

Mini-Dissertation

**DIAGNOSTIC QUALITY OF NEONATAL RADIOGRAPH IMAGES AFTER
50% RADIATION-DOSE REDUCTION ON A COMPUTED RADIOGRAPHY
SYSTEM**

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Declaration

I, Frans Sarel Jacobus Naudé, certify that the mini-dissertation hereby submitted by me for the MMed (Diagnostic Radiology) degree at the University of the Free State is my independent effort and had not previously been submitted for a degree at another university/faculty.

I furthermore waive copyright of the mini-dissertation in favour of the University of the Free State.

10 December 2013

Contents

	Page
Declaration	ii
Table of Contents	iii
List of Tables	iv
List of Images	v
List of Figures	vi
Acronyms and Abbreviations	vii
Abstract	viii
1. Introduction	1
2. Methods	3
3. Results	9
4. Discussion	13
5. Conclusion	22
6. References	2

Appendix A: Patient information leaflet	I
Appendix B: Patient consent forms	VIII
Appendix C: Data tick sheet	XII
Appendix D: Ethics committee approval	XIV
Appendix E: Language editor declaration	XXI

List of tables

	Page
Table 1: Radiation exposure for the mobile X-ray camera, Siemens Mobilett XP, at different mA s settings used in this study	4
Table 2: Results of selection of radiographs showing better visual clarity for the reproduction of certain tissues and borders	9
Table 3: Aspects reviewed in which the low-dose images were diagnostically acceptable	11

List of images

	Page
Image 1a: Routine dose of 3,2 mAs showing an endotracheal tube that was placed too deeply	5
Image 1b: Low-dose 1,6 mAs X-ray after repositioning of endotracheal tube. Improvement of the right-upper lobe consolidation is clearly visible on this low-dose image	6
Image 2a: Standard-dose X-ray in which evaluation of the mediastinal border is not possible due to patient rotation error	18
Image 2b: 1,6 mAs exposure X-ray with correct rotation, in which evaluation of the mediastinal border is possible	19

List of figures

	Page
Figure 1: Clustered column chart showing the breakdown of the specific aspects evaluated	10

List of abbreviations

AED	automated exposure device
ALARA	as low as reasonably achievable
CR	computed radiography
CT	computed tomography
CXR	Chest X-ray
ESK	entrance skin kerma
EC	European Commission
ICU	intensive-care unit
kV	kilovolt
mAs	milliamperere second
mR	milliröntgen
NICU	neonatal intensive care units
NRPB	National Radiation Protection Board
SNR	signal-to-noise ratio

Abstract

Background X-rays are frequently performed in the neonatal intensive care unit (NICU) setting, leading to a high radiation burden on patients. Neonates are more radiosensitive than adults, therefore all imaging should be done with the smallest possible dose. The European Commission guidelines suggest a 60-65 kV setting and maximum entrance skin kerma dose of 80 μ Gy, but no guidance is provided regarding the tube current (mAs) setting.

Consequently, there is large variation in the mAs at different institutions.

Objective To determine whether image quality would be compromised by utilising exposure parameter settings of 55 kV and 1,6 mAs, which delivers a radiation exposure of approximately 24 μ Gy using a computed radiography system in the NICU. This mAs setting can be used as a guideline, thereby preventing unnecessary radiation exposure. This will result in a significantly lower entrance skin kerma than the suggested European Committee guideline.

Materials and methods A prospective study was performed and 60 NICU chest X-ray image sets were collected. These contained standard-dose images of 3,2mAs and lower dose images of 1,6mAs, acquired on the same day on a computed radiography system. The kV remained unchanged at 55kV. Randomised image sets were evaluated by five consultants regarding general image quality and some specific aspects thereof.

Results. Generally, the routine-dose images had a better appearance. However, the image quality was considered acceptable for all the lower-dose exposures.

Conclusion Computed radiography systems allow the use of lower radiation exposure without loss of diagnostic image detail. The radiation-dose burden could be significantly reduced in the NICU by using lower-dose settings. NICU institutions should consider to using 1,6 mAs and 55 kV as reference guidelines for the maximum setting for CR-system for all babies in

NICU. This study suggests that the current EC radiation dose guideline of 80 μ Gy for neonates can be reduced by 66% without meaningful loss of diagnostic image quality.

Keywords radiation dose reduction; computed radiography system; neonatal patients; line and tube placement; ALARA

1. Introduction

Patients in our, and in most other neonatal intensive care units (NICUs) usually receive at least one and often more than one X-ray per day; this adds up to a large amount of radiation exposure during a prolonged stay in an intensive-care unit (ICU). Mobile X-ray machines used in NICUs do not have automated exposure device (AED) and the tube current measured in milliamperes-second (mAs), and beam energy, measured in kilovolt (kV) must be set in advance on mobile X-ray units. The “as low as reasonably achievable” (ALARA) principle is advocated in most NICUs while the Image Gently campaign also focuses on radiation dose reduction for children because children are more radiosensitive than adults [1].

Because the mobile X-ray machines don't have AEDs, this causes a large variation in the mAs dosages used in NICUs of different institutions and between radiographers at the same institution. A 2002 study conducted at 10 medical facilities in the state of Florida found considerable variation in the radiation doses administered to one-year-old children; the mAs setting varied from 2.5–50 mAs, and the kV settings varied between 55 and 90 kV [2]. A more recent study, published in July 2013 into the doses administered at 17 NICUs in Belgium [3], found that the mAs varied between 0.3 and 4 and kV between 40 and 81, resulting in a range of ESK of between 11 and 157 μGy per chest X-ray. Some exposures were much higher than the EC guidelines for entrance surface dose of 80 μGy [4].

The EC guidelines on quality criteria for diagnostic radiographic images in paediatrics for NICUs published in July 1996 advise a tube voltage of 60–65 kV and entrance surface dose of 80 μGy [4]. The National Radiation Protection Board (NRPB) suggests a reference ESK of 50 μGy [5].

The EC guidelines suggest that the lowest mAs setting that provides a satisfactory image quality must be used. However, there is no suggested value for maximum or minimum mAs settings in these guidelines.

Research conducted by Metz et al. and Uffmann et al. [6,7] conclude that it is important to correlate the diagnostic image quality with the exposure. High kV settings will result in a good signal-to-noise ratio (SNR) measurement, but this does not always indicate that the diagnostic image quality is better [6,7,8]. Other studies have found that lower kV improves image quality, due to improved contrast [6,7,9,10], which shows that an SNR measurement of the image noise is not equal to the diagnostic image quality, and that image contrast plays an important role in the diagnostic image quality.

Computed radiography (CR) systems allow for lower-dose administration. There is, however, a limit to dose reduction, as image noise increases with a lower dose, even though contrast may remain the same [11].

In the NICU of our institution (Universitas Academic Hospital in Bloemfontein, South Africa), the Department of Clinical Imaging Sciences uses a tube current of 3.2 mAs and beam energy value of 55 kV on the CR system. This results in a calculated ESK of 49 μ Gy, which is well below the EC guidelines of 80 μ Gy for a NICU chest X-ray. However, other institutions often use lower doses [9,12,13,14].

The aim of this study is to investigate the effect of lowering the mAs dose by about 50% on the quality of diagnostic reporting of neonate images.

2. Method

Any patient in the NICU for whom a follow-up X-ray was requested within 12 hours of an initial radiograph was considered for the study. Radiographs were not specifically requested for the study and only those radiographs performed for clinical indications were included. The time period of the study were the six months from September 2011 to February 2012. All the neonatal intensive-care patients receive, routine daily chest X-rays, with routine X-ray tube current settings of 3,2 mAs, administered by means of a portable CR X-ray unit (Siemens Mobilett XP) and AGFA CR MD4.0 cassette of 24x30cm.

A second X-ray (done with same equipment) is often required later the same day, to evaluate placement of umbilical or intravascular lines and nasogastric or tracheal tubes, or for reevaluation due to deterioration of the patient's condition. For the purpose of this study, the second X-ray was taken with a lower dose; the mAs setting was decreased by 50% to 1,6 mAs; similar mAs ranges are discussed by Olgar et al. [12]. The reason we used the same patient for the routine and lower-dose settings is to ensure that the tissue thickness that the X-ray beam had to penetrate was exactly the same. A voltage of 55 kV and focus distance of 100cm was used for both routine and lower-dose mAs images. All the incubators in the NICU are of the open type. All the patients included in the study had either endotracheal tubes or other lines in place. Radiographs with significant positioning errors as decided by two qualified radiologists, were excluded from the study.

The medical physics department determined the ESK (exposure) of the mobile X-ray unit using the tube output at the focus to detector distance of 100 cm. An ionisation chamber was used to measure exposure at a fixed mAs setting and changing kV values. Calculated values were entered into an Excel spreadsheet to obtain a calibration curve plot of exposure per mAs, and this equation was used to calculate exposure for known clinical parameters.

Table 1 shows the entrance skin exposure administered for the different kV and mAs settings in milliröntgen (mR) and μGy for the mobile X-ray camera in the NICU.

