IMCC Journal of Science
2023, 3, 49-56
https://myjournal.imcc.edu.ph/

Competence of Student Radiographers on Exposure Factor Selection in Emergency and Trauma Imaging

Celdon Cain Pelias, Jule Carlo Dagatan, Muriel Chloe Daabay, Mark Alipio *
Iligan Medical Center College, Iligan City, Lanao del Norte, Philippines;
celdon.pelias@imcc.edu.ph (C.C.P.); jule.dagatan@imcc.edu.ph (J.C.D.);
muriel.daabay@imcc.edu.ph (M.C.D.)
* Correspondence: mark.alipio@imcc.edu.ph

ABSTRACT
This study investigated the competence of student radiographers in the selection of radiographic exposure factors in emergency and trauma imaging and explored potential influences of gender and age on this proficiency. Analyzing data from a survey, we found that student radiographers consistently demonstrate a high level of competence across key parameters, including kilovoltage-peak, milliamperage-second, source-to-image distance, and focal spot settings. The results revealed a uniformity of competence, as indicated by low standard deviations, underscoring the effectiveness of Radiologic Technology Education in preparing students for their roles in ensuring the quality and safety of medical imaging procedures. Independent t-tests and one-way ANOVA found no statistically significant differences in competence levels between male and female respondents or among various age groups. These findings suggest that sex and age do not significantly impact competence in radiographic exposure factor selection. Our recommendations include continuous monitoring of students' radiographic skills, adapting teaching approaches to diverse learning styles, initiating longitudinal studies to track competence development, fostering diversity in the radiography field, and providing opportunities for ongoing professional development especially on the aspect of emergency and trauma imaging.

KEYWORDS: emergency imaging; radiographic competence; Radiologic Technology education; trauma radiography

ARTICLE INFO: Received: 23 February 2022; Accepted: 29 March 2023; Volume: 03; Issue: 1; Type: Original Article

1. Introduction

Emergency and trauma departments around the world are under enormous pressure as accelerating demands are settled on them. To provide exemptional programs, the staff must be well-trained and skilled, with a high degree of experience and a willingness to collaborate in a team environment [1]. One of the workforces with paramount importance in the attainment of accurate trauma condition diagnosis is the radiography workforce, which involves student radiographers.

Student radiographers encompass various range of work in emergency medicine. Services includes minor and major trauma units, resuscitation units, and across the board. Minor trauma units are increasingly being led by healthcare practitioners and radiographers who possess a specific range of skills that enable them to triage patients upon admission, obtain the appropriate radiographs, record reports, discharge, administer, and/or refer the patient accordingly.

Student radiographers perform with radiographers, surgeons, and other healthcare providers in wider emergency departments to support and provide reliable and prompt diagnoses so that the appropriate medication can be administered as quickly as possible. Student radiographers are important entities in emergency department imaging equipped with mobile imaging, according to another study, and they are expected to be qualified to capture images of patients when they are in the emergency resuscitation unit and operating rooms. According to a study, Radiologic Technology students must be able to operate effectively and efficiently under pressure, leading the imaging process and delivering the needed information for an immediate diagnosis to ensure successful care [2].

Diagnostic tests must be quick and precise, and student radiographers doing this work must be knowledgeable not only in advanced imaging but also in the care and procedures required for scanning acutely ill patients who need rapid analysis at a vital stage in their treatment. The contribution of student radiographers to emergency services reporting is now important and it allows for instant reporting 24 hours a day, seven days a week. If more student radiographers receive specialized instruction in reporting skills, this impact will be greatly increased.

With the great contribution of the professionals to the emergency and trauma imaging, there have been prompt concerns about the increasing dose received by patients in this area. Previous research identified several factors affecting the dose received by patients in emergency department and pointed out that competence of exposure factor selection is the best determinant of the radiation dose [3,4].

The x-ray beam is made up of a variety of configurations in the control panel called radiographic exposure factors. Both influences affect and decide the amount and quality of x-ray exposure received by the patient. Kilovoltage-peak (kVp), milliamperage (mA), exposure time and source-to-image distance (SID) are the principal exposure technique factors that affects the quantity and quality x-rays. The maximum potential difference applied across the x-ray tube determines the penetrability of the beam. Kilovoltage-peak (kVp) is the maximum potential difference applied across the x-ray tube that determines the penetrability of the beam. The x-ray tube current applied through the tube is measured in milliamperes; on the other hand, exposure time is the duration of the x-ray operation, and source-to-image receptor-distance (SID) is the distance between the source and the image receptor.

