

## AN AUDIT OF REJECTED REPEATED X-RAY FILMS AS A QUALITY ASSURANCE ELEMENT IN A RADIOLOGY DEPARTMENT

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### ABSTRACT

**Objectives:** To find out the causes, number, percentage and sizes of rejected radiographic films with a view of adopting measures that will reduce the rate and number of rejected films.

**Setting:** Radiology Department of a University Teaching Hospital.

**Materials and Methods:** Over a two-year period (1<sup>st</sup> April 2002 to 31<sup>st</sup> March 2004), the total number of x-ray films utilized for radiographic examinations, rejected films and sizes of rejected films were collected retrospectively from the medical record of radiology department. All the rejected films were viewed by a radiologist and three radiographers for the causes of the rejects which was arrived at by consensus. The data was analysed.

**Result:** A total of 15,095 films were used in the study period and 1,338 films (8.86%) were rejected or wasted. The rate of rejected films varied from 7.69% to 13.82% with average of 8.86%. The greatest cause of film rejects was radiographers' faults 547 (40.88%), followed by equipments faults 255 (19.06%), and patients' faults 250 (18.90%). The highest reject rate (13.82%) was for films used for examination of the spine (15 x 30) cm size. This is followed by 9.92% for skull (18 x 24) cm films and 8.83% for small sized films (24 x 30)cm used for paediatric patients. Of a total of 1,338 rejected films, 1276 (95.37%) additional exposure were done to obtain the basic desired diagnostic information involving 1151 patients; 885 (76.89%) of these patients needed at least one additional hospital visit to take the repeat exposure.

**Conclusion:** Rejected films are not billable; patients receive additional radiation and may even come to hospital in another day for the repeat. Radiographer's work is increased as well as that of the support staff. The waiting room may be congested and waiting time increased. The cost of processing chemical and films are increased, thus if work is quantified in monetary terms, the cost of repeats is high. Rejected-repeated film analysis is cheap, simple, practicable, easy to interpret and an effective indicator of quality assurance of radiology departments.

**Key Words:** Audit, Rejected, Repeated, Wasted, x-ray, Films, Radiography, Radiology, Quality Assurance.  
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### INTRODUCTION

The discovery of x-rays has proved to be beneficial to man. These benefits have been greatly utilised for medical diagnostic and therapeutic purposes. Unfortunately x-ray has its own adverse effects because it causes ionization of molecules in body tissues and this, among other hazards, is known to cause cancer and other malignancies. Therefore, any radiographic exposure which is not beneficial to the patient has a net deleterious effect<sup>1-3</sup>. Radiographic exposure is often repeated when there is any significant fault along the processes that are involved in producing an image. Very often the referring physician, radiographer, darkroom technician, patient or the management of the hospital may fall

short of their duties that are necessary in having a good radiographic exposure. At such instances, it is the duty of the radiologist to maintain adequate protection of undue exposure of the patients, radiology staff and the public. The referring doctor's duties are to write adequate and accurate clinical information and the required views. The radiographers must give adequate instructions to the patients to avoid film blurring due to respiration or movement and also position the patients properly. He must ensure application of adequate collimations and exposure factors. The darkroom technician is to ensure that the films are adequately labelled and processed. Cassette should be loaded in the darkroom. These processes when applied accurately yield good quality films suitable for radiological interpretation. The process of ensuring accurate application of these in the radiology department is called quality assurance<sup>1,3,4,5,6</sup>

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Even though strict application of quality assurance programme is not available in most institutions in the developing countries, accurate assessment of radiographic film repeats and documentation of the reasons for the repeats are accepted as adequate criteria for quality assurance in radiography. Thus if radiographic film repeats and rejects are completely avoided or are reduced to the minimum, it can be adjudged that the radiology department is performing optimally in quality assurance<sup>3-8</sup>. This study is to determine the factors responsible for film rejection or repeat and the amount of film rejection in the hospital. This will be taken as baseline audit, further assessment in future is expected to show whether there is reduction in radiographic film rejects, which could mean improvement in quality assurance. An improvement in quality assurance means improved protection of patients, staff, and the public from unnecessary irradiation, conservation of fund and reduction in patient waiting time in the radiology department.

