Aligning the knowledge and technical skills of radiologic technologists in hospitals in Batangas City on proper chest PA positioning

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Abstract: Technical competencies anchored on proper knowledge are important in radiologic technology. This study was conducted to determine the association and correlation between knowledge and technical skills on proper chest PA positioning among 30 radiologic technologists in Batangas City hospitals. Instruments used were a researcher-constructed 30 examination item test and a standardized tool on imaging quality of chest radiography. Results show that majority of the radiologic technologists had rating of fair in the chest PA positioning exam and rating of good in the total assessment results on imaging quality of chest radiography examination. Cross tabulation of results in the two examinations showed that the radiologic technologists had rating of fair. Tests of association and correlation revealed no significant association and correlation between knowledge and technical skills of the radiologic technologists. More hands-on exposure for technical skills development in imaging is recommended to be added in the radiologic technology program to enhance students' technical skills. Further, a follow-up study is warranted to test on knowledge and technical skills between registered and non-registered radiologic technologists as basis for the development of competencies in chest radiography.

Keywords: *positioning, chest radiography, knowledge, technical skills*

INTRODUCTION

Technological innovation truly influences many developments that affect people's lives. As the level of technology increases, changes and improvements in people's way of living increases too. The same applies to the practice of radiologic technology. Technology unfolds new enhancements in imaging modalities – thus making the scope of the profession even broader.

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Radiologic technology is an auxiliary branch of radiology which deals with the technical application of radiation, such as x-rays, beta rays, gamma rays, ultrasound and radio frequency rays, in the diagnosis and treatment of diseases (Radiologic Technology Act of 1992). It is a medical specialty that uses imaging equipment to examine the human body for the purposes of diagnostics and to treat certain diseases. It uses a variety of technologies to diagnose, treat, and guide other medical techniques.

Radiologic technologists are health care professionals with knowledge in different subject areas of the said discipline. The profession is to protect the public from hazards posed by radiation as well as to ensure safe and proper diagnosis, treatment and research through the application of machines and/or equipment using radiation (Radiologic Technology Act of 1992). Radiographers work is one of the initiatives that should not only promote a better diagnosis in radiology but also to improve the patient safety (Serranheira & Proenca, 2011).

Another thing, a study made by the American Society for engineering education states that there is a common theme posited in consideration of what steps would be necessary in order for U.S. to remain competitive in the global marketplace included the need to promote academic rigor in developing important skills from graduates and to establish a strong connection between academia and industry. (Brush et al., 2014).

One of these disciplines is positioning which is used to describe specific body positions by that body part closest to the image receptor. It is a step to produce radiographic images for diagnosis. Teleroentgenography is one of the most common procedures of positioning done in the radiology department which uses a 72 inch source to image receptor distance (SID) (Bontrager & Lampignano, 2010).

Radiographic positioning refers to the study of patient positioning performed to radiographically demonstrate or visualize specific body parts on image receptors. This discipline is significant to the radiology department for it helps in the reduction of repeat radiographs through proper positioning and clear communication (Bontrager & Lampignano, 2010).

Furthermore, well positioned, non-rotated radiographs are also necessary for proper diagnosis because even minor degrees of rotation can significantly distort the normal anatomy (Frank et al., 2003).

Accurate positioning reduces the exposure of the patient and produces a valuable x-ray image for diagnosis. A study in Japan developed a positioning training tool for radiography to help students improve their positioning techniques and practical skills. This makes

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students perform and learn positions using personal computer with a three dimensional computer graphics (3DCG) phantom constructed from computed tomography (CT) image data and confirm the produced plane image corresponding to the positioned phantom (Maruyama & Yamamoto, 2013).

Correct positioning confirms the subject's body anatomically and adjusts it with respect to the direction of the X-ray so that the organ to be examined can be clearly distinguished from other organs or bones. This means that only the area of interest will appear in the radiograph and thus results to less repeat radiographs and x-ray exposure of the patient (Maruyama & Yamamoto, 2013).

Correct positioning also helps in determining the size of the anatomy of interest. This is similar to hip displacement in cerebral palsy where reliable measures of migration percentage can be obtained using right positioning (Cliffe et al., 2011). Moreover, in lateral humeral condoyle fracture which is common in children, forearm rotation is also a basis in determining the displacement. Even current clinical methods are not sensitive enough to detect a displacement (Knutsen, 2014). Furthermore, positioning can have an important effect on the calculation of scoliosis measurement. This needs to be considered when evaluating the progression of spinal deformity (Siljanderetal, 2011).