Table 1: Radiation exposure for the mobile X-ray camera, Siemens Mobilett XP, at different mAs settings used in this study

kV	mR/mAs	mAs	mR (ESK)	μGy (ESK)
55	1,8	3,2	5,7	49
55	1,8	1,6	2,8	24

Image 1a, is an example of a standard-dose X-ray and 1b is of a low-dose X-ray of the same patient taken for the study. The diagnostic image qualities of the high and low exposures are similar. The improvement of the upper lobe consolidation after endotracheal tube repositioning can be appreciated on the low-dose image.

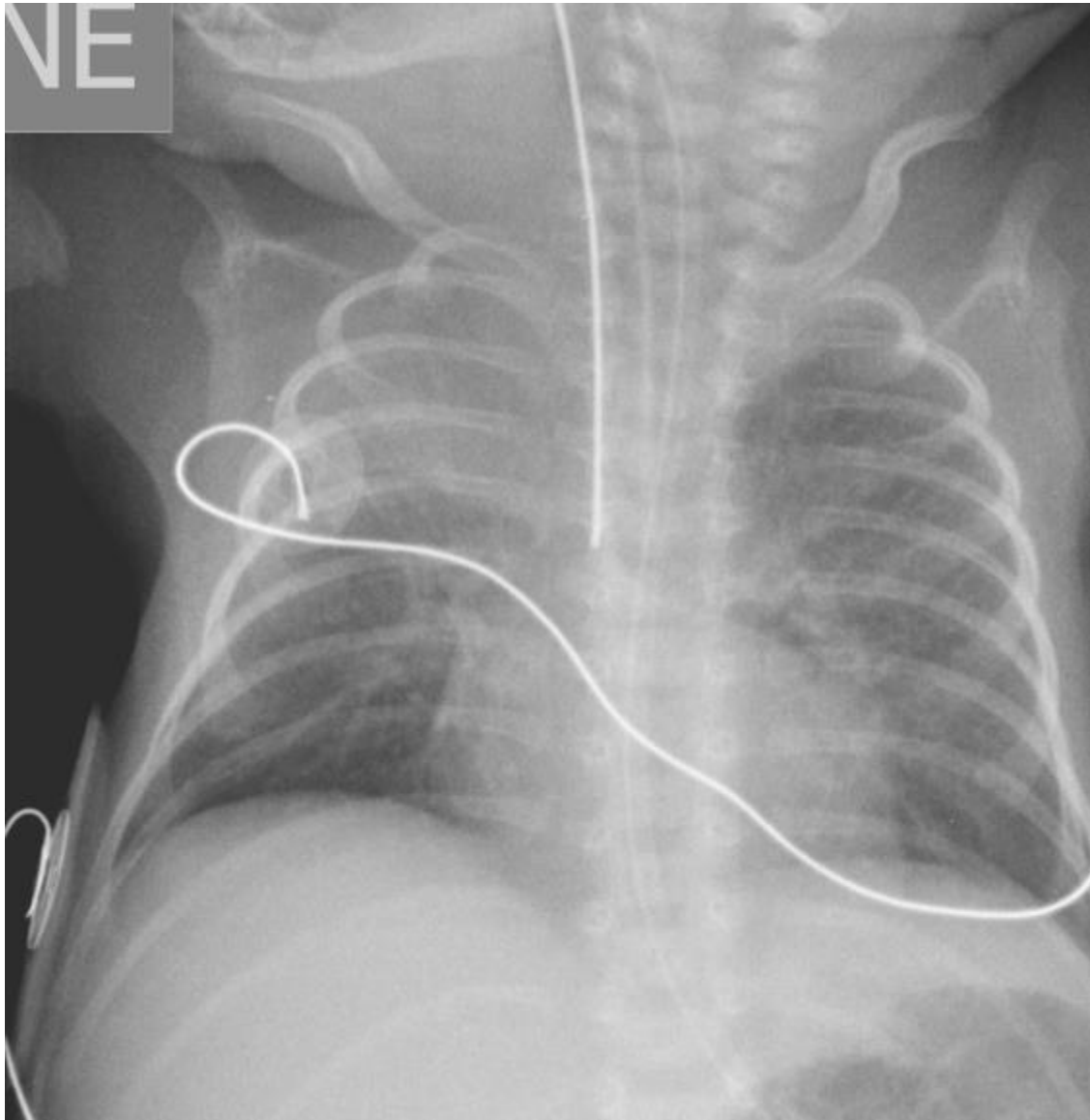


Image 1a: Routine dose of 3,2 mAs showing an endotracheal tube that was placed too deeply.

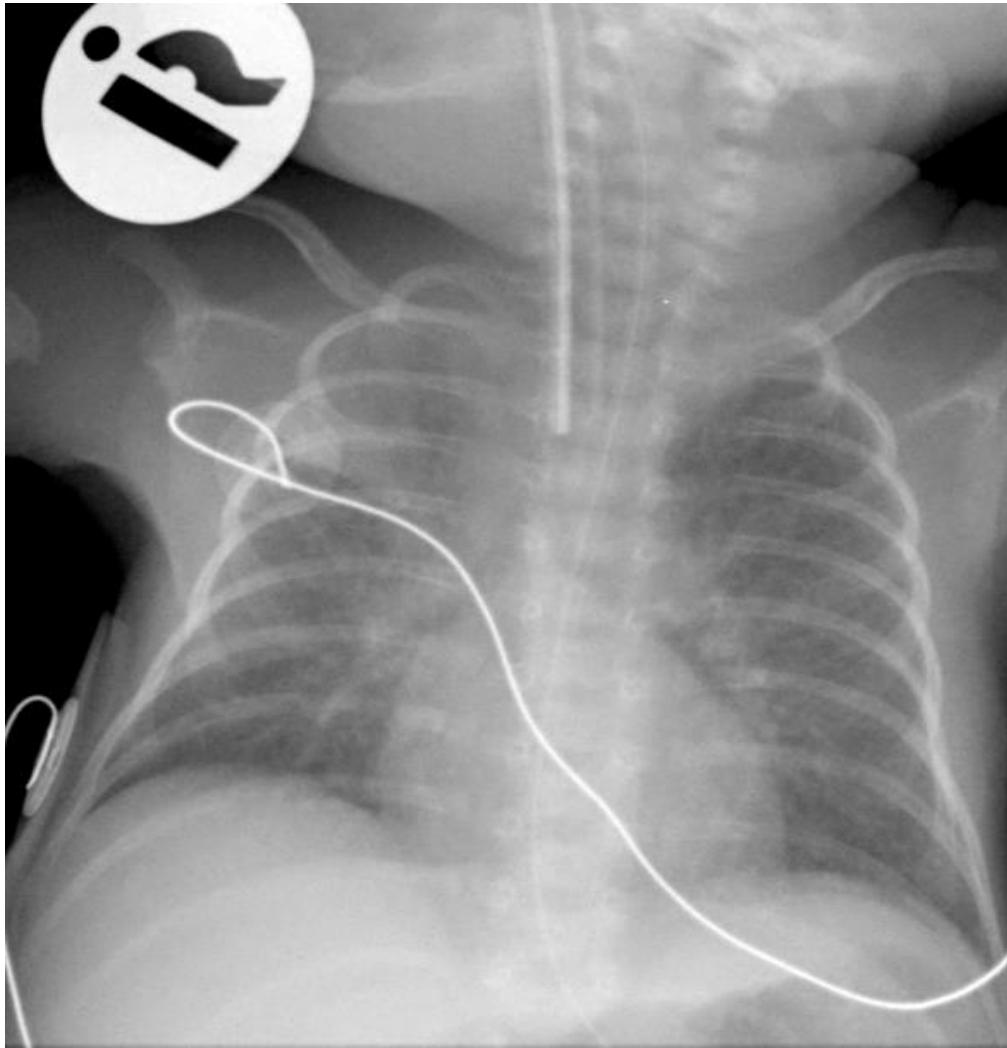


Image 1 b: Low-dose 1,6 mAs X-ray after repositioning of endotracheal tube. Improvement of the right upper lobe consolidation is clearly visible on this low-dose image.

Each X-ray set contained a routine-dose X-ray and a lower-dose X-ray, the latter taken later the same day. In total, 60 pairs of neonatal intensive care X-rays were included in the study. Two qualified radiologists rejected images with significant changes in pathology or positioning errors.

The images were stored on the local picture archiving and communication system (PACS). The images were then randomised and marked as A or B, including the set number. The key to this randomised categorisation was known only to the primary investigator, and was blinded to the readers. The readers were also blinded to the patient details and each other's readings of each of the radiographs in a set. Three general radiology consultants and two paediatric NICU consultants were requested to evaluate the images individually. A tick sheet was provided per image set which the consultants had to complete. The tick sheet and the aim of the study were explained to each reader, with special emphasis on the diagnostic quality difference. Each X-ray image pair was displayed on two diagnostic imaging screens adjacent to each other and no patient information was displayed on the screens. The evaluators had the opportunity to change window widths and levels of the images.

