency as shown in figure (1).

The inadequate training problem manifest itself also in relation the x-ray output in achieving special diagnostic needs, for example in x-ray rooms 1, 2 and 3, we see table (2) recorded significant film reject rate due to characteristic "Too Dark" condition, and x-ray rooms 4, 5, 6, 7, 8 and 9 recorded significant film reject rate due to characteristic "Too Light" conditions. These examples demonstrate the needs to establish regular training for staff in order to reduce the film reject rates and improve related operations.

As we have seen from the previous results, that the majority of waste film were due to lack of the radiation protection culture for radiology staff and absence of in-house quality assurance and programs for immediate corrective action.
# TAEBL (3) : Characteristics of x-ray Equipments.

| Hospital                          | x-ray room | x-ray unit          | Total filtration (mm AL) | Focal spot size (mm) | Processor       | Installation date |
|-----------------------------------|------------|---------------------|--------------------------|----------------------|-----------------|------------------|
| institute of x-ray                | 1          | C.G.R               | Multi pulses             | 2.5                  | 1.2/1.8         | Kodak 5629       | 1980             |
|                                   | 2          | Shimadzu            | Multi pulses             | 3                    | 1/2             | Kodak10016       | 2003             |
|                                   | 3          | Toshiba             | Multi pulses             | 2.5                  | 1.2/1.8         | I.M.S A020206    |                  |
|                                   | 4          | Philips             | Multi pulses             | 2.5                  | 1/2             |                  | 1985             |
| specialist surgeries hospital     | 5          | Sedecal             | High frequency           | 2.5                  | 0.6/1.2         | Siemens          | 2004             |
| yarmook hospital                  | 6          | Sedecal             | High frequency           | 2.5                  | 0.6/1.2         | Kodak green/400  |                  |
|                                   | 7          | Shimadzu            | Multi pulses             | 3                    | 1/2             | C.G.R            | 1984             |
|                                   | 8          | Sedecal             | High frequency           | 2.5                  | 0.6/1.2         | C.G.R            | 1984             |
|                                   | 9          | Shimadzu            | Multi pulses             | 2.5                  | 1/2             | C.G.R            | 1984             |
| Dar-altamreed hospital            | 10         | Toshiba             | Multi pulses             | 3                    | 0.6/1.2         | Kodak 9790       | 1985             |
|                                   | 11         | Sedecal             | High frequency           | 2.5                  | 1.2/1.8         | Sadecal 2682     | 1999             |
|                                   | 12         | Sedecal             | High frequency           | 2.5                  | 0.6/1.2         |                  |                  |
Tables (4): patient information, the mean the corresponding summary of selected techniques at each hospital.

Abdomen/AP first round measurements, results of hospitals and X-ray rooms

| No. | Hospitals                        | Room NO. | Speed class of film screen | Patient weight (Kg)* | Applied potential (kVp)* | Half layer value (mmAL) | Tube current (mAs) * |
|-----|---------------------------------|----------|----------------------------|----------------------|--------------------------|------------------------|---------------------|
| 1   | Institute of X-ray              | 1        | 200                        | 71.5±1.09            | 77.00±0.00               | 3.15                   | 21.72±2.70          |
|     |                                 | 2        | 200                        | 72.2±1.39            | 58.80±2.68               | 3.76                   | 18.64±2.75          |
|     |                                 | 3        | 400                        | 70.92±1.41           | 70.35±3.46               | 3.38                   | 24.33±5.77          |
| 2   | Specialist Surgeries Hospital   | 4        | 400                        | 67.90±1.44           | 67.10±2.18               | 3.01                   | 21.65±3.15          |
|     |                                 | 5        | 200/400                    | 71.5±1.09            | 77.00±0.00               | 3.64                   | 19.53±6.67          |
|     |                                 | 6        | 200/400                    | 71.5±1.09            | 70.10±4.86               | 3.01                   | 25.50±9.45          |
| 3   | Yarmook Hospital                | 7        | 200/400                    | 71.6±1.23            | 65.54±1.71               | 3.13                   | 23.14±3.42          |
|     |                                 | 8        | 200/400                    | 72.2±2.19            | 68.59±3.00               | 3.4                    | 18.57±2.47          |
|     |                                 | 9        | 400                        | 68.3±1.45            | 77.00±0.00               | 3.31                   | 21.67±2.54          |
| 4   | Dar-Altamreedh Hospital         | 10       | 400                        | 69.4±1.24            | 75.50±3.63               | 3.18                   | 28.85±5.14          |
|     |                                 | 11       | 200                        | 72.2±1.15            | 70.24±4.86               | 3.4                    | 23.83±4.13          |
|     |                                 | 12       | 400                        | 68.3±1.43            | 73.14±3.26               | 3.32                   | 24.85±4.89          |