Right positioning is a necessity for radiologic technologists. Correct positioning allows exact measurement of bone displacement. The bones have to be positioned correctly with respect to the x-ray source to avoid projecting oblique shapes and overlapping surfaces onto the radiograph (Kuo et al., 2013). In radiation treatment of patients with head and neck cancer (HNC) accurate positioning is important since multiple critical organs surround the target (Kang et al., 2011).

As to the errors in the radiology department, image acquisition is a main consideration to ensure an accurate patient diagnosis (Serranheira, 2011). Improper positioning results in misdiagnosis or inaccurate measurements for certain procedures. Positioning mistakes are present not only in normal radiography but even in other modalities. Film retakes are possible due to positioning errors. A study in digital radiography shows that more than half of the film retakes were performed due to incorrect positioning. Also, increase in the patient age and male sex of the patient were at significantly higher risk of causing positioning error (Akhtaretal, 2011). It can be related to the results of the study made by the American Society for Engineering Education which shows that interns may have been confident in their critical thinking skills in a controlled setting, the mentors may have perceived this as one of the first steps in building these skills that would eventually be applied in a much broader and less structured context in

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the workforce. This just explain that radiologic technologists are good in terms of theories while they were exposed to the academe compared to a workplace where work become their daily habit (Brush et al., 2014)..

Reliance on subjective positioning may be a cause of diagnostic error in lateral stifle scintigrams (Mathias et al., 2012). Effects like iatrogenic brachial plexopathy from wrong positioning during radiofrequency ablation of a renal mass are possible to occur (Densai & Nemcek, 2011). Patient positioning can have significant effect on calculation of scoliosis measurements. This needs consideration when evaluating the progression of spinal deformity (Siljander et al., 2011). However, the ideal positioning cannot be achieved easily in clinical practice. Artificial projection errors on the radiograph might be a cause due to errors in positioning and x-ray beam by the operator (Kuo et al., 2013).

Positioning is done step by step. Precautionary measures are also considered to give comfort and gain cooperation from the patient. Certainly, safety of the patient is what radiologic technologists need to offer as health care practitioners. If they do not comply in one of the most common procedure in the radiology department they might not be able to apply proper techniques in other radiologic examinations.

Positioning is an important body of knowledge in the science of radiologic technology. It has much significance for the production of a good quality radiograph. Without these, proper diagnosis will be absent. In addition, cases can be filed to the radiologist such as malpractice for wrong diagnosis.

The researcher sought to determine the knowledge of radiologic technologists and their technical skills and find out if the knowledge they have is associated or correlated to their technical skills in positioning. Good results the researchers' tests may, in a small way improve health care delivery, deliver accurate diagnosis and give safety of the patient through proper positioning.

METHODS

Research Design

The study used the descriptive association and correlation design to determine the alignment of knowledge and technical skills on chest PA positioning among radiologic technologists in hospitals in Batangas City.

Respondents of the Study

Respondents were thirty registered and non-registered radiologic technologists working in hospitals of Batangas City. Consulted experts in the face validation of the research instrument were

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excluded in the study. As part of ethical considerations**,** the use of human participants in this study was subjected to ethical review by the Institutional Review Board of Lyceum of the Philippines University. Informed consent was obtained from all participants.

Research Instrument

The study made use of a 30 item researcher constructed test on Chest PA positioning, items of which were framed from Merrill's Atlas of Radiographic Positions and Radiologic Procedures (Frank et al., 2003). The test focused on the theoretical aspect which covered positioning questions mostly focused on chest radiography where teleroentgenograhy is applicable. It also covered sequences of the x-ray procedure. The instrument was face and content validated by a faculty of a BS Radiologic Technology program and a radiographic positioning professor. This exam was used to determine the stock knowledge of the radiologic technologists on radiologic procedures specifically on chest PA positioning.

Another instrument used was standardized tool, the Quality Assurance of Chest Radiography (Eslava, 2014) which covered asymmetry analysis of the radiograph considering the following: identification of marker, patient positioning, density, contrast, sharpness and artifacts). This analysis would determine if the quality was accurate and positioning was proper. An evaluation criteria sheet composed of structures shown required to be visible in a good radiograph was used by the radiologist to determine the positioning levels. These levels had specific scores using a Likert scale ranging from 1 to 5, with 5 being the highest down to 1 as the lowest.

Data collection

As initial step to data gathering, the researchers wrote a letter of request to the Head of the Human Resource Department of each hospital for permission to conduct the study. Given the approval, a census of radiologic technologists in each hospital of Batangas City was done to have baseline information on the possible participants of the study. Name and work schedule of each radiographer were taken to know their availability and to ensure that all of them would be able to participate in the study.

