

## Sedation practice among Nigerian radiology residents

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**Background:** Providing safe and effective sedation to patients, especially those with multiple medical problems, can be challenging for radiology residents and fellows. This study aimed to determine knowledge, attitude and practice of Nigerian radiology residents concerning sedation.

**Keywords:** anaesthetist, guidelines, radiology residents, resuscitation, sedation

### Introduction

Radiological investigations like computerised tomography (CT) scan and magnetic resonance imaging (MRI) require patients to be completely still during these procedures to avoid problems of motion artefacts on the acquired images.<sup>1</sup> Inability of paediatric age groups to understand and comply with instructions, the problem of physical conditions of patients that result in pain and patients' fearful reaction to unpalatable sounds emerging from imaging equipment like MRI and claustrophobia can lead to involuntary and voluntary movements in patients during radiological procedures, which eventually lead to motion artefacts on the acquired images.<sup>1</sup> Sedation is an option for overcoming these envisaged problems during the course of these radiological investigations. Sedation allows patients to better tolerate diagnostic imaging and image-guided procedures by relieving anxiety, discomfort and/or pain.<sup>2</sup> It also facilitates and may optimise diagnostic imaging, image-guided interventions, and radiation oncology procedures that require patient cooperation, especially paediatric patients.<sup>2</sup>

As a result of the shortage of anaesthetists to meet the increasing demands for sedation for radiological procedures, non-anaesthetists, including radiologists, are now more frequently involved in providing sedation.

To ensure safety, with the increasing involvement of non-anaesthetists in the provision of sedation, the Joint Commission for accreditation of health care organisation oversees all operations on sedation in accredited institutions in the United States by ensuring adherence to standard practice guidelines.<sup>3</sup> The American Society of Anaesthesiologists (ASA) Task Force has also developed practice guidelines for sedation and anaesthesia by non-anaesthetists.<sup>4</sup> The ASA practice guidelines are focused on recommendations concerning the evaluation, management and discharge of patients undergoing moderate sedation for a procedure.<sup>4</sup> Similarly, a collaborative effort between the American College of Radiology (ACR) and the Society of Interventional Radiology (SIR) also produced guidelines designed to assist in the safe administration of sedation and analgesia outside the operating room.<sup>3</sup>

Providing safe and effective sedation to patients with multiple medical problems can be challenging for non-anaesthetists. Therefore, it is important for diagnostic and interventional radiology residents and fellows who are involved in procedures that require sedation to develop an adequate knowledge base regarding the standard practice of administering sedation to their patients, to become very adept at identifying patients who have significant sedation-related risk factors and promptly summon an anaesthetist, to understand clinical and pharmacologic effects of common sedative and analgesic drugs and to understand the basic principles involved in their use.<sup>5</sup>

There are very few studies on sedation use in radiology practice and none has been reported in Nigeria to date. Presently there are no national or institutional sedation guidelines for radiologists in Nigeria to the best of our knowledge. A study on the knowledge and sedation practice of radiologists involved in procedures requiring sedation is needed to objectively assess possible deficiencies in the current training curriculum of residents on this subject. This will form the basis for establishment of national guidelines for sedation practice by radiologists based on available resources.

The aim of this study was to assess the knowledge, attitude and practice of Nigerian radiology residents on sedation in radiology practice.

### Methodology

This is a cross-sectional questionnaire study. A validated questionnaire was distributed among 118 radiology residents from 16 centres in Nigeria via an online platform. There were a total of 14 questions, which concerned the level and sources of knowledge, varying opinions and ongoing practice of radiology residents and fellows regarding sedation use in radiology (Appendix 1). The questionnaire was validated before commencement of the study by a pilot study on a subset of 10 residents. Ambiguous questions, as well as questions associated with varied responses identified, were thereafter adjusted accordingly. A printout of the questionnaire was also administered to a set of radiology residents attending a

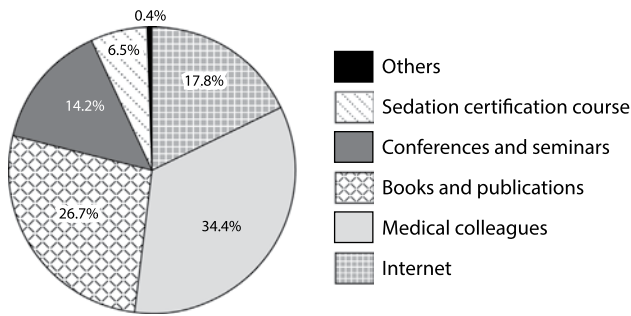


Figure 1: Pie chart showing different sources of information on sedation among respondents.

workshop held in a university teaching hospital within the country from March 7 to 9, 2016. Respondents who had completed the questionnaire online were instructed not to fill in the printout.