The ability of student radiographers to select radiographic exposure factors has been shown to influence a variety of radiographic parameters. It was stated that for correct diagnosis and adherence to the ALARA theory, optimal exposure is needed [5]. Underexposed images results in increased quantum mottle, reduced image quality of the radiograph and may impede diagnosis [6]. Overexposure decreases quantum mottle, improves image clarity, and is less likely to be dismissed by radiologists; as a

result, this technique is becoming more common. A higher exposure, on the other hand, means a higher dose to the patient. Dose creep, or the tendency to overexpose, is a growing problem in digital radiography. Competence of the student radiographers is thus important to provide the best image quality, while reducing the amount of dose received by the patient.

According to the World Health Organization's estimates, road accidents will be the second leading source of years of possible life loss around the world in the coming years [7]. Due to their important role in treatment, health-care facility managers, especially in emergency imaging departments, are responsible for maintaining the quality of student radiographers' work. Any negligence on their part may have irreversible implications for patients. As a result, student radiographer performance assessments are required by organizations, allowing them to recognize challenges, as well as high and weak points, in their workforce and make appropriate adjustments. Personnel attitude and actions are influenced by their level of competence. To have purposeful educational programs, it is important to prepare for the advancement of competence, improve their mindset, produce a desirable performance, and evaluate their awareness and attitude.

In comparison to international standards, studies in the Philippines indicate that emergency technicians perform poorly. This may be attributed to a lack of skills in the field, necessitating additional research [8]. Therefore, the present study aims to determine the student radiographers' competence on radiographic exposure factor selection during emergency and trauma imaging procedures. The findings of the study may be used as quality assurance and quality control measure and may be utilized to evaluate the competency level of the student radiographers in the hospital.

2. Methodology

This cross-sectional survey research was carried out at Iligan Medical Center College (IMCC) situated in Iligan City, Lanao del Norte. The selection of this location was influenced by the health risks associated with the COVID-19 pandemic, resulting in restrictions on entry in various localities. IMCC was chosen as the research site due to its distinguished reputation for maintaining high standards of education in the medical field, particularly within the Radiologic Technology Department. IMCC, established in 1975, is a private, non-sectarian educational institution offering a wide range of educational programs from preschool to tertiary levels.

To select participants, the researchers adopted a census method, involving the inclusion of all available 72 third-year and fourth-year students enrolled in the BS Radiologic Technology program at IMCC. In order to safeguard the privacy of the participants, the researchers provided the option for respondents to use codenames instead of disclosing their full names. Data collection was carried out through a researcher-developed questionnaire employing Likert-type scale responses. The survey was conducted online during the second semester of the Academic Year 2020-2021.

Ethical considerations were diligently observed, with a focus on preserving the privacy of the participants and obtaining their informed consent prior to their involvement in the study. Data analysis entailed the utilization of various statistical

tools, including frequency and percentage calculations, arithmetic mean computation, independent t-test, and One-Way Analysis of Variance (ANOVA), to examine the data and identify significant variations in competencies based on factors such as sex, age, and years of work experience.

3. Results

Table 1 suggests that the student radiographers generally exhibit a high level of competency in selecting radiographic exposure factors. They often make appropriate selections for kilovoltage-peak, milliamperage-second, source-to-image distance, and focal spot settings. The relatively low standard deviations indicate that there is consistency in their responses, implying that this competency is relatively uniform among the respondents. This is a positive indication of their competence in ensuring the quality and safety of medical imaging procedures.

Independent t-tests show that there are no statistically significant differences in the competence levels of male and female respondents in any of the four exposure factor selection areas (kilovoltage-peak, milliamperage-second, source-to-image distance, and focal spot selection), as well as in the overall competence level (Table 2). This suggests that, based on this sample, sex does not appear to be a significant factor influencing competence in radiographic exposure factor selection.

One-way ANOVA tests for each exposure factor selection area (kilovoltage-peak, milliamperage-second, source-to-image distance, and focal spot selection) and the overall competence level show that there are no statistically significant differences in competence levels among the different age groups (Table 3). These findings suggest that age does not appear to be a significant factor influencing competence in radiographic exposure factor selection among the surveyed respondents.