The radiographer in each hospital first took the Chest PA exam after which they took the imaging test using walk in patients. As part of the imaging test, the radiographers took three walk in patients who gave their consent that the radiographs of their imaging test be used for imaging assessment purposes. To counter subjectivity, each of the radiographs was simply numbered and only one radiograph was selected to be assessed by a radiologist who would rate the procedure

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done by the radiologic technologists. The radiologist randomly selected a radiograph imaged by the radiologic technologist who took the exam and analyze it for this study using the evaluation criteria sheet, the gold standard tool for chest radiography.

Statistical Treatment

The study made use frequency/percentage. These were used to describe the number of responses in each of the items in the Chest PA positioning test; it was also used to describe the number of radiologic technologists' ratings in the Imaging Quality of Chest Radiography test. Grading of theoretical test was based on the transmutation table of College of Allied Medical Professions.

The scale used to measure performance in the knowledge aspect on the Chest PA test was as follows:

Range	**Verbal description**
92 and above	Excellent
88 – 91	Very good
84 – 87	Good
80 – 83	Fair
76 – 79	Poor
75	Passed

The results on radiographs using the standardized tool, the Imaging Quality of Chest Radiography test were rated as follows:

Identification of marker-	1-Good;
	2-Fair
	3-Poor
Patient positioning-	1-Good (0-1)
	2-Fair (neither Good nor Poor)
	3-Poor (5 or more)
Density-	1-Good(4-5)
	2-Fair (6-7)
	3-Poor (10-12)
Contrast-	1-Good(4-5)
	2-Fair (6-7)
	3-Poor (10-12)
Sharpness-	1-Good
	2-Fair
	3-Poor
Artifacts-	1-None
	2-Slight
	3-Present

ISSN: 2094-5906

Total Assessment:

Excellent – (3 - 4) with 2 Poor
Fair (8-13)
Good (8-11) without any Poor/Present
Poor (14- 18) with 3 Poor/Present

Cross tabulation. This analytical tool representing a two dimensional table was used to record the number of frequency of the responses in the Chest PA positioning test as associated to the frequencies that appear in the imaging test.

Pearson Chi-square association. This was used to determine association between performance results in knowledge in the Chest PA Positioning Test and that of the radiologic technologists' technical skills as shown in the Imaging Quality of Chest Radiography test.

Pearson Correlation Coefficient. This was used to determine correlation between knowledge shown in the Chest PA positioning test and the technical skills shown in the Imaging Quality of Chest Radiography test.

RESULTS AND DISCUSSION

Table 1
Frequency Distribution of Chest PA Positioning Examination Results

Rating	Frequency	Percentage	Rank
Excellent	3	10.0	3.5
Fair	14	46.7	1
Good	3	10.0	3.5
Passed	1	3.3	6
Poor	7	23.3	2
Very good	2	6.7	5
TOTAL	**30**	**100**	

Results in the table show that majority of the radiologic technologists comprised of 14 or 46.7 had a rating of *Fair*. There were seven or 23.3 who had a rating of *Poor*. There were three or 10.0 each who had a rating of *Excellent* and the other, a rating of *Good*. Two or 6.7 percent had rating of *Very Good* and one or 3.3 a rating of *Passed*.

The results generally show that most radiologic technologists had rating of *Fair*. A survey of the test items that the radiologic technologists had almost perfect to perfect answers to concepts on projection, positioning, common radiographic procedures, and chest PA of ambulatory patients on questions on correct PA radiograph for

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children. Also, item analysis was applied on the data so that evaluations were made.

However, there were concepts where the radiologic technologists had low scores on among which were on best time to make an exposure in a PA chest examination, correct direction of the central ray in the chest PA, position of the midsagittal plane to the IR and coronal plane, right radiological technique for crying pediatric patient, position of clavicle in a chest PA.