We used criteria similar to the European image quality criteria for chest examinations for the evaluation of X-ray quality [15]. The evaluators had to select the image with the best general image quality, with no option of equal quality, based on the radiologists' experience and gestalt interpretation. Specific aspects on the X-ray that also had to be evaluated were the lung parenchyma, mediastinal borders, diaphragm and costophrenic angles, and the visibility of the lines and tubes. The reviewer had the opportunity to select the image with the best visual clarity of reproduction of the specific tissues and borders. If no perceivable difference could be seen, a separate tick block for no difference was provided. If the reviewer did perceive an image quality difference, an additional question was asked, namely whether the difference would have a diagnostic impact, in other words, whether the lower-quality image was still of diagnostic quality.

Results for each image set from all the evaluating reviewers were grouped together. The majority decision of five evaluating reviewers for each image set was considered as the result of that set and then analysed as such. Results were grouped in percentages according to the dose that provided the best quality images and the acceptable image-quality rate according to specific aspects.

The Ethics Committee of the Faculty of Health Sciences approved the protocol for this prospective study. Informed consent was obtained from the neonates' parents. The parents received information leaflets in their preferential language regarding the study.

3. Results

With regard to the first question on general image quality, the majority decision was that the lower mAs dose produced a better image quality in 21 (35%) of cases, while the routine mAs image quality was better in 39 (65%) of cases.

Table 2 summarises the results of the specific aspects of image quality that were evaluated. In general, the routine dose provided the better image quality in slightly more than half of the image sets. In approximately a third of the sets, the low dose provided the best image quality, with the remainder being made up of the “no difference” group.

Table 2: Results of selection of radiographs showing better visual clarity for the reproduction of certain tissues and borders

Aspect	Better visual sharpness					
	Routine dose		Low dose		No difference	
	n	%	n	%	n	%
Lung parenchyma, trachea, proximal bronchi and vascular lung pattern	36	60.0	20	33.3	4	6.7
Mediastinum, including borders of the heart and aorta	34	56.7	18	30.0	8	13.3
Diaphragm and costophrenic angles	28	46.7	16	26.7	16	26.7
Visibility and position of lines or tubes	36	60.0	18	30.0	6	10.0

The distribution of the percentages of the four aspects that were evaluated, namely, lung parenchyma, mediastinum, diaphragm and costophrenic angles, and visibility of lines and

tubes, are summarised in a clustered column chart (Figure 1). The first row of each cluster represents the routine-dose-image percentage, which was chosen as better quality. The second column of each cluster represents the lower-dose images that were chosen as having better quality, and the third row represents the “no difference” group.

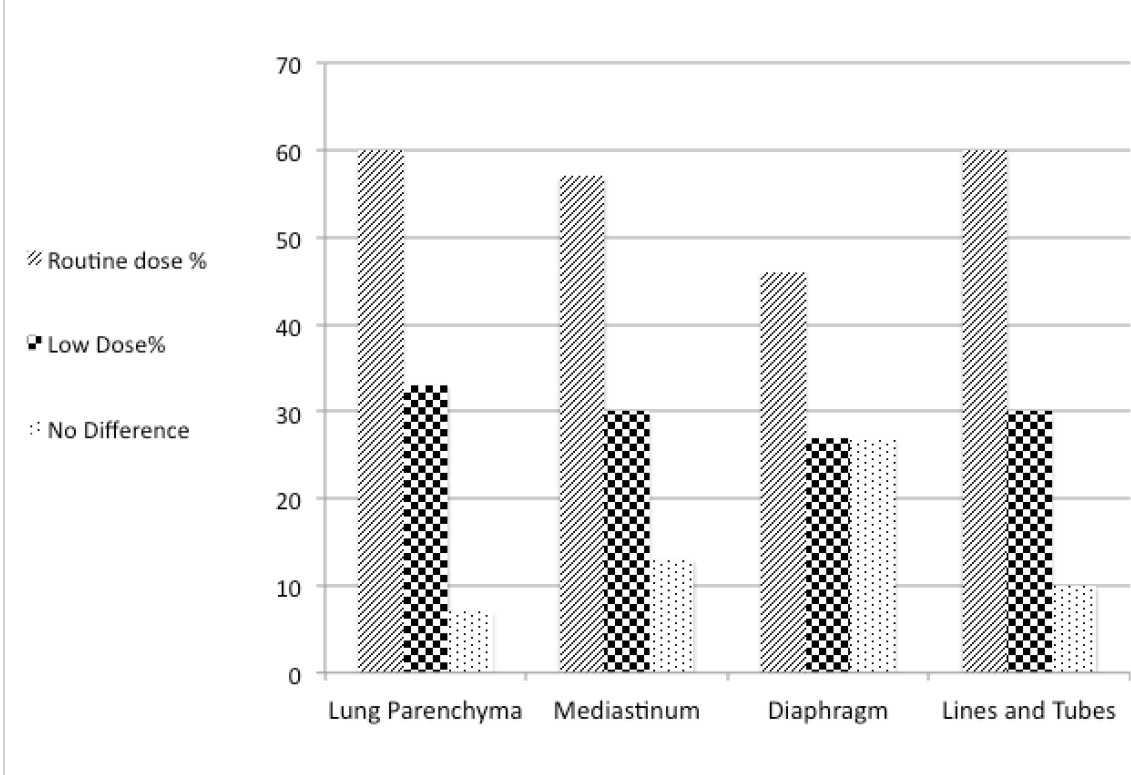


Figure 1: Clustered column chart showing the breakdown of the specific aspects evaluated

The routine dose was chosen as the best image in the majority of cases. In approximately 30% of the cases the lower dose was chosen as the better-quality image. The “no difference” option was selected between 7 and 27%.

Table 3 provides information about the diagnostic image quality of the low-dose images, taking into account the different aspects of the images that were evaluated.

Table 3: Aspects reviewed in which the low-dose images were diagnostically acceptable

Aspect for which visibility must be evaluated	Lower dose acceptable (%)	Lower dose not acceptable (%)	95% confidence interval	Number of cases with no consensus
Lung parenchyma, trachea, proximal bronchi and vascular lung pattern	57/58 (98.3)	1/58 (1.7)	91%; 100%	2
Mediastinum, including borders of the heart and aorta.	56/59 (94.9)	3/59 (5.1)	86%; 99%	1
Diaphragm and costophrenic angles	59/60 (98.3)	1/60 (1.7)	91%; 100%	0
Tubes and lines	59/59 (100)	0/59 (0)	94%; 100%	1

The low dose performed the best regarding lines and tubes, with no images considered as of non-diagnostic quality. The low dose performed the worst on imaging of the mediastinum. Nevertheless, in only three cases (5.0%) the images were regarded as of non-diagnostic quality.

In total, there were five cases of low-dose images that were of non-diagnostic quality for specific aspects. Two qualified radiologists were asked to review the technical quality of these images and the effect the pathology could cause on the image quality. Three of these cases related to the evaluation of the mediastinum, and in all of these cases adjacent lung pathology obscured mediastinal margins. The other two cases related to the lung parenchyma and the diaphragm and costophrenic angles, which, in both cases, were due to poor radiographic positioning. The radiologists concurred that the change in pathology and positioning errors

caused poor visibility of the tissue interfaces, rather than the exposure factors affecting the visibility.

Another noteworthy finding relates to the image sets in which the low dose had been chosen as the best-image quality image. In these cases we requested that the high-dose images be evaluated for diagnostic adequacy. In two cases of the high-dose images were evaluated as unsuitable for the diagnosis for the mediastinum, the same applied to two cases for lung parenchyma, and one case each for diaphragm and costophrenic angles or placement of lines and tubes.

The six cases for which, the high-dose images were declared non-diagnostic belonged to three different patients. Two qualified radiologists also evaluated these images separately. In all these cases, either positioning, overlying foreign material or a severe worsening of pathology rendered the images non-diagnostic. Thus, none of these non-diagnostic images could be attributed to incorrect exposure factors, but all were due to either clinical factors or positioning errors, as demonstrated in Image 2.

The age of the NICU patients included in the study varied from gestational age of 28 weeks and up to 2 months of age. The neonate with the greatest weight at admission was 4750 g, and the lowest weight was 830 g.

4. Discussion

NICU patients often undergo daily X-ray examinations, which may lead to considerable cumulative radiation exposure during an extended ICU stay. Ionising radiation causes an increased risk of cancer. The risk for developing a malignancy is proportional to the radiation dose. Although the risk from diagnostic imaging is low, one should always aim to keep radiation exposure to a minimum. The National Academy of Sciences Committee on the Biological Effects of Ionizing Radiations Committee (BEIR VII) claims that, if a patient under the age of 15 years receives radiation, the risk for this child developing cancer is twice as high as that of someone older [16,17].