Chest/AP first round measurements, results of hospitals and X-ray rooms

| No. | Hospitals                        | Room NO. | Speed class of film screen | Patient weight (Kg)* | Applied potential (kVp)* | Half layer value (mmAL) | Tube current (mAs) * |
|-----|---------------------------------|----------|----------------------------|----------------------|--------------------------|------------------------|---------------------|
| 1   | Institute of X-ray              | 1        | 200                        | 70.3±2.6             | 117±2.6                  | 3.15                   | 0.72±0.22           |
|     |                                 | 2        | 200                        | 67.5±1.5             | 85.9±4.5                 | 3.76                   | 0.62±0.23           |
|     |                                 | 3        | 400                        | 70.1±1.32            | 117±0.0                  | 3.38                   | 0.65±0.12           |
| 2   | Specialist Surgeries Hospital   | 4        | 400                        | 71.6±1.61            | 117±0.0                  | 3.01                   | 0.67±0.24           |
|     |                                 | 5        | 200/400                    | 72.2±2.19            | 113±3                    | 3.64                   | 0.72±0.15           |
|     |                                 | 6        | 200/400                    | 72.4±2.12            | 113±3                    | 3.01                   | 0.82±0.34           |
| 3   | Yarmook Hospital                | 7        | 200/400                    | 68.3±1.44            | 93±1.5                   | 3.13                   | 0.75±0.10           |
|     |                                 | 8        | 200/400                    | 69.4±1.36            | 113±0.9                  | 3.4                    | 0.67±0.14           |
|     |                                 | 9        | 400                        | 71.5±1.09            | 94.7±3.6                 | 3.31                   | 0.73±0.13           |
| 4   | Dar-Altamreedh Hospital         | 10       | 400                        | 72.2±1.45            | 109±0.0                  | 3.18                   | 0.46±0.21           |
|     |                                 | 11       | 200                        | 70.92±132            | 117±0.0                  | 3.4                    | 0.19±0.24           |
|     |                                 | 12       | 400                        | 67.90±148            | 109±0.0                  | 3.32                   | 0.54±0.20           |
## Lumber spine /AP first round measurements, results of hospitals and X-ray rooms

| No. | Hospitals                   | Room NO. | Speed class of film screen | Patient weight(Kg)* | Applied potential (kVp)* | Half layer value (mmAL) | Tube current (mAs) * |
|-----|----------------------------|----------|----------------------------|---------------------|-------------------------|------------------------|---------------------|
| 1   | Institute of X-ray         | 1        | 200                        | 73.00±2.5           | 68.60±2.6               | 3.15                   | 35.00±0.0           |
|     |                            | 2        | 200                        | 66.10±4.16          | 77.00±0.00              | 3.76                   | 32.67±2.52          |
|     |                            | 3        | 400                        | 76.20±2.3           | 84.10±1.75              | 3.38                   | 37.26±3.18          |
| 2   | Specialist Surgeries Hospital | 4       | 400                        | 79.00±2.00          | 65.45±2.5               | 3.01                   | 35.00±0.00          |
|     |                            | 5       | 200/400                    | 73.00±2.5           | 82.00±0.00              | 3.64                   | 38.42±2.89          |
|     |                            | 6       | 200/400                    | 75.00±2.2           | 78.00±0.00              | 3.01                   | 30.28±1.75          |
| 3   | Yarmook Hospital           | 7       | 200/400                    | 70.75±5.3           | 77.00±0.00              | 3.13                   | 32.67±2.52          |
|     |                            | 8       | 200/400                    | 73.00±2.6           | 67.88±3.4               | 3.4                    | 36.09±3.05          |
|     |                            | 9       | 400                        | 70.8±3.0            | 80.00±0.00              | 3.31                   | 30.28±1.82          |
| 4   | Dar-Altamreedh Hospital    | 10      | 400                        | 66.10±4.2           | 69.5±3.0                | 3.18                   | 32.67±2.52          |
|     |                            | 11      | 200                        | 72.60±8.0           | 62.00±1.2               | 3.4                    | 36.00±0.00          |
|     |                            | 12      | 400                        | 79.00±0.0           | 80.00±0.00              | 3.32                   | 30.28±0.83          |

