

Table of Contents

	<i>Page</i>
Table of contents	i
Dedication	v
Acknowledgement	vi
Abstract	vii
Abstract in Arabic	viii
 <i>Chapter 1. GENERAL INTRODUCTION</i>	
1.1. Introduction	2
1.2. Problem statement	2
1.3. Hypothesis	2
1.4. General Objectives	3
1.5. Specific Objectives	3
1.6. Methodology	3
1.7. Source of data	5
1.8. Materials of the study	5
1.8.1. Equipments	5
1.8.2. Method of data analysis	5
 <i>Chapter 2. LITERATURE REVIEW</i>	
2.1. Historical background	7
2.2. Conventional x-ray systems for general purposes	8
2.2.1. General purpose radiography equipment	9
2.2.2. Specific equipment requirements	10
2.3. Radiology physics and Equipment	10

2.3.1. X-ray generation ant tube design	10
2.3.2. X-ray generators	17
2.3.3. The x-ray spectrum	17
2.3.4. Collimation	20
2.3.5. Scatter & attenuation of the x-ray and grids	20
2.3.6. Film screen integrity	21
2.3.7. Contrast	23
2.3.8. Resolution	23
2.4. Structural Shielding in Diagnostic Imaging	24
2.4.1. Theory of Shielding	24
2.4.2. Basic shielding calculation data	25
2.4.3. Construction of Shielding	28
2.5. The Darkroom	29
2.5.1. Minimum requirements for a Darkroom	30
2.5.2. Preparing processing solutions	33
2.5.3. Under & over processing	33
2.5.4. Cleaning processing tanks	34
2.5.5. Automatic processor	34
2.6. Repeat analysis	35
2.6.1 Reject-repeat analysis	35
2.6.2 Reasons for repeat	36
2.7 Staff radiation exposure & personal monitoring	36
2.7.1 Objectives of personal monitoring	37
2.7.2 Benefits of personal monitoring	37
2.7.3 Classification of radiation areas	37

2.7.4 Methods of monitoring	37
2.7.5 Thermoluminescence dosimeters TLD	38
2.7.6 TLD reader	39
2.7.7 Proper care of personal dosimeter	40
2.7.8 The dosimetry report	40
2.8. Quality assurance	41
2.8.1 Quality Assurance Program	41
2.8.2 Quality Control	42
2.8.3 Quality Control Program	42
2.8.4 QC techniques	44
2.8.5 Routine QC tests for conventional radiographic equipments	45
2.9. Review of conventional QC tests	47
2.9.1 kVp Accuracy	47
2.9.2 Timer accuracy	47
2.9.3 Relative mA & mAs linearity	48
2.9.4 mAs consistency	49
2.9.5 kVp & time reproducibility and linearity test	49
2.9.6 Half Value Layer test	51
2.9.7 Radiation field test	52
2.9.8 Focal spot size	53
2.10. Review of Darkroom QC tests	54
2.10.1. Intensifying screens/cassettes/films	54
2.10.2. Darkroom fog check	57
2.10.3. Grids (grid alignment test)	59
2.11. Review of reject film analysis procedure	60

2.12. Personnel monitoring for the radiation workers	62
2.13. Quality Control Economics	62
2.13.1. Costs of Quality Control	63
2.13.2. Calibration of test equipments	64
2.13.3. Benefits of quality control program	64
 <i>Chapter 3. DATA COLLECTION AND ANALYSIS</i>	
3.1. Introduction	66
3.2. Machine Quality Control results	66
3.3. Darkroom Quality Control results	72
3.5. Cost Analysis results	78
3.6. Personal monitoring results	79
3.7. Quality Assurance review work sheet results	81
 <i>Chapter 4. DISCUSSION AND CONCLUSION</i>	
5.1. Discussion	84
5.2. Conclusion	88
5.3. Recommendations	89
References	94
Appendices	96

DEDICATION

This research document is dedicated to the efforts to improve Quality Assurance Programs in Sudan were instrumental in bringing about this program. Also I dedicate it for my parents, brothers; and all those who patient care is their responsibility.

ACKNOWLEDGEMENTS

This research was prepared through the efforts, advice and input of many people. I offer my thanks to all of the contributors. In particular, I thank my supervisor; Mr. Mamdouh Yassin Osman, Medical Physicist; and all my colleagues in Radiation Safety institute; especially Nada Abbas, Radiation Physicist; Enas Hamed, Radiation physicist; Alghazali Abdallah, Omayma Gaafar, Hiba Hashim, Nahla Suleiman. Also my regards are to the Medical Corps in Omdurman medical base, especially Brigadier General Omer Adam, senior medical engineer; Brigadier General Dr. Ahmed Elawad, Chief of Medical Imaging Departments; Brigadier general Abdurrahman Mobie, Colonel Amara Atta.