In a study in Shanghai, China, the risk of childhood cancer increased if the number of X-rays taken increased [18]. These findings reinforce the importance of keeping radiation exposure of the paediatric population to a minimum. As mentioned in the introduction, the ALARA principle and the Image Gently campaign focus on radiation-dose reduction for children because children are more radiosensitive [1]. An Australian cohort-data-linked study published in May 2013 studied 680 000 people exposed to computed tomography (CT) in childhood or adolescence, and found a 24% increased cancer incidence for exposed people. They made the assumption that if CT scan exposure was the cause of each cancer, then 1 in every 1800 CT scans was followed by a cancer, which is a ratio 0,035 per mSv. The ionising radiation exposure from CT is between 5-50 mGy per organ imaged [19] compared to the ESK of 24-49 μ Gy for the NICU chest x-rays, which is thus approximately a 1/100 of the CT exposure. (Table 1)

Various methods are available for reducing the radiation dose to the patients. Decreasing the mAs setting lowers the radiation dose. The X-ray tube current (mAs) determines the amount

of X-ray photons emitted, which influences the image noise. Exposure per mAs increases as the kV increases, but higher kV results in greater transmission, in turn resulting in less absorption [20]. The tube voltage (kV) determines the penetration of the X-ray beam that affects the SNR and contrast of the image. Lower kV values improve image quality, due to improved image contrast. In addition, most digital systems have higher dose-efficiency at lower kV ranges [10,16]. This low kV approach is different to the older film-screen system, in which a high-kV and low-mAs technique was promoted to achieve an optimal image quality and radiation ratio. Few clinical studies have been done to compare the image quality with CR at lower kV settings, as mentioned in Paragraph 1 [6,7]. Other factors that decrease the dose to neonates include avoidance of the use of a grid system, proper use of collimators/shielding, copper /aluminium filtration and limiting scatter [17].

With the theoretical advantage of a wider dynamic range of CR images compared to traditional film-screen systems, we postulated that we could lower the dosage on mobile NICU X-rays without a significant loss of quality. We decreased the tube current from 3,2 mAs to 1,6 mAs, based on the literature review [3,12,13]. We decided to set the tube output to 55 kV for all the studies, although the EC suggests a setting of 60-65 kV. A study in Greece [9] revealed that older radiographers tend to use a lower kV of 44-53,5 whereas younger radiographers use a higher a kV of 55-63,5. They found that high image-quality scores were obtained for both high-kV and low-kV techniques. High-kV settings will result in a good SNR measurement, which is the basis of image quality evaluation by Monte Carlo simulation programs, but this does not necessarily indicate that the diagnostic image quality is better. Monte Carlo method is a stochastic, mathematical technique using random numbers, which can be used to evaluate the exposure settings and detector efficiency that will influence the image quality. It is difficult to calculate an image being formed by a large amount of X-ray photons, because of the random interaction with matter that causes a large distribution range

of possible x-ray scatter. To consider the possibility of multiple random interactions on the x-ray photon, Monte Carlo simulation can be used to determine all the different distribution possibilities. In short, it is a method of obtaining complex numerical solutions by random sampling. It is often displayed as an SNR/kV ratio curve. Monte Carlo simulation allows simultaneous estimates of measure of image quality and radiation dose absorbed. Several Monte Carlo codes have been developed for specific scenarios [21]. However, studies have found that lower kV improves image quality, due to improved contrast [6,7,9,10]. This shows that SNR measurement of the image noise is not equal to the diagnostic image quality, and that image contrast plays an important role in clinical image evaluation. In Belgium the kV varies between 40 and 81 [3].

The five radiology and paediatric ICU consultants involved in the evaluation of the image quality of the X-rays had experience ranging from 5 to 20 years in evaluating neonatal chest X-rays. The responses from all the evaluators were considered and the majority decision was taken in order to eliminate individual bias and preferences.

The first question on the tick sheet provided related to the consultants' gestalt interpretation of the quality of the X-rays. It is often very difficult to assign a value of importance to the image quality of different structures on an X-ray. For example, the quality of the lung fields on a chest X-ray (CXR) is more important than the quality of the bones in an ICU X-ray image, as the lung field is usually the region of interest. In this question about general image quality, we relied on the consultants experience to take into account the importance and quality of the different aspects of the image. The reviewer was forced to choose the better quality image.

Regarding the general question about identifying the best-quality image, 35% of the lower-mAs-dose images were chosen as the better-quality images. The most likely reason why the

routine-dose images were not always chosen could be that the image quality at the routine doses was not different to that of lower doses. It can also be attributed to the fact that the reviewers were forced to choose between the routine and lower-dose image sets.

The routine dose images appeared superior in the majority of cases. Nevertheless, none of the lower-dose images was non-diagnostic, excluding the images where positioning errors or severe change in pathology caused poor image quality. This finding emphasises the importance of proper radiographic positioning technique. Pathologic processes like pulmonary oedema cause haziness between borders of different types of tissue, which can mimic poor image quality. Most radiologists appreciate high image quality, but should not strive to obtain higher-quality images at all costs, when it might be detrimental to the patient without providing a diagnostic advantage.

The next subjects on the tick sheet required the evaluators to focus on certain aspects of the image. If an image aspect was regarded as inferior, they had to decide whether that image aspect was still of diagnostic quality.

A common indication for X-rays in the NICU setting is to evaluate tube or line placement.

When this aspect was evaluated on the lower-dose (1.6 mAs) images, 30% of images were chosen as being the best, whilst the routine dose was chosen as the best in 60% of cases.

When evaluating for diagnostic acceptability, however, not a single case occurred in which the image quality of the lower dose was regarded as unacceptable. Further research regarding line and tube placement X-rays can be done to determine the lowest exposures that can be used and still evaluate positioning. In the future this could permit the use of very low-dose X-ray imaging, specifically for tube and line placements.

Evaluation of the pulmonary parenchyma is another common indication for NICU chest X-rays. This aspect was more visible on the lower mAs images in 33.3% of the cases. All the cases with proper radiographic positioning have acceptable diagnostic quality.

Although the lower-dose images were chosen as inferior in 60% of the cases, only one of these cases was evaluated as not diagnostically acceptable. Therefore, the lower-dose images were diagnostically acceptable for evaluation of the pulmonary parenchyma in 98% of the cases. The consensus regarding the case with the poor image quality is that it was caused by radiographic rotational error, and not the mAs dosage.

However, two cases in the high-dose group were not diagnostically acceptable either. Even though more routine-dose images were chosen as the best, the diagnostically acceptable rate for the routine images were 96%, which is slightly below the low-dose group, though not clinically significant. The two radiologists reviewing these images, had consensus that the poor image quality was due to rotation error. (see Image 2)

Image 2 is an example of a standard-dose X-ray in which evaluation of the mediastinal border is not possible due to patient rotation error. In this case the routine-dose image (3.2 mA s) was rotated and the image set was rejected from the study. The right heart border is projected on the thoracic vertebrae due to rotation error, and cannot be used for evaluation of the mediastinum border. Image 2b is the 1,6 mA s exposure, which was not rotated.

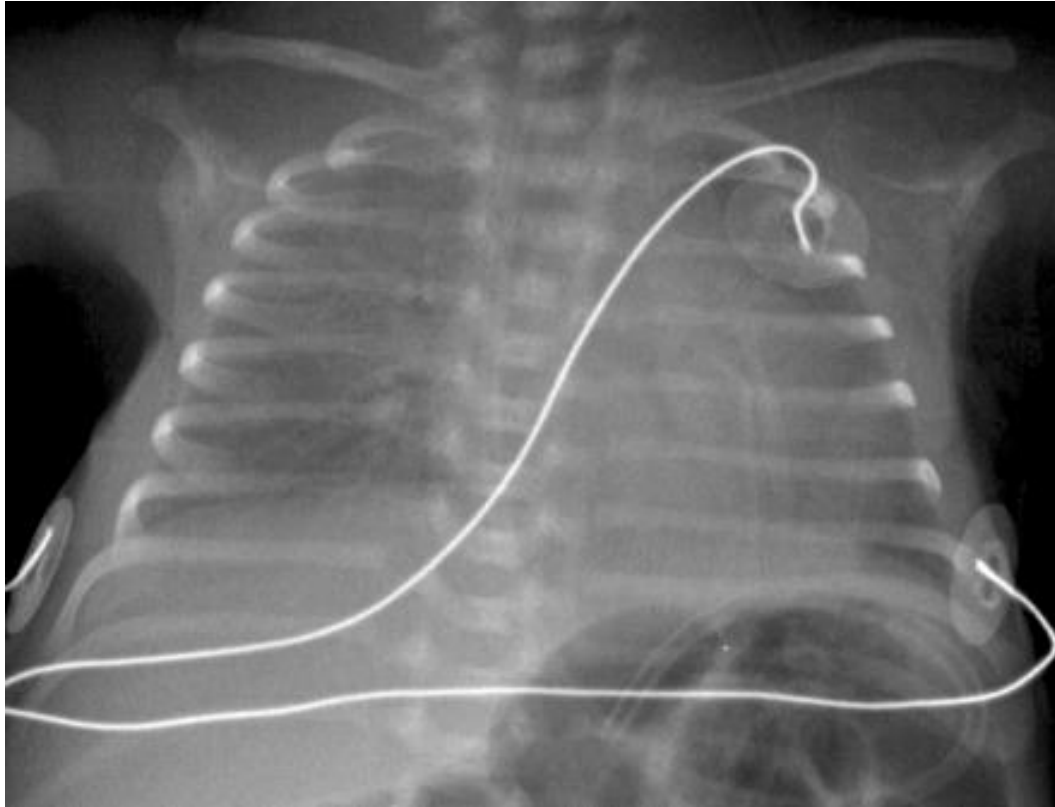


Image 2a: Standard-dose X-ray in which evaluation of the mediastinal border is not possible due to patient rotation error