Table 2
Assessment of Chest Radiography Examination Results

		Frequency	**Percentage**
	Fair	8	26.7
Assessment on	Good	21	70.0
Marker	Poor	1	3.3
	TOTAL	**30**	**100**
Assessment on	Fair	11	36.7
Positioning	Good	19	63.3
	Total	**286**	**100.00**
Assessment on	Fair	9	30.0
Density	Good	21	70.0
	Total	**286**	**100.00**
Assessment on	Fair	8	26.7
Contrast	Good	22	73.3
	Total	**286**	**100.00**
Assessment on	Fair	8	26.7
Sharpness	Good	22	73.3
	Total	**286**	**100.00**
Assessment on	Fair	5	16.7
Artifacts	Good	24	80.0
	Poor	1	3.3
	TOTAL	**30**	**100**
Total Assessment	Excellent	13	43.3
	Fair	1	3.3
	Good	16	53.3
	Total	**30**	**100.0**

It is stated in the Radiologic Technologists Act of 1992, RadTechs are health care professionals with knowledge in different subject areas of the said discipline. This infers need for training or upgrading of knowledge of radiographic technologists to reorient them of basics of radiography which they could have taken for granted and considered their work as routine work. The standard assessment test in chest radiography involved six factors: identification marking of the

ISSN: 2094-5906

patient, patient positioning, density, contrast, sharpness, and artifacts. Data are presented in Table 2.

Data on patient marking show that majority of the radiologic technologists comprised of 21 or 70 percent had *Good* rating, while eight or 26.7 percent had *Fair* and one or 3.3 percent had rating of *Poor*.

Patient positioning exam results of 19 or 63.3 percent radiologic technologists was assessed as *Good* while 11 or 36.7 of them had rating of *Fair*. Results in the imaging test for density showed that majority of the radiologic technologists comprised of 21 or 70.0 percent had rating of *Good* and nine or 30.0 percent had rating of *Fair*. Results of the imaging test on contrast show that majority of the radiologic technologists had rating of *Good* as evidenced in 22 or 73.3 percent and eight or 26.7 percent had rating of *Fai*r.

Imaging results for sharpness had 22 or 73.3 percent with rating of Good and eight or 26.7 with rating of Fair.

Data on performance of radiologic technologists on imaging in artifacts showed that majority, with 24 or 80.0 percent of radiologic technologists had Good rating. Five or 16.7 had rating of Fair and one or 3.3 had rating of Poor.

Table 3
Cross Tabulation for Association between Chest PA Positioning and Imaging Quality of Chest Radiography Results

Chest PA Positioning Results	**Imaging Quality of Chest Radiography Results**			
	Excellent	**Fair**	**Good**	**Total**
Excellent	1	0	2	3
Fair	5	1	8	14
Good	2	0	1	3
Passed	1	0	0	1
Poor	4	0	3	7
Very good	0	0	2	2
Total	**13**	**1**	**16**	**30**

As based on the overall results on the factors on imaging, it can be noted that most of the radiologic technologists had rating of *Good* with 16 or 53.3 of them and 13 with 43.3 percent had rating of *Excellent*. One or 3.3 percent had rating of *Fair*. Most of the radiologic technologist in this assessment possesses a *good* rating in technical skills. In relation to this, a study made by Maruyama and Yamamoto states that accurate positioning reduces the exposure of the patient and produces a valuable x-ray image for diagnosis. This also confirms the subject's body anatomically and adjusts it with respect to the direction of the x-ray so that the organ to be examined can be clearly distinguished from other organs or bones. In relation to this, correct

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positioning also helps in determining the size of the anatomy of interest (Cliffe et al., 2011).

Cross tabulation results between Chest PA positioning exam and that of results on Imaging Quality of Chest Radiography exam show that of the 14 radiologic technologists who had *Fair* ratings in the Chest PA test, eight of them had rating of *Good* in the imaging test, five had rating of *Excellent* and one with rating of *Fair*.

Of the seven radiologic technologists with rating of *Poo*r in the Chest PA positioning exam, four had *Excellent* rating and three had rating of *Good* in the imaging test.

Of the three radiologic technologists with *Excellent* rating in the Chest PA positioning test, two had rating of *Good* and one had rating of *Excellent* in the imaging test. Conversely of the three radiologic technologists with rating of *Good* in the Chest PA positioning exam, two had *Excellent* rating and one had *Good* rating in the imaging test.

The two radiologic technologists with *Very Good* rating in the Chest PA positioning test had a rating of *Good* in the imaging test while one who had Chest PA positioning rating of *Passed* was *Excellen*t in rating in the imaging test.

To determine the association between the exam results of the two tests, the researchers hypothesized on the association between the Chest PA Positioning and Imaging Quality of Chest Radiography results. For this purpose, a null hypothesis was posted and Pearson chi-square was used to test the association. Data are shown in Table 10.