### MATERIALS AND METHOD

Over a two-year period (1<sup>st</sup> April 2002 to 30<sup>th</sup> March 2004), the rejected films and records of film usage were analysed retrospectively. A record of all the radiographic repeats was taken. The rejected films were then viewed by a radiologist and three radiographers for the reasons for the rejection. The cause of the rejection was arrived at by consensus of the four persons.

The hospital has an established consistent film audit programme as well as adequate accountability of all purchased radiographic films. Every used film and every repeated film was recorded and kept in a particular box for auditors. Thus there was an accurate record of film usage and rejects.

The hospital uses two manual film processors, three functioning x-ray machines made up of two stationary units and a mobile unit. There are three trained radiographers, three radiologists consisting of one permanent radiologist, two locum radiologists; and two darkroom technicians.

From the analysis of the rejected film, the discarded films were categorised based on the reasons for the rejection as follows.

1. **Film fault:** Due to basic film fog.
2. **Radiographer's fault:** Wrong positioning, wrong exposure factors, wrong collimation, double exposure, wrong placement of marker, use of wrong film size, non contributory films.
3. **Processing fault:** Faulty development, drying artefacts, hangers scratch marks, development of unexposed films.
4. **Patient's fault:** Movement from position after adequate positioning, lack of co-operation on breath holding.
5. **Equipment fault:** Non-exposure, tube off-centring (after accurate positioning), faulty alignment of diaphragms.

Non contributory films which comprised of exposures taken by the radiographers which were not requested for and did not contribute to diagnosis were actually recorded as rejects and classified as radiographer's fault.

### RESULT

For the study period, a total of 15, 095 films were utilized for radiographic examination. Within this number 1, 338 (8.86%) were identified as rejected or wasted films. The causes of rejects (Table 1) were radiographers' fault 547(40.88%), equipment fault 255 (19.06%), patients' fault 250 (18.90), processing fault 245 (18.31%) and film fault 41 (3.06%). For film sizes used (Table 2), the reject rate was 9.92% for (18 x 24) cm, 8.83% for (24 x 30) cm, 13.82% for (15 x 40) cm, 7.69% for (30 x 40) cm, 7.79 % for (35 x 35) cm, and 8.21% for size (35 x 43) cm.

Size (15 x 40) cm films were actually size (30 x 40) cm films which were cut into two in the dark room and it was used mostly for examination of the spine. However the process of cutting the films, handling and exposure by darkroom light appears to be largely responsible for the rejects. Surprisingly, radiographic positioning contributed little to rejection of this size of films. Wasted films were also more with films used for skull and children.

Film wastage was also more for films used for skull examinations and children which are size (18 x 24) cm (9.92%) and (24 x 30) cm (8.83%). There was also slight increase in rate of rejected films for films used for acute abdominal emergency conditions which is size (35 x 43) cm (8.21%).

Of a total number of 1, 338 rejected films seen in this study, 1276 (95.37%) films needed additional exposure to get the basic desired diagnostic information and 1151 patients were involved. Some films were repeated more than once. Sixty-two (4.63%) films were not repeated. These comprised fogged films that were discovered before loading into the cassette or films obtained from studies in which other aspect of the study or using other investigative modalities compensated for the lost information. Of the 1151 patients involved with the repeated films, 266 (23.11%) did not need additional hospital visit as the errors were detected immediately while 885 (76.89%) made at least one additional hospital visit to take the repeat exposure.

Table 1: Causes of Film Rejects.

Causes of rejects	No rejected	Percentage
Film fault	41	3.06
Radiographer's fault	547	40.88
Equipment fault	255	19.06
Patient's fault	250	18.69
Processing fault	245	18.31
<b>Total</b>	<b>1338</b>	<b>100</b>

Figure 2: **Radiographic Film Reject Rate of Different Sizes of Films.**

Size (cm)	No used	No of rejects	Percentage
(18x 24)	2,298	228	9.92
(24x30)	3,385	299	8.83
(15x40)	1,078	149	13.82
(30x40)	1,951	150	7.69
(35x35)	2,913	227	7.79
(35x43)	3,470	285	8.21
<b>Total</b>	<b>15095</b>	<b>1338</b>	<b>8.86</b>

## DISCUSSION

The rate of rejected films recorded in this study varied from 7.69% to 13.82% with average of 8.86%. In a study by AlMalki, et al<sup>5</sup> of radiographic repeat rate in several hospitals in Saudi Arabia, they found individual repeat rate to vary from 7.44% in King Abdulaziz Hospital (KAH) to 9.57% in Maternal and Children Hospital in Jeddah. In a study in Norway, Gadeholt et al<sup>6</sup> found the repeat rate to be 15% in 1980-1981 but dropped to 8.4% in 1982 due to a continuing reject- repeat film analysis programme. They further found that movement from old department to new department increased the reject rate to 13.2%. Bassey<sup>2</sup> in Calabar, Nigeria found the reject rate to be 4%. In another study by Bassey et al<sup>7</sup> in Ilorin, Nigeria, reject rate was reported at 3.7%.