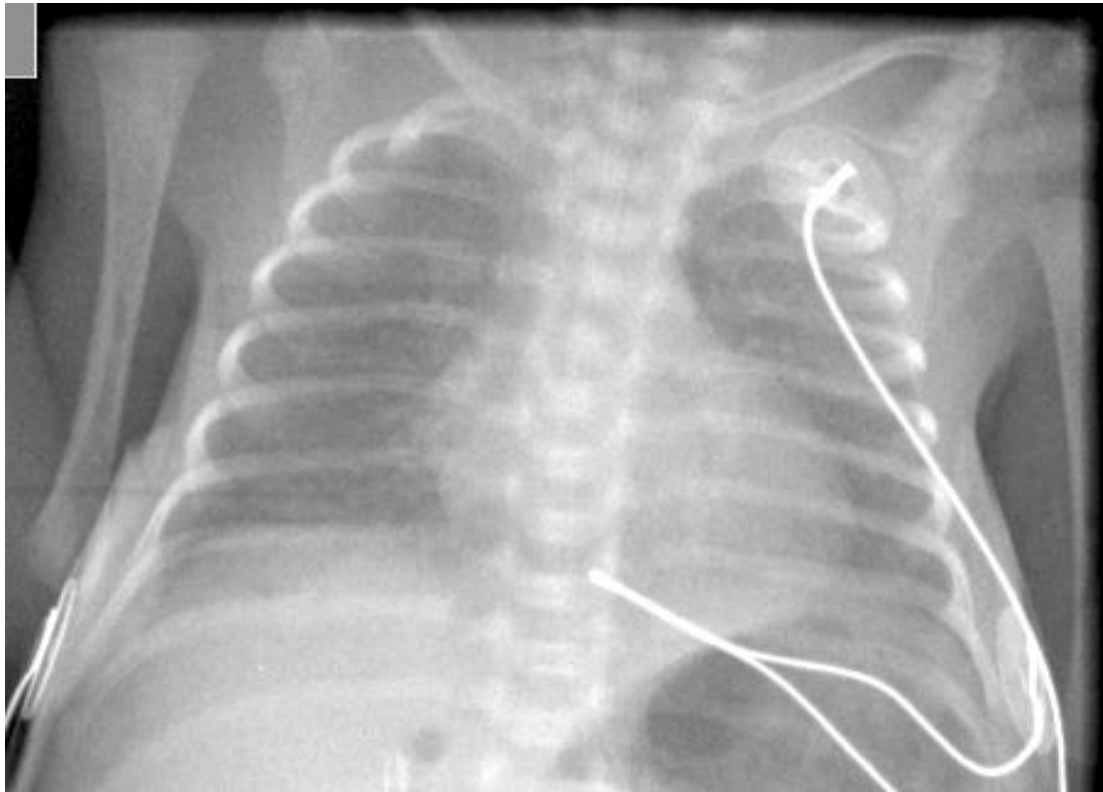


Image 2b: 1,6 mA s exposure X-ray with correct rotation, in which evaluation of the mediastinal border is possible

Our result is similar to that of the study of Dougeni et al, who categorised the NICU patients according to weight groups, with the heaviest neonate measuring 4440g [9]. Their results indicate that a diagnostic-quality image could be achieved between 1,2 and 1,6 mAs at 55 kV for the greatest weight group. Dougeni et al's ESK is also similar to our findings. Our study shows that image quality of an exposure of 1,6 mAs / 55 kV is still diagnostically acceptable for neonates weighting up to at least 4750g.

As there was no information available in Belgium regarding the dose and image quality of neonatal radiographs, K. Smans decided to use this as topic for the dissertation of her degree of Doctor in Medical Sciences at Katholieke Universiteit, Leuven, Belgium in 2009 [8]. She

researcher also mentions that it is important to use as low as possible radiation without losing diagnostic image detail.

Smans found that radiologists prefer to look at images with the same noise, which can be achieved by using higher mAs settings for higher-birth-weight neonates. This is dependent on the sensitivity of the CR cassette and processing, which differs between vendors [8].

Smans developed a Monte Carlo model from her research. It can be used for evaluation and optimisation of all the aspects of a CR system. To obtain a constant air kerma of 20 μGy , she adjusted tube load (mAs) was adjusted for each type of phantom. However, Smans does not mention the impact this had on the diagnostic image quality, or provide specific guidelines regarding the mAs setting for CR system to be used. It is important to correlate the exposure settings with the diagnostic image quality, as this model emphasises the SNR rather than the image contrast.

The lack of specific guidelines relating to diagnostic reference limits for exposure settings in NICU was also raised in a study in Ohio, United States. This study also states that there is an urgent need to establish diagnostic reference levels for extreme low birth weight patients [22].

In practice our findings indicate that significantly lower radiation exposure can be used in the NICU without diagnostic image quality being lost. The lower radiation exposure will benefit the patient, because the chance of radiation-induced malignancy developing later in life would be lower.

Further research is indicated to determine the value of the maximum weight of neonates in determining settings without diagnostic image quality lost. It may be that the ideal exposure settings should be calculated according to the patient weight and/or thickness of the

chest/abdomen. Further research regarding these aspects could result in dramatic decreases in the radiation doses used in NICUs.

A major limitation is that this study did not take into account missed pathology that could have developed in the 12-hour time frame between the low and high exposures. Conducting the low and high exposures in quick succession could have prevented this, however it would have been unethical to expose the neonates without clinical indication. Phantom studies could also be done to determine the image quality of small objects at different exposures.

Images were excluded in which progression of pathology mimicked poor technical appearance of the image quality, e.g. the clarity of the diaphragm border with consolidation. This necessity would also be minimised by consecutively image exposures, though the also ethical questions remain.

5. Conclusion

Lack of consensus about setting standardised mAs values for NICU images leads to a large range of exposures being used at different institutions.

Our results show that using a CR system and decreasing the mAs to 1,6 in the NICU did not lead to any significant loss in diagnostic image quality compared to the 3,2 mAs/55 kV images.

Portable CR system settings of 1,6 mAs and 55 kV can be used for all the NICU patients up to 4750 g, without loss of diagnostic image quality being observed. Small adjustments might be needed for different CR systems.

This exposure results in a calculated ESK of 29 μ Gy, which is significantly lower than the EC guidelines of 80 μ Gy. This reduction will reduce the patient's entrance radiation exposure to 66% per CXR taken in NICU, without loss of diagnostic image quality.

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Appendix A: Patient information leaflet

Information document

Title of study: Diagnostic Quality of neonatal radiograph images after 50% radiation dose reduction on a computed radiography system

Ethics committee approval number: ECUFS 46/2011

Good day. Would you be willing to help us with this research study?

I, Dr Frans Naude, am currently busy with research on radiation in the neonatal unit of Universitas Hospital. Research is the process to get answers for questions. The aim in this study is to administer lower radiation to the neonatal patients, without influencing the diagnostic image quality or treatment. The new digital film system, is more sensitive than the previous film system, which allows lower radiation without loss of diagnostic image quality. There is already a study by the Medical Physics Department done which confirmed this. The advantages of the lower radiation dose, is partly because of the reduced risk for the child to develop cancer later in his life due to the radiation.

Invitation to participate: Hereby I ask your permission, that your child may participate in this study, which requires that the 2nd X-ray taken per day would be at a 50% reduced radiation dose.

What this study entails: This study is only performed at the neonatal unit of Universitas Hospital. The aim is for all the children in the Neonatal ICU to participate, if permission is granted. The 1st routine X-ray per day would be done with the current radiation dosages. If a 2nd X-ray is needed later the same day, this will be obtained at 50% decreased radiation dose. (The preliminary study did not show a image quality difference up to 66% decreased radiation dose).

The 2nd X-ray, will be evaluated by a Radiology and Pediatric Consultant. If the image quality is not of diagnostic quality due to the reduced radiation dose, the X-ray will be repeated and the study will be stopped.

Risks: This study will reduce the radiation dose to the children, and consequently reduce the risk for radiation side-effects later in life, like the development of cancer. The X-rays will be evaluated by Radiology and Pediatric Consultants, which will ensure optimal diagnostic image quality.

No unwanted side-effects or disadvantages are suspected.

Participation is free. If you do not want your child to participate in this study, you or your child would not be penalized or lose any privileges. You are welcome at any stage to withdraw your child from participation, also without any penalization or loss of privileges, which you or your child would have had.

No remuneration will be given for participation. There is no additional cost for you or the hospital.

Privacy: Efforts will be made to keep all the personal information private. Absolute privacy however cannot be guaranteed. Personal information might need to be made available if requested by law. Organizations that might have to review the records and/or copying the records for quality purposes, include groups like the Ethics Committee for Medical Research and Medical Council, where appropriate. Publication of results is a possibility, which will

imply that patient of Universitas Neonatal unit were involved in this study. No individual identification will be published.