Data were entered into a spreadsheet and analysed using the Statistical Package for the Social Sciences (SPSS®) version 22 (IBM Corp, Armonk, NY, USA). Descriptive analysis was undertaken and the results were presented as frequencies, tables and charts.

Table 1: Frequency of age-based procedures involving sedation by respondents

	n	%
Paediatric cases	88	74.6
Adults	36	30.4

Table 2: Frequency of procedure types involving sedation by respondents

Procedure	n†	%
CT	77/118	65.3
MRI	75/118	63.6
Interventional radiology	19/118	16.1
HSG	10/118	8.5
Others	3/118	2.5

†Multiple responses question.

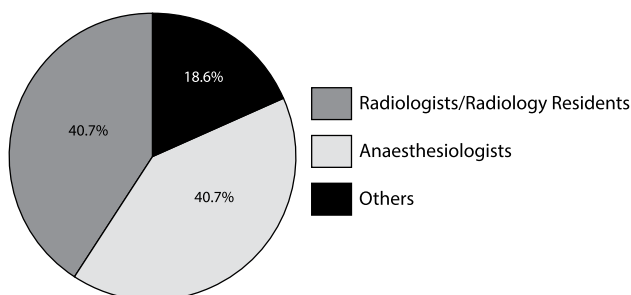


Figure 2: Pie chart showing who administers sedation during radiological procedures.

## Results

### Profile of respondents

The response rate was 78.7% from the 150 surveys sent out. In total, 55.1% of the respondents were from centres located in the South West geopolitical zone of the country, 17.8% were from the North Central, 14.3% from the South South, 11% from the North West, and 1.7% from the North East. Also 49.2% were registrars while 50.8% were senior registrars.

### Knowledge, attitude and practice in sedation

Most respondents (97.5%) claimed to know about sedation in radiology practice, mostly from their medical colleagues (34.4%) (Figure 1). Over half (52.5%) of the respondents do at least one procedure involving sedation per week, despite no formal training in sedation in about 76.3%. Some 74.6% of sedations are done in paediatrics while 30.4% are in adult cases among the respondents (Table 1). Computerised tomography (CT), magnetic resonance imaging (MRI), interventional procedures and HSG accounted for 65.3%, 63.6%, 16.1% and 7.6% of these procedures respectively (Table 2). Only 26 respondents (22.0%) spread over 5 centres have a standard protocol to guide their practice in sedation and radiologists/radiology residents (40.7%) administer sedation as frequently as the anaesthetists (40.7%) during radiological procedures (Figure 2).

Fifty-five (46.5%) of the respondents perceived their knowledge in sedation to be good to excellent, despite only 17 (30.9%) of the respondents having had formal training in sedation. A subgroup analysis of these 55 respondents showed diazepam to be the drug regularly, often or always used by 80.0% of the respondents (Table 3). Expected duration of action for 52 (94.5%) of the respondents was the commonest factor influencing their choice of drug for sedation. Midazolam, lorazepam, morphine, fentanyl, propofol, ketamine and dexmedetomidine are never or rarely used by the majority of the respondents (76.4%, 76.8%, 89.1%, 87.3%, 91.7%, 96.4% and 100% respectively). Only 14 (25.5%) of these 55 respondents use an objective sedation scale, e.g. the Ramsay scale, for the assessment of degree of sedation in their patients. Subgroup analysis based on years in training showed that the number of years in training did not significantly influence the respondents' choice of drugs for sedation and their methods of assessment of the level of sedation in patients.