And great thanks for the staff in the radiographic imaging department in both casualty and main centers.

Abstract

The purpose of this study is to evaluate the Quality Assurance procedures in the Military Corps in Khartoum state, through the comprehensive Quality Control QC procedures of the x-ray machines and darkrooms in the x-ray departments, and to provide a Quality Assurance Manual to support the federal ministry of Health running QA program.

This study is the first time that the departments of the Military Corps apply Qc tests on their x-ray machines. The total number of x-ray machines in Khartoum state is 10 machines with 4 darkrooms. Only three of the x-ray machines are tested and the results showed that there are unacceptable parameters of the major exposure factors which determine the image quality. The percentage of accuracy defects are 67% for kVp Accuracy, 67% for Time Accuracy, 33% for Relative mA Linearity, 33% for Relative mAs Linearity, 67% for kVp Reproducibility, 67% for Collimator test. Also the tested darkrooms showed that the percentage of unacceptable parameters as: 15% for tested intensifying screens, 18% for tested Cassettes, 100% for light leakage, 67% for Safelight.

Reject film Analysis showed that 5.3% & 10% is the reject percentage during four months for the main and casualty centers respectively.

Personal monitoring showed that the dose is within the dose limits the maximum and minimum Dose equivalent in 2001 is $4.231\mu\text{Sv}$, $0.154\mu\text{Sv}$ and in 2002 is $2.736\mu\text{Sv}$, $0.167\mu\text{Sv}$ consequently, and the monitoring is stopped since July 2002.

The study gives a review of all definitions and QC procedures needed for the QA manual and can be referenced as a QA Manual for the Military Corps or any other hospital.

Through this study it has been obviously clear that there is no QAP or any other parts of QA, such as QCP.

الخلاصة

الهدف من هذه الدراسة هو تقييم وضع عمليات تأمين الجودة في أقسام التصوير بالأشعة السينية العامة بمستشفيات السلاح الطبي ولاية الخوّم، وذلك من خلال عمليات ضبط الجودة لأجهزة الأشعة والغرف المظلمة وتحليل سجلات الرقابة اليومية للجوعات الإشعاعية للعاملين في تلك الأقسام. كما تهدف إلى وضع أساسيات دليل لتأمين الجودة لدعم برنامج تأمين الجودة المطبق حالياً بوزارة الصحة الاتحادية.

وفت هذه الدراسة ولأول مرة إجراء اختبارات ضبط الجودة لأجهزة الأشعة والغرف المظلمة بمستشفيات السلاح الطبي ولاية الخوّم. حيث وجد 10 أجهزة تم إجراء اختبارات ضبط الجودة لثلاث منها وهناك 4 قيد التشغيل كما تم إجراء قياسات ضبط الجودة على جميع الغرف المظلمة المتاحة بتلك الأقسام.

بينت الاختبارات وجود ضعف في عوامل التوضؤ المؤثرة مباشرة على جودة الصور ونسب الضعف هي، 67% لدقة الجهد العالي، 67% لدقة الوقت، 33% لخطية التيار النسبية، 33% لخطية التيار ولومن (mAs)، 67% لإمكانية إعادة ضبط الجهد العالي و 67% لمحدد الأشعة. وكذلك كانت نسب ضعف أداء الغرف المظلمة كالتالي، 15% للأواح التركيز، 18% لحفاظ أفلام الأشعة، 100% لتسرب الضوء، 67% لضوء الأمان.

كما أظهرت نتائج تحليل الأفلام المعادة أن نسبة إعادة التصوير بلغت 5.3% و 10% وذلك خلال فترة أربعة أشهر بالوكز الرئيسي والحدث على التوالي.

كما وجد أن الجرعات الإشعاعية المكافئة السويدية العليا والدنيا هي لعام 2001 هي 4.231 مللي سيفوت و 0.15 مللي سيفوت على التوالي؛ ولعام 2002 هي 2.7 مللي سيفوت و 0.167 مللي سيفوت على التوالي أن رقابة الجرعات الإشعاعية موقفة منذ يوليو 2002.

وأوضح من خلال الواسة عدم وجود برنامج تأمين الودة أو أي جزء منه والحاجة المطودة له للمحافظة على التطور الذي تشهده مستشفيات السلاح الطبي على امتداد البلاد.