## Lumber spine/LAT first round measurements, results of hospitals and X-ray rooms

| No. | Hospitals                   | Room NO. | Speed class of film screen | Patient weight(Kg)* | Applied potential (kVp)* | Half layer value (mmAL) | Tube current (mAs) * |
|-----|----------------------------|----------|----------------------------|---------------------|-------------------------|------------------------|---------------------|
| 1   | Institute of X-ray         | 1        | 200                        | 66.00±5.66          | 95±2.62                 | 3.15                   | 37.08±1.56          |
|     |                            | 2        | 200                        | 75.40±2.59          | 90±3.57                 | 3.76                   | 35.17±2.45          |
|     |                            | 3        | 400                        | 71.20±4.69          | 90±4.72                 | 3.38                   | 38.24±1.71          |
| 2   | Specialist Surgeries Hospital | 4       | 400                        | 78.67±5.6           | 93±2.88                 | 3.01                   | 32.43±5.62          |
|     |                            | 5       | 200/400                    | 71.00±8.15          | 90±3.24                 | 3.64                   | 39.76±7.35          |
|     |                            | 6       | 200/400                    | 66.45±3.42          | 90±2.72                 | 3.01                   | 36.31±4.93          |
| 3   | Yarmook Hospital           | 7       | 200/400                    | 75.40±2.6           | 94±7.25                 | 3.13                   | 35.25±5.77          |
|     |                            | 8       | 200/400                    | 71.30±1.5           | 92±6.33                 | 3.4                    | 37.34±5.81          |
|     |                            | 9       | 400                        | 74.00±3.16          | 95±2.52                 | 3.31                   | 32.75±3.22          |
| 4   | Dar-Altamreedh Hospital    | 10      | 400                        | 70.75±2.31          | 93±3.29                 | 3.18                   | 35.16±5.44          |
|     |                            | 11      | 200                        | 67.30±1.96          | 95±2.75                 | 3.4                    | 38.27±3.12          |
|     |                            | 12      | 400                        | 73.18±4.5           | 90±3.42                 | 3.32                   | 33.47±2.63          |
### Pelvis /AP first round measurements, results of hospitals and X-ray rooms

| No. | Hospitals                      | Room NO. | Speed class of film screen | Patient weight(Kg)* | Applied potential (kVp)* | Half layer value (mmAL) | Tube current (mAs) * |
|-----|-------------------------------|----------|----------------------------|---------------------|--------------------------|------------------------|---------------------|
| 1   | Institute of X-ray            | 1        | 200                        | 75.40±2.3           | 85.00±2.5                | 3.15                   | 28.85±8.43          |
|     |                               | 2        | 200                        | 71.20±4.69          | 83.00±3.7                | 3.76                   | 32.00±0000          |
|     |                               | 3        | 400                        | 67.34±2.6           | 79.14±0.41               | 3.38                   | 21.72±2.70          |
| 2   | Specialist Surgeries Hospital | 4        | 400                        | 73.24±3.17          | 82.75±1.74               | 3.01                   | 18.58±2.47          |
|     |                               | 5        | 200/400                    | 74.00±3.16          | 80.00±2.33               | 3.64                   | 23.83±4.13          |
|     |                               | 6        | 200/400                    | 78.67±2.31          | 80.35±4.15               | 3.01                   | 24.85±4.98          |
| 3   | Yarmook Hospital              | 7        | 200/400                    | 66.00±5.66          | 79.85±2.72               | 3.13                   | 28.85±5.49          |
|     |                               | 8        | 200/400                    | 75.00±2.7           | 82.68±1.6                | 3.4                    | 32.32±5.81          |
|     |                               | 9        | 400                        | 71.34±4.67          | 85.38±0.25               | 3.31                   | 21.72±2.70          |
| 4   | Dar-Altamreedh Hospital       | 10       | 400                        | 68.00±3.62          | 84.43±7.41               | 3.18                   | 18.68±2.47          |
|     |                               | 11       | 200                        | 71.00±8.14          | 79.75±1.32               | 3.4                    | 32.00±0000          |
|     |                               | 12       | 400                        | 77.32±5.41          | 78.72±0.91               | 3.32                   | 25.46±7.66          |