### Knowledge, attitude and practice in resuscitation

Although 100 (84.7%) of the respondents have resuscitation equipment available in their facilities, only 19 (16.1%) have had formal training in resuscitation. Eighty-nine (75.4%) of the respondents also rated their perceived confidence in handling a sedation emergency as good, very good or excellent. However, their practice showed that despite 117 (99.2%) of the 118 respondents using the intravenous route to administer sedation, only 101 (96.2%) of the respondents identified an intravenous cannula as resuscitation material; also only 56 (53.3%) and 59 (56.2%) of the respondents respectively were able to recognise the importance of oxygen and a face mask for resuscitation during an emergency. Only 106 (89.8%) of the respondents monitor pulse rate, 104 (88.1%) monitor respiratory rate and 97 (82.2%) monitor blood pressure. Sixty-five (55.1%) of the respondents considered oxygen saturation monitoring as important during sedation, while 4 (3.4%) respondents were of the opinion that no vital sign should be monitored during sedation in their patients after administering sedation. Among

the respondents, 18.6% had observed one form of adverse event or another with sedative use in their practice, of which vomiting was the most frequent (54.2%), followed by airway obstruction (29.2%) and aspiration (25.0%).

Of the 19 (16.1%) respondents who have received additional training in resuscitation, 15 (78.9%) were either satisfied or very satisfied with the training. Sixteen (84.2%) of the respondents have a resuscitation tray for sedation procedures. None of these 16 respondents have oxygen, reversal agent or defibrillator listed as part of their resuscitation equipment. However, 63.2% have a face mask and 21.1% have an IV cannula. Blood pressure and temperature are the 2 vital signs commonly monitored by 10 (52.6%) and 6 (31.6%) respectively of this subset of respondents. Only 5 (26.3%) respondents had observed an adverse effect with the use of sedatives, i.e. aspiration.

## Discussion

The priority during radiological sedation is to ensure patients

interventional procedures at the moment are in the North East, where we had the lowest percentage of respondents. The pattern of procedures involving sedation among our respondents may be reflective of available equipment in various facilities at the time of this study.

Almost all the respondents in this study claimed to know about sedation in radiological practice, although less than half of them claimed to have good to excellent knowledge of it. The higher percentage of respondents (53.5%) who reported poor knowledge in sedation supports the need for formal training in sedation for residents. In a Canadian study, Mayson *et al.*<sup>6</sup> showed support for additional training for residents in sedation in 68% of respondents.

Sedation practice among our respondents differs from the recommended standard, based on the existing ASA guidelines<sup>4</sup> for sedation and analgesia. This is seen in the spectrum of drugs used among the 55 respondents who claimed to have good to

Table 3: Frequency of use of various sedatives among respondents with claim of good to excellent knowledge in sedation

Sedative	Never (0%)	Seldom (< 25%)	Regularly (50%)	Often (> 75%)	Always (100%)	Missing responses	Total responses
Diazepam	1.80%	18.20%	34.50%	40.00%	5.50%	0.00%	100%
	1	10	19	22	3	0	55
Midazolam	60.00%	16.36%	12.73%	7.27%	0.00%	3.64%	100%
	33	9	7	4	0	2	55
Lorazepam	63.64%	20.00%	10.91%	1.82%	0.00%	3.64%	100%
	35	11	6	1	0	2	55
Morphine	67.27%	21.82%	5.45%	1.82%	0.00%	3.64%	100%
	37	12	3	1	0	2	55
Fentanyl	78.18%	9.09%	7.27%	1.82%	0.00%	3.64%	100%
	43	5	4	1	0	2	55
Propofol	83.63%	9.09%	1.82%	3.64%	0.00%	1.82%	100%
	46	5	1	2	0	1	55
Ketamine	58.18%	21.82%	9.09%	7.27%	1.82%	1.82%	100%
	32	12	5	4	1	1	55
Dexmedetomidine	90.91%	5.45%	0.00%	0.00%	0.00%	3.64%	100%
	50	3	0	0	0	2	55

safety and comfort.<sup>2</sup> The results of this study suggest that the respondents' knowledge of sedation is inadequate; also there is gross deficiency in their knowledge of sedative drugs, appropriate monitoring and capability in resuscitation and management of complications of sedation. This deficiency in knowledge is not unexpected as only 22% of the respondents across 5 residency training centres have an institutional or departmental protocol whether developed from sedation guidelines issued by the ASA, ACR and SIR for radiologists able to sedate outside the operating theatre, or locally based on available resources.