You are more than welcome to contact Dr. Frans Naude from the Department of Diagnostic Radiology, Ground Floor, Faculty of Health Sciences, University of Free State, Bloemfontein (Tel. 0827878181, short code: 6448, e-mail: fransnaude@gmail.com) at any time for questions regarding the study .

Contact details for secretary and head of the Ethical Research committee – regarding any complaints or questions about your rights as research subject: Mrs Henriette Strauss, Research department (Ethics Committee), Block D, Deans Office, Room 108, Faculty of Health Sciences, PO Box 339 (Internal bus G40), University of Free State, Bloemfontein, 9300. Tel: 0514052812, Fax : 0514444359, E-mail: StraussHS@ufs.ac.za

Inligtings dokument

Titel van studie : Diagnostic Quality of neonatal radiograph images after 50% radiation dose reduction on a computed radiography system
(Diagnostiese Kwaliteit van neonatale radiografie beelde na 50% radiasie dosis vermindering met 'n rekenaar radiografie sisteem.)

Etiëkomitee – goedkeurings nommer: ECUFS 46/2011

Goeie dag. Sal u dalk bereid wees om ons met hierdie navorsing studie te help?

Ek, Dr. Frans Naude, is tans besig om navorsing te doen oor bestraling in die neonatale eenheid van Universitas hospital. Navorsing is slegs die proses om antwoorde op vrae te verkry. In hierdie studie word gepoog om laer bestraling aan die neonate te gee, sonder om diagnostiese beeldings kwaliteit of behandeling te beïnvloed. Die nuwe digitale film sisteem, wat meer sensitief is as die vorige film sisteem, laat dit toe om laer bestraling te gee, sonder verlies aan film kwaliteit.

Daar is reeds 'n voorlopige studie deur die Mediese Fisika Departement gedoen wat dit bevestig het.

Die voordele van 'n laer radiasie dosis, is onder andere dat dit die risiko vir kanker later in die kind se lewe verminder.

Uitnodiging om deel te neem: Hiermee vra ek toestemming, dat u kind kan deelneem aan die studie, wat behels dat die 2de X-straal per dag teen 'n 50% laer radiasie dosis geneem sal word.

Wat die studie behels: Die studie word slegs by die neonatale eenheid van Universitas Hospital uitgevoer. Ek beplan om al die kinders in die neonatale eenheid by die studie te betrek, mits u toestemming gee. Die 1ste roetiene X-straal van die dag word teen huidige bestralings waardes geneem. As daar 'n 2de x-straal benodig word dieselfde dag, sal dit teen 'n 50% verminderde radiasie dosis geneem word. (Die voorlopige studie het getoon dat daar geen verskil in beeldings kwaliteit selfs tot op 66% verminderde radiasie dosis is nie). Die 2de X-straal, sal deur 'n Radiologie konsultant en Pediatrie konsultant evalueer word. Indien die beeldings kwaliteit slegter is as gevolg van die laer bestralings dosis, sal die 2de x-straal herhaal word teen huidige radiasie dosis en die studie gestaak word.

Risiko: Die studie behels verminderde bestraling vir die kinders, met gevolglike verminderde risiko vir bestralings nuwe-effekte, onder ander kanker, later in die kind se lewe. Die x-strale sal deur Radiologie en Pediatrie Konsultante evalueer word, moet sodoende deurgaans beeldings kwaliteit en optimale behandeling te verseker. Geen ongunstige effekte of nadele word verwag nie.

Deelname is vrywillig. Indien u nie wil he u kind moet deelneem nie, sal u of u kind nie gepenaliseer word of enige voordele verloor nie. U mag in enige stadium u deelname onttrek, sonder penalisering of verlies aan voordele waarop u of u kind andersins geregtig is nie.

Geen vergoeding sal aangebied word vir deelname nie. Daar is geen addisionele kostes vir u of die hospitaal nie.

Vertroulik: Pogings sal aangewend word om u persoonlike inligting vertroulik te hou. Absolute vertroulikheid kan egter nie gewaarborg word nie. Persoonlike inligting mag bekend gemaak word as dit deur die wetgewing vereis word. Organisasies wat u navorsingsrekords

mag ondersoek en/of kopieer vir gehalte versekering of data analisering, sluit in groepe soos die Etiekkomitee vir Mediese navorsing en die Mediesebeheerraad, waar gepas. Publikasie van resultate is 'n moontlikheid en dit beteken dat dit bekend sal wees dat pasiente van die Universitas neonatale eenheid betrokke was by die studie. Geen individuele identifikasie sal geplaas word nie.

Kontak besonderhede van navorser: Vir enige verdere inligting. Kontak asb. Dr.Frans Naude , Departement Diagnostiese Radiologie, Grondvloer Universitas hospital, UV,Bloemfontein, 9301. Tel. no 0827878181, kort nommer: 6448 , e-pos: fransnaude@gmail.com

Kontak besonderhede van sekretaresse en voorsitter van die Navorsingsetiekkomitee- vir enige rapportering van klagtes of problem: Mev Henriette Strauss, Navorsingsafdeling (Ettiëkkomitee), Blok D, Dekanskantoor, kamer 108, Fakulteit Gesondheidswetenskappe, Posbus 339 (Interne Bus G40) , UV, Bloemfontein, 9300 Tel no.: 0514052812, Faks : 0514444359, Epos: StraussHS@ufs.ac.za

Tokomane tsebo

Sehloho sa diphuputso: Bolleng ba ho hlahloba ditshwantsho tsa bana basa tswa hlaha ka mora hore ho fokotswe mahlasedi a ho fanwang ka ona boemong ba dikhomputara).

Nomoro ya Tumello ya komiti ya tsa Botho:

Ka ditumediso.A na o ka bana le bolokolohi ba ho ka thusa ka diphuputso na? Nna,Ngaka Frans Naude, ha jwale ke sebetsana le diphuputso tsa mahlasedi lefapeng la bana ba sa tswang ho hlaha Sepetleleng sa Universitas.Diphuputso ke boemo ba ho fumana dikarabo dipotsong.Maikemisetso a diphuputso tsena ke ho sebedisa mahlasedi a Fokotsehileng baneng bas a tsw hlaha ,ntle le tlisa phetoho boleng ba ditshwantsho kappa thuso ho mokudi.Boemo bo botsha ba ho ka fumana ditshwantsho, bon ale phihlello ya ho ka fumana ditshwantsho ka mahlasedi fokotsehileng ha o bapisa le boemo ba kgale., Mme sena ha se bake tahlehelo ya boleng ba ditshwntsho. Ho so ho entswe diphuputso ka sena ke lefapa la Mahlale a tlhaho(Medical Physics department). Molemo wa mahlasedi a fokotsehileng ho bakudi bana,ke hore ka boemo bo itseng ,bo fokotsa kgonahalo ya ho ka bana le dihlala baneg ka nako e tlang bophelong ka lebaka la mahlased.

Memo ya ho nka karolo:Mona, ke kopa tumello yah ore ngwana wa hao a nke karolo diphuputsong ,mme sena se hloka hore Setshwntsho sa bo-bedi se tla nkuwang, setla nkuwa ka mahlasedi a fukuditsweng ka persente tse 50.

Diphuputso tsena di akaretsa eng:Diphuputso tsena di etsetswa fela Lefapheng la bana basa tswa hlala Sepetleleng sa Universitas.Sepheo ke hore bana bohle Lefapheng la Bana ba sa tswa hlaha ba ICU ba nke karolo,haeba ho fannwe ka tumello.Setshwantsho sa pele se tla nkuwa ka mahlasedi jwalo ka setlwedi.Ha ho hloka hloka sa bobedi se tla nkuwa ho fokoditswe mahlasedi ka dipersente tse 50.(Setshwantsho se qalang ha se aka sa bontsha phapang ho fihla persenteng tse 66,boleng ba sona.)Setshwantsho sa bobedi se tla lekolwa ke Ngaka ya Radiology Ngaka ya bana(Pediatric Consultant.Ha eba boleng ba setshwantsho sa bobedi ka mahlasedi a fokotsehileng se sa khotsofatse, se tla pethwa,mme kamora moo,ho emiswe ka diphuputso.

Mathata:Diphuputso tsena di tla etsa hore mahlasedi a fumanwang ke bana a fokotsehe,mme a tla baka hore mathata a ka hlahang ka lebaka la mahlasedi ha morao bophelong le ona a fokotsehe jwalo ka ho ka ba le hlala(cancer).Ditshwantsho tsena di tla lekolwa ke Ngaka ya ditshwantsho(Radiologist) le Ngaka ya bana(Pediatrician),bat la netefatsang boleng bo amohelehang ba sethwantsho se ka fanang ka boemo ba ho ka etsa qeto.Ha ho moo ho lebeleletsweng diketsahalo tse ka thoko kappa boemo ba se sa amohelehang.