4. Discussion

The findings from this study shed light on the competence of student radiographers in selecting radiographic exposure factors and the potential influence of gender and age on this competence. First, our original hypothesis posited that student radiographers would exhibit a high level of competence in selecting radiographic exposure factors. This aligns with the positive indication of competence observed in Table 1. Indeed, the results support this hypothesis, as the data indicate that student radiographers frequently make appropriate selections for kilovoltage-peak, milliamperage-second, source-to-image distance, and focal spot settings. The low standard deviations suggest a consistent level of competence among respondents, reinforcing the idea that they are proficient in ensuring the quality and safety of medical imaging procedures.

This finding aligns with a body of research suggesting that radiography students typically demonstrate a high level of competence in exposure factor selection [9,10]. These findings are in line with the importance placed on this skill in Radiologic Technology education and practice. However, it is essential to acknowledge that the lack of significant sex and age differences in competence supports some earlier studies that have reported variations in radiographic skills based on these demographic factors [11,12].

Table 1. Level of competence of the respondents on exposure factor selection in emergency and trauma imaging.

Items	Mean ± SD	Descriptive Rating
Kilovoltage-peak selection	3.65 ± 0.68	High
Milliamperage-second selection	3.59 ± 0.74	High
Source-to-image distance selection	4.02 ± 0.71	High
Focal spot selection	3.82 ± 0.66	High
Overall	3.77 ± 0.60	High

Note: 4.20–5.00=Very High; 3.40–4.19=High; 2.60–3.39=Moderate; 1.80–2.59=Low; 1.00–1.79=Very Low

Table 2. Independent t-test on the level competence of the respondents on exposure factor selection when grouped by sex.

Items	Mean	SD	df	t-value	p-value
Kilovoltage-peak selection					
Male	3.58	0.61	24	-0.409	0.686
Female	3.69	0.72			
Milliamperage-second selection					
Male	3.51	0.74	24	-0.399	0.694
Female	3.63	0.76			
Source-to-image distance selection					
Male	4.07	0.62	24	0.263	0.794
Female	3.99	0.77			
Focal spot selection					
Male	3.84	0.61	24	0.648	0.874
Female	3.80	0.71			
Overall	3.77	0.60	24	0.023	0.762

The absence of significant sex and age differences in competence raises intriguing questions. It is possible that the uniformity in competence levels among male and female respondents and across age groups reflects the effectiveness of the educational program at ensuring consistent skill development. Alternatively, it may suggest that radiography students, regardless of sex or age, are exposed to similar educational experiences and clinical training, resulting in comparable competence levels.

To further explore this phenomenon, future research could investigate the specific components of radiologic technology education that contribute to skill development. Previous studies have highlighted the importance of mentorship, clinical exposure, and individual learning styles in radiography skill development [13,14]. Understanding how these factors interact and their impact on competence could provide valuable insights.

Moreover, longitudinal studies tracking students' skill progression over time could provide a deeper understanding of the development of radiographic competence. By following students throughout their educational journey and into their professional careers, researchers could uncover how competence evolves and whether early educational experiences have lasting effects.

Table 3. One-way ANOVA on the level competence of the respondents on exposure factor selection when grouped by age group.

Items	Mean	SD	df	F-value	p-value
Kilovoltage-peak selection					
20 – 22	3.65	0.72	3	2.036	0.138
23 – 26	3.47	0.58			
27 – 29	4.00	0.85			
30 - 33	4.60	0.57			
Milliamperage-second selection					
20 – 22	3.60	0.91	3	0.688	0.569
23 – 26	3.46	0.64			
27 – 29	4.20	1.13			
30 - 33	3.90	0.42			
Source-to-image distance selection					
20 – 22	4.05	0.64	3	1.340	0.287
23 – 26	3.86	0.68			
27 – 29	4.10	1.27			
30 - 33	4.90	0.14			
Focal spot selection					
20 – 22	3.85	0.76	3	0.624	0.607
23 – 26	3.74	0.59			
27 – 29	3.60	0.85			
30 - 33	4.40	0.85			
Overall	3.77	0.60	25	1.172	0.400

5. Conclusion

In conclusion, this study highlights the high level of competence among student radiographers in selecting radiographic exposure factors in emergency and trauma imaging. While gender and age did not emerge as significant factors influencing competence in this sample, it is crucial to maintain this level of proficiency.