Our study also showed that sedation was more commonly done in paediatric cases compared with adult cases. CT and MRI were the commonest types of radiological procedures that involve sedation among the respondents. The low percentage of respondents that use sedation for interventional procedures is predictable as the only two centres in the country that do

excellent knowledge in sedation. The choice of drugs was skewed towards diazepam, which is not the ideal drug for sedation in radiology practice due to its long duration of action. Their choice is probably influenced by drug availability, exposure to the drug and familiarity with the drug.

Tan *et al.*<sup>7</sup> did a survey on the frequency of use of various sedatives among medical residents and pulmonology fellows in training, which was similar to the procedure used in our study. They found midazolam to be the first-line preferred sedative and second-line preferred analgesic drug, morphine the first-line preferred analgesic and dexmedetomidine the second-line sedative drug among their respondents. The most preferred drug for sedation in our study was diazepam, which is not ideal for sedation based on ASA guidelines for sedation by non-anaesthetists. We opine that the choice of sedatives among our respondents might be based on familiarity, availability and non-dependence of the drugs on technology like syringe drivers and

infusion pumps, which are not readily available for administration in resource-challenged settings.

Mayson *et al.*<sup>6</sup> undertook their survey among radiology residents, which is similar to our study. However, they addressed the dose, onset and duration of action of various recommended sedatives, unlike our study, which addressed choice and frequency of use of common sedatives. Knowledge of the appropriate dosages of lorazepam (54%), midazolam (51%), and fentanyl (58.7%) among their respondents was good. However, their knowledge regarding the duration of action of commonly used medications (lorazepam, 23.8%; midazolam, 31.9%; diazepam, 15.9%; and fentanyl, 28.6%; and onset of action (fentanyl, 22.2%; midazolam, 19.1%; lorazepam, 6.35%; and diazepam, 11.1%) was poor. A further study among our study's respondents is advised to be able to make adequate comparison of our study with that of Mayson *et al.*<sup>6</sup>

Practitioners of sedation are expected to recognise the various levels of sedation and also to be able to recognise a deeper level of sedation than is intended for the procedure and promptly provide rescue measures to avert a catastrophic outcome.<sup>4</sup> The method of assessment of degree of sedation in patients by our respondents showed that only 27.1% of respondents use a sedation scale for assessing degree of sedation in their patients. The percentage (25.5%) was much lower among those that claimed to have a good to excellent knowledge of sedation. In the study by Tan *et al.*<sup>7</sup> the percentage of respondents (34.32%) that use sedation scales (Ramsay/Richmond agitation and sedation scales) appears similar to ours (27%) though their study was done among medical residents and pulmonology fellows in training in contrast to ours, which studied radiology residents. The similarities to ours in resourcefulness of the setting where the study by Tan *et al.*<sup>7</sup> was performed could have been responsible for the similarity in results. However, the percentages from both studies are far from ideal. Routine use of a sedation scale is the standard for the purposes of objectivity, proper documentation and comparison of data, and patient safety.

Knowledge and practice of the respondents regarding resuscitation is also substandard as suggested by our results. The low percentage of respondents that have observed adverse effects with sedation use could be due to lack of competency among the respondents in recognising these adverse events. This is supported by the lack of training on the subject in most of our respondents (83.9%). All practitioners of sedation are expected to have resuscitation skill to rescue a patient in the event of unanticipated deeper level of sedation and also to be able to provide cardiopulmonary support if needed.<sup>4</sup> The spectrum of the reported adverse events is also a reflection of their knowledge on the subject, as respondents will tend to recognise what they know as adverse effects. The poor knowledge of most of our respondents in recognising the basic materials needed for resuscitation portends danger in our environment.

Monitoring is the key for successful outcome during sedation. The responses provided by respondents showed inadequate knowledge and reflected lack of recognition of the importance of adequate monitoring during procedural sedation. Parameters to be monitored during radiological sedations include the depth of sedation to ensure desired depth for the procedure and

prevent over-sedation. Others include continuous pulse oximetry, respiratory rate, and interval non-invasive blood pressure measurement. Oxygen saturation monitoring is mandatory to assess oxygenation but it is not a substitute for monitoring ventilatory function. End tidal carbon dioxide (EtCO<sub>2</sub>) monitoring provides assessment of ventilatory function during deep sedation.<sup>8-10</sup>