Ho nka karolo ke mahala.Ha o sa battle ngwana a nka karolo diphuputsong tsena ,ha ho moo hotla bang le kotlo,kappa hona lahlehelwa ke ditokelo.O amohelehile ho ka ikhula diphuputsong tsena,ntle le ho ka bana le kotlo kappa hona ho lahlehelwa ke ditokelo tsa hao.

Ha ho tefo e o tla e amohelang ,bakeng sa ho nka karolo, le ha ele ditjeho tse eketsehileng ho wean kappa sona Sepetlele.

Boikgetho:Ho tla nkuwa mehato yohle ya hore tsebo ya motho ka mong sireletsehe le ho ba ka ho ikgetha.Boikgetho bo netefaditsweng ha bo kgone ho netefatswa.Ho ka etsahala hore ho be le tsebo e hlokahalang ka tlasa molao, mme e tla lokela ho fetiswa ka kopo e lokelang.Ho nale mekgahlo e kanang ya ba le batla ho lekola diphuputso tsena jwalo ka Komiti ya tsa Botho ho tsa Mahlale Maphelo a Diphuputso le Khansele ya tsa Maphelo.Diphatlalatsa tsa diphetho ke kgoneho,ho bolelang hore bakudi ba Lefapha la Bana ba sa tswa hlaha (Neonatal) baneng ba nka karolo diphuputsong ,mabitso a bona ha ana ho hlahiswa diphatlalatsong.

Mona o ka ikopanya le Ngaka Frans Naude ho tswa Lefapheng la Diagnostic Radiology,mokatong o fatshe wa tsa Mahlale,Univesiting ya Freistata.Bloemfontein Mohala:0827878181,nomoro e khutshwane:6448 e-mail:fransnaude@gmail.com) ka nako engwe le engwe ha ho nal dipotso mabapa le dipatlisiso tsena

Ho ka ikopangwa le mongodi kappa hloho ya Komiti ya Dipatlisiso tsa Botho,mabapi le mathata kapa dipotso ka Ditokelotsa hao jwalo ka motho eo ho etswang diphuputso ho yena:Me Henriette Straus,Lefapha la Diphuputso(Komiti ya Tsa Botho,Block D,Ofising ya Mookamedi wa LefaphaKamoreng 108,Lefapha la tsa Mahlale,P.O.Box 339(Internal bus G40),Univesiti ya Freistata,Bloemfontein,9300._Founo:0514052812,Fax:0514444359,[E-mail:StraussHS@ufs.ac.za](mailto:StraussHS@ufs.ac.za)

Appendix B: Patient consent forms

Consent for Research

Name: _____

Reference number: _____

You have been asked to participate in a research study (Diagnostic Quality of neonatal radiograph images after 50% radiation dose reduction on a computed radiography system).
Ethics Committee approval number: ETOVS: ECUFS 46/2011

Informed by: _____

You are more than welcome to contact Dr Frans Naude from the Department of Diagnostic Radiology, Ground Floor, Faculty of Health Sciences, University of Free State, Bloemfontein (Tel. 0827878181, short code: 6448, e-mail: fransnaude@gmail.com) at any time for questions regarding the study .

Contact details for secretary and head of the Ethical Research committee – regarding any complaints or questions about your rights as research subject: Mrs Henriette Strauss, Research department (Ethics Committee), Block D, Deans Office, Room 108, Faculty of Health Sciences, PO Box 339 (Internal bus G40), University of Free State, Bloemfontein, 9300. Tel: 0514052812, Fax: 0514444359, E-mail: StraussHS@ufs.ac.za

Your participation in the research is voluntary and you or your child will not be penalized or will not loose any privileges if you do not want your child to participate in this study/ or if you wish to stop the participation.

If , for whatever reason, your child is not suitable to participate further in this study , the participation of your child will be stopped and no further data will be obtained.

There will be no additional costs for you or the hospital, if you decide to participate, and there will also be no benefits for participation in this study.

If you agree that your child can participate in this study, you will receive a copy of this document as well as a participant’s information leaflet, which is a summary of this research document.

This research study, as well as above information is explained to me. I understand what my child participation to this study entails and I hereby freely give my consent.

Signature of Parent

Date

Signature of Witness (where applicable)

Date

Signature of translator (where applicable)

Date

Toestemming vir Navorsing

Naam:

Verwysings nommer:

U is gevra om aan 'n navorsingstudie getiteld 'Diagnostic Quality of neonatal radiograph images after 50% radiation dose reduction on a computed radiography system' (Diagnostiese kwaliteit van neonatale radiografie beelding na 50% bestraling dosis vermindering op 'n rekenaar radiografie sisteem) deel te neem.

Etiëkkomitee-goedkeuringsnommer: ETOVS: ECUFS 46/2011

U is in kennis gestel deur

U is welkom om Dr Frans Naude by die Departement Diagnostiese Radiologie, Fakulteit Gesondheidswetenskappe, UV, Bloemfontein (Tel. no 0827878181, kort nommer: 6448) enige tyd kontak indien u verdere navrae aangaande die studie het.

Kontak besonderhede van sekretaresse en hoof van die Navorsingsetiëkkomitee - vir enige rapportering van klagtes of vir enige navrae van u regte as navorsings subjek.: Mev Henriette Strauss, Navorsingsafdeling (Ettiëkkomitee), Blok D, Dekanskantoor, kamer 108, Fakulteit Gesondheidswetenskappe, Posbus 339 (Interne Bus G40) , UV, Bloemfontein, 9300 Tel no.: 0514052812, Faks : 0514444359, Epos: StraussHS@ufs.ac.za

U betrokkeheid by die navorsing is vrywillig en u of u kind sal nie gepenaliseer word of enige voordele verloor indien u nie deel van hierdie studie wil vorm nie/ of u deelname aan die studie staak nie.

Indien u kind om een of ander rede nie geskik is om verder in die studie gebruik te word nie, sal die kind se deelname aan die studie beëindig word en daar sal nie verdere inligting bekom word nie.

Daar sal geen addisionele kostes vir u of die hospital wees nie, indien u sou deelneem aan die studie , en u sal ook geen vergoeding ontvang vir deelname aan die studie nie.

Indien u instem dat u kind aan die studie deel neem, sal u 'n afskrif van die dokument ontvang asook die deelnemerinligtingsdokument, wat 'n opsomming van die navorsingstudie is.

Die navorsingstudie, sowel as bogenoemde inligting is mondelings aan my verduidelik. Ek verstaan wat my en my kind se betrokkeheid by die studie behels en stem vrywillig in dat my kind kan deelneem.

Handtekening van deelnemer

Datum

Handtekening van Getuie
(waar van toepassing)

Datum

Handtekening van vertaler
(waar van toepassing)

Datum

Tumello ya ho etsa Diphuputso

Lebitso_____

Nomoro ya Bopaki_____

Mona o kopilwe ho nka karolo diphuputso(Bolleng ba ho hlahloba ditshwantsho tsa bana basa tswa hlaha ka mora hore ho fokotswe mahlasedi a ho fanwang ka ona boemong ba dikhomputara).

Nomoro ya Tumello ya komiti ya tsa Botho: ECUFS 46/2011

O tsebisitswe ke:_____

Mona o ka ikopanya le Ngaka Frans Naude ho tswa Lefapheng la Diagnostic Radiology,mokatong o fatshe wa tsa Mahlale,Univesiting ya Freistata.Bloemfontein
Mohala:0827878181,nomoro e khutshwane: 6448
e-mail:fransnaude@gmail.com) ka nako engwe le engwe ha ho nal dipotso mabapa le dipatlisiso tsena

Ho ka ikopangwa le mongodi kappa hloho ya Komiti ya Dipatlisiso tsa Botho,mabapi le mathata kapa dipotso ka Ditokelotsa hao jwalo ka motho eo ho etswang diphuputso ho yena:Me Henriette Straus,Lefapha la Diphuputso(Komiti ya Tsa Botho,Block D,Ofising ya Mookamedi wa LefaphaKamoreng 108,Lefapha la tsa Mahlale,P.O.Box 339(Internal bus G40),Univesiti ya Freistata,Bloemfontein,9300._Founo:0514052812,Fax:0514444359,E-mail: StraussHS@ufs.ac.za

Ho nka karolo ha hao,ke bolokolohing ba hao,mme ha ho moo wena kapa ngwana Le ka lefisiwang kapa hona ho lahlehelwa ke ditokelo tsa lona ha o sa battle ha ngwana a nka karolo diphuputso tsena.

Haeba ho nale lebaka le itseng le etsang hore ngwana a seke a gona ho tswela pele ho nka karolo diphuputso tsena ,ho tla emiswa hang-hang,mme ha ho na hlola ho nkuwa diphuputso tseo.

Ha ho na ho bana le ditjeho tse eketsehileng ho wena kappa Sepetlele, ha o nkile qeto ya ho nka karolo Diphuputso tsena le ha ele se o ka se kholang hobane o nkile karolo.

Ha o dumela hore ngwana wa hao a nke karolo Diphuputso tsena, o tla fuwa kopi ya tokomane le pampitshana e hlalose tsang Monka karolo, eleng khutsufatso ya tokomane ya Diphuputso.

