

CHALLENGES OF PAEDIATRIC RADIOGRAPHY IN SELECTED HOSPITALS AND RADIO-DIAGNOSTIC CENTRES IN ANAMBRA STATE, NIGERIA

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ABSTRACT

Background: The difficulties experienced by radiographers in positioning and immobilizing the paediatric patient before and during radiographic examinations have been poorly documented in Nnewi metropolis.

Objective: To assess the challenges encountered by radiographers in conventional imaging of paediatrics in the study area.

Methods: This was a non-experimental prospective cross-sectional survey research. The population size was 45 and consisted of all licensed radiographers working in three selected radio-diagnostic centres with a sample size of 40. A semi-structured questionnaire was used for data collection using consecutive sampling of all radiographers in the selected facilities, who also consented to participate in the study. Obtained data was summarized and presented using frequencies, percentages, mean and standard deviation.

Result: This study found the challenges of paediatric radiography to include: lack of specialized skills 32(92.5%), lack of dedicated

paediatric equipment 26(26%), the inability of paediatrics to remain still for the examination 25(62.5%), excess workload/stress 19(47.5%), inadequate immobilization devices 16(40%), apprehensiveness of the paediatrics 13(32.5%), the playfulness of paediatrics 7(17.5%), and poor pain tolerance 1(2.5%). Out of these only, the apprehensive nature of paediatrics was a statistically significant challenge ($P \leq 0.05$, $F=6.845$, $P=0.015$) to paediatric radiography. The most effective way of gaining the co-operation of paediatric patients was through the assistance of parents/caregivers 32(80%).

Conclusion: The significant challenges of radiographers during paediatric radiographic examinations were difficulty in positioning for skull examinations and the apprehensive nature of the paediatric patients. Other challenges included inability of the radiographer to obtain the co-operation of the paediatrics during radiological procedures, lack of specialized skills among radiographers and lack of paediatric-specific immobilization devices.

Keywords: challenges, paediatric radiography,

selected hospitals, radio-diagnostic centres.

Introduction

Paediatric radiography is a subset within general radiography, specializing in the radiographic imaging of the paediatric population. The general principles of radiography remain the same in paediatric radiography but additional consideration needs to be taken into account when determining patient-specific exposure factors, immobilization techniques and appropriateness of examinations. Paediatric radiography is an integral part of paediatric health care which is frequently requested to assist in the diagnosis, management, and treatment of childhood diseases and illnesses. Accurate interpretation of paediatric radiographs can depend entirely on the quality of images produced by the Radiographer, yet there are few materials available on this important aspect of the radiographic practice^{1,2}.

Although paediatric imaging and adult radiography have many similarities, including basic positioning and image quality assessment, there are some significant differences. The way to approach the child tops the list of differences. Another characteristic of paediatric imaging revolves around the increased sensitivity of children to radiation and the imperative need to take steps to reduce the dose administered every time a procedure involving X-radiation is done. The concept of 'imaging gently' has been introduced in paediatric radiography to increase the awareness of radiographers and other radiation workers in order to address the concern of parents and guardians to unnecessary radiation exposures of paediatrics^{3,1}.

However paediatric radiography, despite being acknowledged as an imaging specialization, does not have a strong presence in either undergraduate or

postgraduate radiography education programs, and the availability of current published literature aimed at general radiographers is extremely limited. Thus, paediatric radiography is not recognized as an extended role for registered Radiographers and radiographers have no special recognition in this area. Also, Paediatric radiography has no formal career structure and thus there is little incentive for radiographers to specialize in this area¹.

Imaging in paediatrics also poses challenges, especially in ultrasonography where getting the cooperation of the child and prevention of infection to infants during paediatric ultrasound scans remains an issue. There are general concerns about the amount of radiation exposure from paediatric CT due to the radiosensitivity of developing and immature tissues in children. The main challenge involved in imaging children with MRI emanates from the following; The small anatomic structures of body parts in children result in challenges with respect to the availability of signals as well as limits of resolution. The speed of image acquisition and contrast media injection rates may be affected by physiological changes in children, for example, the heart as well as pulse rates, breathing and rate of blood flow are different in neonates when compared with adult subjects, thereby requiring protocol modification with shorter times for acquisition of diagnostic images. Children often find it difficult to hold their breath during radiographic examinations and this may introduce artefacts during the process of image acquisition. Children are also increasingly aware of changes in their environment and less likely to co-operate with strangers which poses more difficulties on the time and energy of the staff². Parents can therefore be encouraged to be as supportive as possible and to bring the child's favourite toys, blanket or books. It is preferable for