We recommend ongoing monitoring of students' radiographic skills, tailored teaching approaches to accommodate diverse learning styles, and the initiation of longitudinal studies to track competence evolution. Additionally, fostering sex and age diversity within the radiography field should be encouraged, and continuous professional development opportunities should be provided to ensure competence remains current and aligned with industry advancements especially on the aspect of emergency and trauma imaging.

Acknowledgment

Heartfelt thanks are extended to the College of Radiologic Technology of Iligan Medical Center College for their invaluable support throughout this research endeavor. Gratitude is directed to the two anonymous reviewers for the valuable suggestions that greatly improved this manuscript.

Conflict of Interest Statement

The authors declare no conflict of interest.

Author Contributions: All authors have contributed equally. They have approved the final version of this manuscript.

References

1. Person, J.; Spiva, L.; Hart, P. The culture of an emergency department: An ethnographic study. *Int Emerg Nurs* **2013**, *21*, 222-227.
2. Zorn, C.; Dillenseger, J.P.; Bauer, E.; Moerschel, E.; Bachmann, B.; Buissink, C.; Jamault, B. Motivation of student radiographers in learning situations based on role-play simulation: A multicentric approach involving trainers and students. *Radiography* **2019**, *25*, e18-e25.
3. Griffey, R.T.; Sodickson, A. Cumulative radiation exposure and cancer risk estimates in emergency department patients undergoing repeat or multiple CT. *AJR Am J Roentgenol* **2009**, *192*, 887-892.
4. Bushberg, J.T.; Kroger, L.A.; Hartman, M.B.; Leidholdt Jr, E.M.; Miller, K.L.; Derlet, R.; Wraa, C. Nuclear/radiological terrorism: emergency department management of radiation casualties. *J Emerg Med* **2007**, *32*, 71-85.
5. Gislason-Lee, A.J. Patient X-ray exposure and ALARA in the neonatal intensive care unit: Global patterns. *Pediatr Neonatol* **2021**, *62*, 3-10.
6. Ching, W.; Robinson, J.; McEntee, M. Patient-based radiographic exposure factor selection: A systematic review. *J Med Radiat Sci* **2014**, *61*, 176-190.
7. Hamzeh, B.; Najafi, F.; Karamimatin, B.; Ahmadijouybari; T., Salari, A.; Moradinazar, M. Epidemiology of traffic crash mortality in west of Iran in a 9 year period. *Chin J Traumatol* **2016**, *19*, 70-74.
8. Cagayan, M.S.; Armada, G.L.V.; Castro, M.C.R.; Nisperos, G.A. Factors influencing provision of basic emergency obstetric care services in Luzon, Philippines. *Int J Public Health* **2022**, *11*, 1305-1316.
9. O'Connor, M.; Rainford, L. The impact of 3D virtual reality radiography practice on student performance in clinical practice. *Radiography* **2023**, *29*, 159-164.
10. Benfield, S.; Hewis, J.D.; Hayre, C.M. Investigating perceptions of 'dose creep' amongst student radiographers: A grounded theory study. *Radiography* **2021**, *27*, 605-610.
11. Farajollahi, A.R.; Fouladi, D.F.; Ghojazadeh, M.; Movafaghi, A. Radiographers' professional knowledge regarding parameters and safety issues in plain radiography: A questionnaire survey. *Br J Radiol* **2014**, *87*, 20140090.
12. Aura, S.; Metsävainio, K.; Paakkonen, H.; Saano, S.; Selander, T.; Jordan, S.; Turunen, H. Factors associated with radiographers' intravenous pharmacotherapy theoretical competence: A comparative repeated-measures study. *J Radiol Nurs* **2017**, *36*, 253-260.
13. Morris, K.; Cathcart, J.M. An evaluation of the current mentorship/preceptorship practices for newly qualified radiographers in Northern Ireland. *Radiography* **2021**, *27*, 589-597.
14. Ward, P.; Makela, C. Radiography students' clinical learning styles. *Radiol Technol* **2010**, *81*, 527.

Publisher's Note: IMCC stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.