Both studies in Nigeria did not have adequate record of the rejected films but rather relied on secretly collecting any rejected films they could see and accepting that these were probably the only rejected films. However we do know that some rejected films are actually put back in the patient's folder and even films which were not adequately marked were also put in the folders. When radiologists ask for repeat of views for over- or under- penetration it is unlikely that those films were discarded but rather they existed alongside the accepted repeated film in the patients' folders unless there is prospective attempt at adequate recording of rejects and the reasons for rejects. Thus the studies by Bassey<sup>2</sup> in Calabar and Bassey et al<sup>7</sup> in Ilorin probably represented gross under reporting. Our study of film rejects, agrees with the study by Al Malki<sup>5</sup> in Jeddah, Gadeholt et al<sup>6</sup> in Norway and Lewentat and Bohndorf<sup>8</sup> in Germany.

The greatest cause of film reject is radiographers fault (40.88%) which is technical. This is followed by equipment fault (9.06%). These agree with the study in Jeddah<sup>5</sup>, Norway<sup>6</sup> and Germany<sup>8</sup> with accurate record of film rejects. Film fault (8.06%) as a result of basic fog was the least cause of wastages of x-ray film in our study. This is in contrast with the study by Bassey<sup>5</sup> which noted film fault as the highest cause of film wastage. Patients' faults

(18.69%) and processing faults (18.31%) are also human factors and are subject to improvement with radiographers' consciousness and adequate instruction to patients.

Inability of the management of the hospital to repair faulty equipment due to cost, lack of adequately trained or knowledgeable technician are partly responsible for equipment faults. Persuasion of the radiographer by management to use the faulty equipments especially when such faults are minor also contributed to the high equipment faults. There is also likely to be an overlap between equipment fault and radiographer's faults in some cases. Processing faults arises as a result of mistakes by the darkroom technician. These are subject to improvement.

The highest reject rate of (13.82%) was found in films used for examination of the spine, (15 x 20) cm. This is because this size of films was actually cut in the darkroom before being placed in the cassette. Whereas alignment fault is surprisingly very low, film fog, handling artefacts and exposure faults were the major causes of rejects among this size of films. Films, (18 x 24) cm, used for children (9.92%) and films (24 x 36) cm, used for skull, were the second and third sizes of rejected films respectively. Films used for emergency examinations especially acute abdomen, and fractures were the fourth size of film wastages (5.21%).

Rejected films are not billable most of the time. Patients receive additional radiation and may even come to hospital in another day to see the referring physician only to be told that the film must be repeated. Thus the patients for the present day must wait because those for repeat may be given preference. Radiographer's work is increased as well as that of the support staff. The waiting room may be congested and waiting time increased. The cost of processing chemical and equipment maintenance increased, thus if work is quantified in monetary terms, the cost of repeats is actually enormous<sup>1-8</sup>. Reject rate are lower with digital radiography when compared to conventional radiography<sup>9</sup>, but the cost of implementing digital radiography, where power is inconstant and in lean economy is enormous. Therefore continuous assessment of reject film analysis with the aim of its reduction is the most cost effective means of ensuring quality assurance. Developing countries must adopt quality assurance programme which are cheap, continuous, and practicable and generate data which are easy to interpret<sup>3</sup>. Effective film reject analysis is one of the easiest and probably the most important criteria of ensuring quality assurance in developing countries. A previous study in Nigeria showed that there is non-compliance of the entrance surface dose of some x-ray examinations with European reference doses

signifying poor quality assurance<sup>10</sup>. However the process of conducting this test may not be economically viable in most hospitals in developing countries with lean economy.

In conclusion, accurately documented reject analysis is a practicable quality assurance procedure. When done continuously it can be used as a guide to effective dose reduction and reduction of unnecessary irradiation of the patients, staff and the public.

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