the staff to give explanations to the child with the parents listening. Great care must be taken to talk slowly, clearly and in short, succinct sentences. Oftentimes a more senior member of the department may be needed to discuss any significant problems. The parent may be present as a participator, assist with immobilization and may be asked to remain in the waiting area and not accompany the child into the radiography room. Some children who act fearful and combative in the waiting room in the presence of their parents may be more cooperative without their presence. At this time, the radiographer's communication skills and knowledge will be tested and applied to calm the child down or he/she may seek assistance from other staff in the department to solicit the child's attention and obtain quality radiographic images. This requires special considerations and treatments so as to obtain the best diagnostic results during the radiographic results^{4,1}. Conventional radiographic examination in paediatrics presents several challenges compared to that of adults and even geriatrics. Radiographic imaging that involves children come with many difficulties because of the special nature of children both anatomically and psychologically, their tender age, and inability to comprehend the examination procedures or comprehend a change in environment. When children are ill, they follow their instincts, which is usually to cry and stay close to their parents. This presents a huge challenge to the Radiographer, who must try to gain the child's trust and cooperation⁵. Once this has been achieved there is another big challenge of keeping the child still or immobilized for the radiographic examination to be carried out which can be very difficult for most children. Staying still for a few seconds might translate to hours for children coupled with the fear of the hospital environment may make them very anxious

and uncooperative during the radiographic exposure. This may lead to motion blur and the production of images of poor diagnostic quality. To prevent the production of poor-quality paediatric radiographs, specialized imaging protocols, special training for radiographers and radiologists on techniques and paediatric image evaluation is required^{4,5}. The need to prevent avoidable exposure to ionizing radiation is another facet of the challenges relevant in a radiographic examination of paediatrics⁶.

Repeat radiographic examinations in paediatric cases can be tracked over time to ensure its justification to avert increased radiation dose to the child or infant which may lead to radiation hazards in the future. Nevertheless, radiation dose tracking, as well as the provision of alternate radiological protocols or pathways/techniques which can be incorporated in paediatric patient management to reduce the overall cumulative radiation exposure has remained a challenge in Nigeria due to poor infrastructure and records⁷. Repeat also results in waste of film materials and increases patient waiting time. Therefore, overcoming these challenges through the use of appropriate skills/experience, and paediatric positioning equipment and devices is key to obtaining quality images for the management of the paediatric patient.

The production of high-quality images by the radiographer may vary from one locality to another due to several factors including the availability of relevant skills, training, equipment as well as accessories⁴ that are suboptimal in our locality. Moreover, few studies have evaluated the challenges of conventional paediatric radiography in our locality, especially in Nnewi, Anambra State. Therefore, the aim of this study was to assess the major challenges faced by Radiographers during

paediatric x-ray examination, in Nnewi, Anambra State of Nigeria.

Methods

This prospective cross-sectional study was carried out in the radio-diagnostic departments in Nnamdi Azikiwe University Teaching Hospital [NAUTH], Waves Diagnostic Centre and ObiJackson Children (both in Nnewi) and Women Hospital Okija, all in Anambra state, Nigeria. The study sampled all practising Radiographers (n = 45) working in the radiology department in Nnamdi Azikiwe University Teaching Hospital [NAUTH] Nnewi (centre A), Waves Diagnostic Centre Nnewi (centre B) and Obijackson Children and Women Hospital Okija (centre C). Ethical approval with reference number: NAU/FHST/2021/rad41 was obtained from the Ethical Review Committee of the Faculty of Health Science and Technology, Nnamdi Azikiwe University, Nnewi Campus, Anambra state. Consecutive sampling was used to enlist consenting paediatric patients for the study which involved the use of questionnaires which was administered by the researchers. The sample size of 40 was determined using the method described by Otabor and Obahiagbon, (2016) ⁸. The Instrument for data collection was a semi-structured questionnaire divided into sections A, B and C. Section A contained information on the demographic data of respondents, section B contained questions related to challenges in paediatric radiography that the respondents must have encountered while section C contained questions related to the solution to these challenges. The questionnaire was then distributed to consenting the radiographers who were enlisted for the study. Obtained data was summarized and presented using frequencies, percentages, mean and standard deviation.