There are differences between departmental or institutional sedation guidelines and clinical experience of radiology residents across regions, which could result in significant variance in their knowledge of sedation. Formal education in sedation incorporated in the teaching curriculum for radiology residents will help bring about uniformity in residents' knowledge of sedation. It is recommended that radiology residents should have formal training in sedation, on sedative drugs, appropriate monitoring, management of complications and cardiopulmonary resuscitation with regular reinforcement. The use of simulators<sup>11,12</sup> to better train radiology residents to respond more appropriately and effectively to rare events should be encouraged. Adherence to recommended guidelines is mandatory to prevent potentially life-threatening complications. The ASA-ACR-SIR guidelines for radiologists<sup>2</sup> or ASA guidelines for non-anaesthetists for sedation outside the operating theatre<sup>4</sup> can be adapted to local practice patterns and resource availability, and used as a template for institution-specific protocols in sedation. However, credentialing of the supervising radiologist to perform sedation procedures might ultimately be left to the institution where the radiologist works.

## Conclusion

Sedation and resuscitation are an integral part of radiology practice. Radiology residents are therefore required to have a good grasp of these procedures. Current findings suggest that the knowledge of Nigerian radiology residents in the use of medications required for sedation is poor, and their practice in sedation assessment and resuscitation is substandard.

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## Appendix 1

**Gender:** Male  Female  **Cadre of Resident:** Registrar  Senior Registrar

**Number of years in training:** \_\_\_\_\_

### Centre of residency training:

1. Do you know about sedation in radiology practice? Yes  No

2. If yes, what is the source of your knowledge?

- Internet      -Medical colleagues      -Books and publications  
-Conferences and seminars      -Sedation certification course      -Others (please specify)

3. Do you do procedures involving sedation? Yes  (Go to Part A) No  (Skip part A, continue from 4)

#### Part A

i. For which cases do you use sedation? \_\_\_\_\_

ii. Which route of administration do you use?

(a) Oral  (b) Inhalational  (c) Intravenous

iii. Have you ever observed any adverse event with use of sedatives? Yes  No

If yes, what type of adverse event?

- Aspiration      -Airway obstruction/Apnoea      -Hypotension  
-Excessive secretions      -Vomiting      -Others (please specify)

iv. In your practice who usually administers sedation for radiological procedures?

- Radiologists/Radiology residents      -Anaesthetists      -Nurses  
-Trained sedation medical personnel      -Any available medical staff listed above

-Others (please specify)

4. Which of these should be made available during administration of sedation?

- Face mask      -Intravenous cannula      -Reversal agents/drugs  
-Oxygen      -Defibrillator      -Others (please specify)

5. Do you think there are risks with use of sedatives? Yes  No

If yes, what are the risks?

- Hallucinations      -Anxiety/Depression      -Addiction/Dependence  
-Blurred vision      -Restlessness

6. Do you think vital signs monitoring is important during sedation? Yes  No

If yes, which vital signs?

- Temperature    -Blood pressure    -Respiratory rate  
-Pulse rate    -Oxygen saturation

7. Do you know how to handle a medical emergency? Yes  No

8. If yes to 7, what is the source of your knowledge?

- Internet    -Medical colleagues    -Books and publications  
-Conferences and seminars    -Emergency medical training    -Others (please specify)

9. Have you ever received any form of training on sedation during residency training?

Yes  No

10. Do you believe residents should be trained in sedation? Yes  No

11. If you have to administer sedation to your patient, please tick how frequently you will consider each of these agents?

	Never (0%)	Seldom (< 25%)	Regularly (50%)	Often (> 75%)	Always (100%)
Diazepam					
Midazolam					
Lorazepam					
Morphine					
Fentanyl					
Propofol					
Ketamine					
Dexmedetomidine					
Other (please specify)					

12. Which of these factors will influence your choice of sedative agent?

- (i) Expected duration for sedation: Yes  No   
(ii) Pharmacokinetics & pharmacodynamics of the drug: Yes  No   
(iii) Patient's clinical diagnosis: Yes  No   
(iv) Familiarity with the drug: Yes  No   
(v) Cost: Yes  No   
(vi) Others (please state) \_\_\_\_\_

13. How will (do) you assess the degree of sedation in your patients?

- Subjectively from experience  
-objectively using recognised scales, e.g. Ramsay scale  
-Others (please state)

14. Do you have a protocol (written or otherwise) to guide the use of sedation in your unit?

Yes  No