Thuto ena ya Diphuputso le tsebo ena e ka hodimo ke e hlaloseditswe. Ke utlwisisa hore ngwana wa ka o tlo nka karolo boemong ba eng,mme ke fana ka Tumello ka bolokolohi.

Ho Tekena ha Motswadi

Letsatsi

Ho Tekena ha paki(Mo ho khonehang)

Letsatsi

Ho Tekena ha Mofetoledi(Mo ho khonehang)

Letsatsi

Appendix C: Data tick sheet

Data form

Diagnostic Quality of neonatal radiograph images after 50% radiation dose reduction on a computed radiography system

Radiograph study number:

Consultant name:

For Office use

		1-3
		4-6

1. Mark which of the neonatal CXR has the best diagnostic image quality:

A B

7

For Office use

Which XR has better <i>visual sharpness of the reproduction of tissue and the borders of the:</i>	A	B	If there is a difference- is the poorer quality film still diagnostically acceptable ? (Mark if acceptable)	No difference	
2. lung parenchyma, trachea, proximal bronchi and vascular lung pattern	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> 8-9
3. mediastinum , including borders of the heart and aorta.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> 10-11
4. diaphragm and costophrenic angles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> 12-13
5. Visibility and position of lines or tubes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> 14-15

Appendix D: Ethics Committee Approval

UNIVERSITEIT VAN DIE VRYSTAAT
UNIVERSITY OF THE FREE STATE
YUNIVESITHI YA FREISTATA



Direkteur: Fakulteitsadministrasie / Director: Faculty Administration
Fakulteit Gesondheidswetenskappe / Faculty of Health Sciences

Research Division
Internal Post Box G40
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Fax (051) 4444359

E-mail address: StraussHS@ufs.ac.za

Ms H Strauss

2011-05-25

DR FSJ NAUDÉ
DEPT OF DIAGNOSTIC RADIOLOGY
FACULTY OF HEALTH SCIENCES
UFS

REC Reference number: REC-230408-011

Dear Dr Naudé

ECUFS NR 46/2011
PROJECT TITLE: **DIAGNOSTIC QUALITY OF NEONATAL RADIOGRAPH IMAGES AFTER 50% RADIATION DOSE REDUCTION ON A COMPUTED RADIOGRAPHY SYSTEM.**

- You are hereby kindly informed that the Ethics Committee approved the above study at the meeting held on 24 May 2011.
- ***The Ethics Committee indicated that this is an open study and not a double-blind study.***
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Kindly note that permission letters from the authorities have to be submitted to the Ethics Committee prior to collecting data/conducting the study.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.
- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.
- Kindly refer to the ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully


pp CHAIR: ETHICS COMMITTEE

Cc Prof C De Vries



✉ 339, Bloemfontein 9300, RSA ☎ (051) 405 2812 ✉ StraussHS@ufs.ac.za
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**ETHICS COMMITTEE
OF THE FACULTY OF HEALTH SCIENCES**

ATTENDANCE LIST OF THE MEETING HELD ON 24 MAY 2011

A. FACULTY MEMBERS

1. SCHOOL OF MEDICINE REPRESENTATIVES

Prof WH Kruger	Dept of Community Health (Chairperson) M.B. Ch.B (UFS) M.Med. (Community Health) (UFS) MBA (PU for CHE)	Present
Prof DK Stones	Dept of Paediatrics and Child Health M.B. CH.B (UCT) M.Med Paediatrics (UFS)	Present
Dr SM le Grange (Lady)	Dept of Surgery (Vice-chair) M.B. Ch.B (UFS) M.Med. (Surgery) (UFS) Cert. Paediatric Surgery (College of Surgeons of SA)	Present
Prof PJ Pretorius	Dept of Psychiatry M.B. Ch.B (UFS) M.Med (Psychiatry)	Absent
Prof BJS Diedericks	Dept of Anaesthesiology FFA (SA) M.Med (Anaesthesiology) (UFS) BA (Philosophy) UNISA M.B. Ch.B (UFS)	Present
Prof WJ Steinberg	Dept of Family Medicine M.B. Ch.B; DPH; DTM & H (Wits) M.Fam.Med (UFS) Dip. Obst (SA), FCFP	Present

Prof PH Wessels	Dept of Obstetrics and Gynaecology M.B. Ch.B; M. Med. (O. et G.) (UFS) L.K.O.G. (SA) MD (UFS)	Absent
Prof BW J van Rensburg	Dept of Internal Medicine M.B. Ch.B (UP) M. Med (Internal Medicine) (UP) FCP (SA)	Present
Dr WJ Rabie	Dept of Family Medicine M.B. Ch.B (UFS) M.Fam.Med. (UFS) ATLS, Trauma Society ATLS instructor, Trauma Society	Absent
Ms M Nel (Lady)	Dept of Biostatistics B.A. (Urbanology) B.A. Hons. (Statistics) M.Med (Biostatistics) (UFS) IRENSA Diploma in International Research Ethics 2006	Present

2. SCHOOL OF NURSING REPRESENTATIVES

Ms RM Mpeli (Lady)	School of Nursing Diploma in General Nursing Diploma in Midwifery Advance University Diploma in Clinical Nursing (Advanced Midwifery and Neonatology) B.Soc.Sc. (Nursing Education) M.Soc.Sc (Nursing)	Present
Dr DE Botha (Lady)	School of Nursing M. Soc.Sc (Nursing) (UFS) Ph.D (Nursing) (UFS)	Present
Dr L Roets (Lady)	School of Nursing B.Soc.Sc (Nursing) Honn (UFS) M.Soc.Sc (UFS) Ph.D (UFS)	Absent

3. SCHOOL OF ALLIED HEALTH PROFESSIONS REPRESENTATIVES

Prof CM Walsh (Lady)	Dept of Human Nutrition B.Sc Dietetics (UFS) M.Sc Dietetics (UFS) Ph.D (Dietetics) (UFS)	Present
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Ms PA Hough (Lady)	Dept of Occupational Therapy B.Sc Occupational Therapy (UFS) M.Sc Occupational Therapy (UFS)	Present
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Ms R Smith (Lady)	Dept of Physiotherapy B.Sc (Physiotherapy) (UFS)	Present
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4. BIOSTATISTICIAN

Prof G Joubert (Lady)	Dept Biostatistics B.A. UCT, B.Sc. UCT B.Sc (Hons) (Mathematical Statistics) UCT M.Sc. (Mathematical Statistics) UCT	Present
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B. NON-SCIENTIFIC MEMBERS

1. RELIGIOUS/LAY MEMBER

Dr GE Dames	Dept of Practical Theology B.Th (UWC) Theology B.Th. Hons (UWC) Theology M.Th. (UWC) Practical Theology D.Th. (UWC) Practical Theology M.Th. Clinical Pastoral Care and HIV Ministry	Resigned
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2. LEGAL MEMBER

Prof H Oosthuizen	Dept Criminal Law B.lur., LL.B., LL.D. (UFS)	Present
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Prof R-M Jansen (Secundus) (Lady)	Dept Private Law B.Soc.Sc. (Nursing) Hons. B.lur., LL.B., LL.M. (UFS)	Absent
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C. INDEPENDANT MEMBERS NOT AFFILIATED WITH INSTITUTION

1. LAY MEMBERS

Ms KM Jingosi (Lady)	Child and Family Welfare Society Social Auxiliary Work SA Council for Social Service Professions	Present
Ms SS Seclave (Secundus) (Lady)	Retired Primary Lower Teacher's Certificate Teacher's Higher Bilingual Certificate Education Diploma for the Junior Primary Phase (UFS)	Present
Ms EF Makowa (Secundus) (Lady)	Admin Clerk Drakensberg Logistics Bloemfontein	Present

D. THE CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE


Prof WMJ v d Heever Kriek (Lady)	Clinical Technology School of Health Technology Central University of Technology, Free State Bloemfontein	Present
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E. EX OFFICIO MEMBERS (not entitled to vote)

Dr NRJ van Zyl	Clinical Head: Universitas Hospital Bloemfontein M.Med. (UFS) Business MBL (UNISA)	Absent
Dr BM Masitha (Lady)	H.O.C.S. – Chief Medical officer Free State Psychiatric Complex Bloemfontein M.B. Ch.B. B.Sc Hons Health Sciences IFE - Nigeria B.Sc NBLS – ROMA	Absent

Dr RJ Khoali	Chief Executive Officer Pelonomi Hospital Bloemfontein	Absent
Ms BJ Ramodula	Chief Executive Officer National District Hospital Bloemfontein	Absent

for


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CHAIR: ETHICS COMMITTEE

Appendix E: Language editor decleration

HESTER SOPHIA HUMAN

(Editor, Writer, Proofreader)

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To Whom It May Concern

5 December 2013

Client: Frans SJ Naude

Description of work

Final edit of mini dissertation entitled “Diagnostic quality of neonatal radiograph images after 50% radiation-dose reduction on a computed radiography system.”

Note: I raised a number of queries and made suggestions for changes to the document. I cannot guarantee that all my suggestions were accepted or that the queries were attended to.

Yours sincerely

Hester Sophia Human