RESULTS

A total of 27 (67.5%) respondents were males while 13(32.5%) were females (Table 1), mostly between the ages of 21-30 years. Centre A had the highest number of radiographers with practice experiences from 0-15 years while Centre C had the least no of radiographers with working experience (Table 2).

Most radiographers 26 (65%) did not like handling paediatric radiographic examinations. There were few specialist paediatric radiographers 3 (7.5%) and dedicated paediatric equipment 5 (12.5%). Positioning of paediatric patients did not pose a challenge to most radiographers 28 (70%) (Table 3). Additionally, 33 (82.5%) radiographers often encountered apprehensive and uncooperative paediatric patients while 24 (60%) do not get the cooperation of paediatric patients during radiographic examinations (Table 4). The use of children-friendly terms 57.5% (n=23), assistance from caregivers 80% (n=32) as well as the use of immobilization devices 62.5% (n=25) and coercion 12.5 (5%), staff assistance 15% (n=6), others 0%(0) were the main and least methods of gaining the cooperation of children during radiography examinations (Table 5).

Of the patients seen, 90% (36) and 2.5% (1) of the paediatric patients aged 2-3 years and above 5 years respectively were most and least difficult to handle during radiographic examination (Table 6).

The main challenges faced by radiographers during paediatric radiography include lack of specialized skill in paediatric imaging 92.5% (n=37), lack of dedicated paediatric unit, the inability of paediatric to remain still during paediatric examination 62.5% (n=25) while poor tolerance of pain in sick paediatric patients 2.5% (n=1) and playful nature of the paediatrics 17.5% (n=7) were the least (Table 7). The availability of Sandbags and foam pads was

100% (n=40), while the availability of head clamps, Compression bands, sheets towels, Pig-o-stat, Mummy sheet restraint, stockinette, Tam-em board and Plexi-glass hold-down paddle were 10 (10%), 37 (92.5%), 3 (7.5%), 0 (0%), 4 (10%), 0 (0%), 0 (0%) respectively (Table 8).

Radiographic imaging of the postnasal space 45% (n=18), skull 27.5% (n=11), chest 20% (n=8) and pelvis 0% (n=0) as well as spine 12.5% (n=5), were the main and least body parts in paediatric that pose a challenge during radiographic imaging (Table 9).

TABLE 1: BIODATA OF RADIOGRAPHERS STUDIED

Age range(years)	Gender		Educational Qualification				
	Male	Female	DIR	B.Sc	M.Sc	PhD	Others
21-30	14(35%)	9(22.5%)	0	23(57.5%)	0	0	0
31-40	12(30%)	4(10)	0	11(27.5%)	5(12.5%)	0	0
41-50	1(2.5%)	0(0)	0	0	1(2.5%)	0	0
>51	0(0)	0(0)	0	0	0	0	0
Total	27(67.5%)	13(32.5%)	0(0)	34(85%)	6(15%)	0(0)	0(0)

TABLE 2. EXPERIENCE AND WORKSTATION OF THE RADIOGRAPHERS

Age range	Years of Experience				Place of Work		
	0-5	6-10	11-15	16-20	Centre A	Centre B	Centre C
21-30	21(52.5%)	1 (2.5%)	0	0	21(52.5%)	0	1(2.5%)
31-40	6(15%)	10(25%)	0	0	11(27.5%)	3(7.5%)	2(5%)
41-50	0	0	1(2.5%)	0	1(2.5%)	0	0
> 51	0	0	0	1(2.5%)	0	1(2.5%)	0
Total	27(67.5%)	11(27.5%)	1(2.5%)	1(2.5%)	33(82.5%)	4(10%)	3(7.5%)