### Skull/AP first round measurements, results of hospitals and X-ray rooms

| No. | Hospitals                      | Room NO. | Speed class of film screen | Patient weight(Kg)* | Applied potential (kVp)* | Half layer value (mmAL) | Tube current (mAs) * |
|-----|-------------------------------|----------|----------------------------|---------------------|--------------------------|------------------------|---------------------|
| 1   | Institute of X-ray            | 1        | 200                        | 71.5±1.09           | 70.10±4.86               | 3.15                   | 23.14±3.42          |
|     |                               | 2        | 200                        | 71.6±1.23           | 65.54±1.71               | 3.76                   | 18.57±2.47          |
|     |                               | 3        | 400                        | 72.2±2.19           | 77.00±0.00               | 3.38                   | 21.67±2.54          |
| 2   | Specialist Surgeries Hospital | 4        | 400                        | 68.3±1.45           | 58.80±2.68               | 3.01                   | 28.85±5.14          |
|     |                               | 5        | 200/400                    | 71.5±1.09           | 70.35±3.46               | 3.64                   | 23.83±4.13          |
|     |                               | 6        | 200/400                    | 72.2±1.39           | 67.10±2.18               | 3.01                   | 24.85±4.89          |
| 3   | Yarmook Hospital              | 7        | 200/400                    | 70.92±1.41          | 77.00±0.00               | 3.13                   | 21.72±2.70          |
|     |                               | 8        | 200/400                    | 67.90±1.44          | 68.59±3.00               | 3.4                    | 18.64±2.75          |
|     |                               | 9        | 400                        | 71.6±2.18           | 77.00±0.00               | 3.31                   | 24.33±5.77          |
| 4   | Dar-Altamreedh Hospital       | 10       | 400                        | 69.4±1.24           | 75.50±3.63               | 3.18                   | 21.65±3.15          |
|     |                               | 11       | 200                        | 72.2±1.15           | 70.24±4.86               | 3.4                    | 19.53±6.67          |
|     |                               | 12       | 400                        | 68.3±1.43           | 73.14±3.26               | 3.32                   | 25.50±9.45          |
Skull/LAT first round measurements, results of hospitals and X-ray rooms

| No. | Hospitals                  | Room NO. | Speed class of film screen | Patient weight (Kg)* | Applied potential (kVp)* | Half layer value (mmAL) | Tube current (mAs)* |
|-----|---------------------------|----------|----------------------------|----------------------|--------------------------|------------------------|---------------------|
| 1   | Institute of X-ray        | 1        | 200                        | 71.20±4.69           | 68.00±00                 | 3.15                   | 21.72±2.70         |
|     |                           | 2        | 200                        | 75.00±2.58           | 60.00±3.00               | 3.76                   | 19.68±2.47         |
|     |                           | 3        | 400                        | 71.00±8.15           | 77.00±00                 | 3.38                   | 26.32±5.8          |
| 2   | Specialist Surgeries Hospital | 4        | 400                        | 78.67±3.52           | 64.80±5.35               | 3.01                   | 23.45±5.77         |
|     |                           | 5        | 200/400                    | 70.75±5.66           | 75.00±00                 | 3.64                   | 23.14±3.42         |
|     |                           | 6        | 200/400                    | 74.00±3.16           | 77.00±0.00               | 3.01                   | 21.67±2.54         |
| 3   | Yarmook Hospital          | 7        | 200/400                    | 68.30±4.42           | 68.00±0.00               | 3.13                   | 23.83±4.13         |
|     |                           | 8        | 200/400                    | 63.50±4.95           | 63.00±1.37               | 3.4                    | 26.60±0.44         |
|     |                           | 9        | 400                        | 70.00±00             | 79.00±1.41               | 3.31                   | 20.84±0.50         |
| 4   | Dar-Altamreedh Hospital   | 10       | 400                        | 75.00±7.07           | 64.73±3.00               | 3.18                   | 24.80±4.98         |
|     |                           | 11       | 200                        | 72.50±3.02           | 76.00±5.00               | 3.4                    | 21.65±2.45         |
|     |                           | 12       | 400                        | 71.70±2.71           | 73.84±2.52               | 3.32                   | 24.76±3.96         |

References
1- International Commission on Radiation Protection, Recommendation of the International Commission on Radiological Commission, ICRP PUBLICATION 60, Pergamon Press Oxford. (1990).
2- H. Geijer, K.-W. Beckman, T. Andersson, J. Persliden ((Radiation dose and image quality with a flat-panel amorphous silicon digital detector European Radiology)), 11 (2 Suppl. 1) p. S280, (2001).
3- Zewdeneh, D., Teferi., S and Admassie,( ( D. X-ray reject analysis in TikurAnbessa and Bethzatha hospitals.Ethiop). J. Health Dev. 22(1), 63–67 (2008).
4- M.A. Dunn, A.T. Rogers(( X-ray film reject analysis as a quality indicator Radiography)), pp. 29-31 , (2008) .
5- B. Verdonck, R. Nijlunsing, N. Melman, H. Geijer ((Image quality and X-ray dose for translation reconstruction overview imaging of the spine, colon and legs Proceedings of Computed Assisted Radiology and Surgery)), pp. 500-505, (2012).