Table 3: RESPONSES ON GENERAL AND PERSONAL CHALLENGES OF PAEDIATRIC RADIOGRAPHY IN THE STUDY AREA

STATEMENT	FREQUENCY/PERCENTAGE (%)	
	YES	NO
1. Personally do you like handling paediatric radiography examinations?	14 (35.0)	26(65.0)
2. Do you have specially trained personnel in the department that handles paediatric radiography examination?	3 (7.5)	37(92.5)
3. Is there any dedicated functional equipment for paediatric radiography examination in your department?	5(12.5)	35(87.5)
4. Does positioning of the paediatric patient pose a challenge to you?	28(70.0)	12(30.0)

Table 4: Experiences of radiographers during paediatric radiography

	FREQUENCY/PERCENTAGE		
	RARELY	SOMETIMES	ALWAYS
How frequently do you encounter paediatric patients?	3(7.5%)	11(27.5%)	26(65%)
	ALWAYS	SOMETIMES	NEITHER
Are paediatric patients apprehensive and uncooperative before the examinations?	7 (17.5%)	33 (82.5%)	0 (0%)
	YES	NO	NOT ALWAYS
Ability of radiographers to gain paediatric cooperation before the examination	2(5)	24(60)	14(35)

Table 5: METHODS OF GAINING CHILD’S COOPERATION AND IMMOBILIZATION

METHODS OF GAINING CHILD’S COOPERATION AND IMMOBILIZATION	Frequency/Percentage		Mean+Sd
	Yes	No	
1. Using Child friendly terms to explain the procedure to the child	23 (57.5)	17(42.5)	1.42±0.50
2. Parent/Caregiver assistance	32 (80.0)	8(20.0)	1.20±0.40
3. Coercion	5 (12.5)	35(87.5)	1.87±0.33
4. Staff assistance	6 (15.0)	34(85.0)	1.85±0.36
5. Use of immobilization devices	25(62.5)	15(37.5)	1.38±0.49
6. Sedation	10(25.0)	30(75.0)	1.75±0.44
7. Others	0(0.0)	40(100)	2.00±0.00

Table 6: AGE GROUP MOST DIFFICULT TO HANDLE

AGE GROUP	FREQUENCY/PERCENTAGE	
	YES	NO
1. 0-1YEARS	4(10)	36(90.0)
2. 2- 3 YEARS	36(90.0)	4(10.0)
3. 4-5 YEARS	6(15.0)	33(82.5)
4. ABOVE 5 YEARS	1 (2.5)	39(97.5)

Table 7: RESPONSES ON THE CHALLENGES FACED DURING PAEDIATRIC RADIOGRAPHY IN THE STUDY AREA

FACTORS	FREQUENCY/PERCENTAGE (%)		MEAN_+STD.DEV
	Yes	No	
1. Lack of dedicated paediatric unit	26(65.0)	14(35.0)	1.35±0.48
2. Inadequate paediatric accessories	16(40.0)	24(60.0)	1.60±0.80
3. Excess workload	19(47.5)	21(52.5)	1.52±0.51
4. Apprehensive nature of paediatrics	13(32.5)	27(67.5)	1.67±0.47
5. Playful nature of paediatrics	7(17.5)	33(82.5)	1.83±0.38
6. poor pain tolerance in sick paediatrics	1(2.5)	39(97.5)	2.0±0.16
7. lack of specialized skill in paediatric imaging	37(92.5)	3(7.5)	1.93±0.27
8. Inability of paediatrics to remain still for their examination	25(62.5)	15(37.5)	1.38±0.49

Table 8: LIST OF AVAILABLE IMMOBILIZATION DEVICES

IMMOBILIZATION DEVICES	FREQUENCY/ PERCENTAGE(%)	
	YES	NO
1.Head Clamps	4(10.0)	36(90.0)
2.Compression bands	37(92.5)	3(7.5)
3.Sandbags	40(100)	0(0.0)
4. Sheet towels	3(7.5)	37(92.5)
5. Pig-o-stat	0(0.0)	40(100)
6. Foam pads	40(100)	0(0.0)
7. Mummy sheet restraint	4(10)	36(90.0)
8. Stockinette	0(0.0)	40(100)
9. Tam -em board and Plexi -glass hold-down paddle	0(0.0)	40(100)
10. Others	0(0.0)	40(100)

Table 9: DIFFERENT BODY PARTS POSING THE GREATEST CHALLENGE IN PAEDIATRIC RADIOGRAPHY EXAMINATION

BODY PARTS	FREQUENCY/PERCENTAGE	
	YES	NO
Extremities	3(7.5)	37(92.5)
Skull	11(27.5)	29(72.5)
Chest	8(20.0)	32(80.0)
Postnasal space	18(45.0)	22(55.0)
Paranasal sinuses	6(15.0)	34(85.0)
Cervical spine	2(5.0)	38(95.0)
Thoracic/lumbar/sacral spine	5(12.5)	35(87.5)
Pelvis/hips	0(0.0)	40(100)

Discussion

Paediatric Radiography is a subspecialty of Radiography, which lays emphasis on diagnostic imaging of foetuses, neonates, infants, children and adolescents and has been bedeviled with various

challenges. In the present study, the main challenge of paediatric radiography in the studied population was the inability of majority of the radiographers to gain paediatric patient cooperation for variety of radiographic examinations. This was as a result of

either the child playing with things around him/her during the examination, the inability of the radiographers to get the child's trust and cooperation for proper positioning, poor communication skills between the radiographer and the child, lack of appropriate immobilization devices, apprehensiveness of the patient probably due to present state of the paediatric illness, fear of the equipment, hospital environment and staff. From our findings, there appear to be inadequacy of paediatric-specific immobilization devices in the present study. Foam pads and sand bags were recorded as the most available, followed by compression bands, head clamps, mummy sheet restraint and sheet towels. There was complete absence of Pig-o-stat, Tam-em board and Plexi-glass hold-down paddle. This led to possible inefficiency in immobilization and obtaining the paediatric patient co-operation for the examinations in the three study centres. Obtaining the paediatric patient co-operation during the examination is required to obtain quality radiographic images which are required for correct diagnosis and management of the patient. The use of immobilization devices and the use of child-friendly terms were not generally effective at obtaining the cooperation of paediatrics for radiography examination in the present study. The use of immobilization devices, sedation and calling for staff assistance were also used to a lesser degree to achieve the cooperation of the paediatric patient for radiological examination in some cases. However, majority of the radiographers were able to gain the paediatric patient's cooperation through their parents or caregiver. This can be explained by the fact that the parents were well known to the paediatric patients and are willing to find trust in them, unlike the hospital staff whom they may see as

strangers. This agrees with the opinion of Breiner et al who opined that younger children, in particular, found security in having a parent close by during the examination⁹. This was re-emphasized by Albert et al., who suggested that a non-occupationally exposed person must be recruited for the purpose of gaining cooperation of the paediatrics and the best candidate is usually the child's parent provided the person is not pregnant³. Similarly, another factor which affected the radiographer's inability to spend quality time communicating with the paediatric patients. This involves coming down to the child's level and speaking with the paediatric patient in the language that the patient will understand and cooperate with the examinations to achieve the desired result. This finding has been corroborated by a related study in which a high workload on clinical radiographers made them less likely to spend good time on paediatric patients to ensure the production of images of diagnostic quality but rather will concentrate more at completing the examinations as quickly as possible¹⁰. This will ultimately affect the quality of the final radiographic image.

Our study also showed that majority of the radiographers in the radio diagnostic facilities studied always receive requests for paediatric radiography examinations in their various departments. Therefore, paediatric radiography examinations constitute the bulk of the day-to-day business of these radiography facilities similar to the findings of a related study¹¹. These categories of patients should be respected and treated with utmost care⁵. Unfortunately, we found out that majority of the respondents who are radiographers did not like handling paediatric patients especially those between ages 2-3 years who were the most difficult to handle. Mammass et al confirmed the findings of our study stating that it is more difficult to obtain the

cooperation of younger children during radiography examinations⁴. Also, there was a paucity of specially trained pediatric radiographers in the three diagnostic centres studied. This could either mean that the radiographers did not show enough interest to be trained in paediatric radiography or that the diagnostic centres/hospitals did not show any special interest in developing manpower needs in the paediatric subspecialty. Radiographers may be reluctant to spend their hard-earned money or time to be trained as specialist paediatric radiographer because he/she realizes that they stand to gain no rewards or recognition from such training. This agrees with the opinion of Erondy (2013) that paediatric radiography is not recognized as an extended role for registered radiographers and paediatric Radiography has no special recognition in Nigeria². Since Paediatric radiography has no formal career structure in Nigeria, there is little incentive for radiographers to specialize and be recognized in this area.

In addition, another challenge to paediatric radiography in the present study was the lack of dedicated and functional equipment for paediatric radiography. Dedicated radiography equipment was expected to help the radiographer in his techniques and positionings to avoid repeats as well as unnecessary irradiation of the young child. When this dedicated equipment is lacking in the department as in the present study, the tendency for the radiographer to be frustrated with the examination or engage in unsafe and unprofessional practice to obtain a near clear image arises. This agrees with the opinion of Mathers, et al., (2011)⁴ that most radiology departments were not specially designed to meet the needs of a variety of developmental stages. The need for dedicated functional equipment for pediatric radiography

arises because of the nature and structure of paediatrics. The advances in technology and computing, often associated with radiology, has launched a new era for Pediatric Radiology training and practice necessitating the use of dedicated pediatric radiography equipment, child-friendly restraining and positioning accessories. These ensures faster sequences and protocols for image acquisition to optimize radiation dose to the paediatrics, minimize movement blur, reduce the number and duration of sedation and eventually produce images of diagnostic quality⁴. The price paid for lack/inadequate dedicated equipment and accessories/ restraining devices were positioning problems and repeats which will increase the radiation dose to the patient, increase patient waiting time for the examination and increase the overhead cost. The body parts that proved very difficult to position in the present study were the skull, followed by postnasal space and chest. Although positioning for postnasal space was one of the major concerns to the radiographers, as posing the major positioning challenge to paediatric imaging. The radiographer should always use relevant skills and parents assistance during paediatric skull radiographic examinations to obtain excellent diagnostic results. Another common challenge encountered in pediatric radiography as observed from the modal response on challenges was the lack of specialized skill in paediatric imaging. The tender nature of children coupled with their inability to comprehend and obey the instructions of the radiographer as well as the perceived hostile nature of the hospital environment and equipment means that they require special skills to handle them. This can be acquired through regular training and re-training programs as well as from years of clinical experience. In our study, only very few of the radiographers 1(2.5%)

had clinical experience above 10 years. Sufficient clinical experience has been reported to have been used by radiographers during radiographic examinations to alleviate any fear or stress that the child might have had¹⁰. These include spending a good time with the paediatrics communicating and explaining the procedure and equipment to them, playing along with them in a friendly manner, use of toys, beautiful colours and showing them the result of the investigations after the examinations have produced good results¹⁰. When these clinical and specific paediatric experiences are lacking as in the present study, the radiographer may fail to deliver quality diagnostic images without repeats. This agrees with the findings of Erondy (2013)² who opined that paediatric imaging requires experience, specific training and certification that guarantees the application of thorough knowledge, expertise and a variety of dedicated or adaptable equipment. We observed that when children become apprehensive during radiographic examinations, they become difficult to restrain and generally uncooperative throughout the examination which will negatively affect the quality of the final radiographic image. Paediatric patients should be handled with care especially by a specialist paediatric radiographer or where this is lacking by an experienced radiographer. This is necessary to provide the paediatric patient information and instruction for the examination that is appropriate for his/her age and development to win the child's co-operation for the investigation so as to obtain images of good diagnostic quality. Experience and skill is needed to combat the ever changing emotion and apprehensiveness of the paediatric patient in the radiology department by tactically providing strength to a child who feels defenseless in the presence of perceived strangers and hostile hospital

equipment, letting the paediatric patient know everything about the investigation and what to expect as well reassure and allay the fears and apprehensiveness of the child. This will provide strength for the child so as to feel emotionally protected and lend his or her support for the investigation. Therefore, reducing episodes of anxiety and apprehensiveness of the paediatric patient during radiographic examinations is important at mitigating the challenges of radiographers in paediatric radiography in the population.

Conclusion

The significant challenge for radiographers during paediatric radiographic examinations were difficulty in positioning for skull examinations and the apprehensive nature of the paediatric patients. Other challenges include the inability of the radiographer to obtain the cooperation of the paediatrics during radiological procedures, lack of specialized skills among radiographers and lack of paediatric-specific immobilization devices.

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