Table 4
Chi Square Test for Association between Chest PA Positioning and Imaging Quality of Chest Radiography Results

	Value	df	Sig. (2-tailed)	Decision on Ho	Interpretation
Pearson Chi-Square	5.549[a]	10	.852	Do not reject Ho	No significant association

The test for association between performance of radiologic technologists reflected in Chest PA Positioning and Imaging Quality of Chest Radiography results show that there was no significant association between these two exams as evidenced in Pearson Chi-Square value of 5.549[a] with df of 10. The null hypothesis was then not rejected. It also implies that as their experience in the workplace affects the theories the have learned. As the study conducted by the American Society for Engineering Students their results shows that most of the interns think that they were good in terms of critical thinking skills. It is considered the same that as radiologic technologists moved to their

ISSN: 2094-5906

respective workplaces, thinking skills or reasoning out tends to decrease and sometimes are not used mostly in practice.

To further validate the alignment of the knowledge and the technical skills of the radiologic technologists, the researchers had a correlation test using Pearson correlation coefficient. Data are shown in Table 11.

Table 5
Correlation between Chest PA Positioning and Total Assessment on Imaging Quality of Chest Radiography Results of Radiologic Technologists

Pearson Correlation Coefficient	p -level	Decision on Ho	Interpretation
.059	0.758	Do not reject Ho	Not significant

The correlation test revealed a .059 Pearson correlation coefficient at p-level of 0.768 indicating no significant correlation between Chest PA Positioning and Total Assessments on Imaging Quality of Chest Radiography. The null hypothesis was accepted.

Same as Table 10, in this study just showed that most of the radiologic technologists are knowledgeable in terms of technique. As associated to the Radiologic Technology Act of 1992, radiologic technologists is a profession which protects the public from hazards posed by radiation as well as to ensure safe and proper diagnosis, treatment and research through the application of machines and/or equipment using radiation.

CONCLUSIONS

Majority of the radiologic technologists had rating of *Fair* in the Chest PA positioning examination and rating of *Good* in the total assessment results on Imaging Quality of Chest Radiography examination. Cross tabulation of results in the two exams showed that the radiologic technologists had rating of *Fair*. Tests of association and correlation revealed no significant association and correlation between knowledge and technical skills of the radiologic technologists Therefore, radiologic technologists have greater competencies in terms of imaging or exposure techniques than theoretical knowledge.

RECOMMENDATIONS

It is recommended that the knowledge-based exam of the researchers be validated for reliability and that a more comprehensive exam be prepared and developed that would appropriately measure competencies. Also, more hands- on exposure for technical skills

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development in imaging is recommended to be added in the Radiologic Technology program to enhance students' technical skills.

REFERENCES

Akhtar, W., Hussian, M., Aslam, M., Ali, A., Faisal, A. (2011). Predictors of positioning error in digital radiography. *Pakistan Journal of Radiology*; 21(3).

Berlin, L. (2009). Radiography: The importance of position and technique. *Radiology Today*, 10(5), 22.

Bontrager, K. L., & Lampignano, J. P. (2010). *Radiographic Positioning and Related Anatomy*. Elsevier, Singapore.

Brush, K., Hall C., Pinelli, T. & Perry, J. (2014) Interns and Mentors' Evaluation of Workforce Knowledge and Skills and the Perceived Importance of these Skills in Engineering and Science Career. *American Society for Engineering Education. 2*

Cliffe, L., Sharkey, D., Charlesworth, G., Minford, I., Elliot, S. & Morton, R.E. (2011). Correct positioning for hip radiographs allows reliable measurement of hip displacement in cerebral palsy. *Development Medicine and Child Neurology.* doi:10.1111/j.1469-87492011.03970.x.

Densai, K.R., Jr. Nemcek, A. A. (2011). Iatrogenic brachial plexopathy due to improper positioning during radiofrequency ablation. *Seminars in Interventional Radiology*. 28(2).

Eslava, J. N. (2014) Quality assurance of chest radiography ppt. Retrieved May 2014 from http://www.*doh.gov.ph*

Frank, E. D., Long, B. W., Smith, B. J., Ballinger, P. W., & Merrill, V. (2003). *Merrill's atlas of radiographic positioning & procedures*. St. Louis, Mo: Mosby/Elsevier.

Kang, H., Lovelock, D.M., Yorke, E.D., Kriminski, S., Lee, N. & Amols, H.I. (2011). Acute Positioning for head and neck cancer patient using 2D and 3D image guidance. *Journal of Applied Clinical Medical Physics*; 12(1); 3270.

Knusten, A., Avovian, T., Borkowski, S.L., Ebramzadeh, E., Zoints, L.E. & Sangiorgio, S.I. (2013). Accuracy of radiographs in assessment of displacement in lateral humeral condyle fractures. *Journal Children's Orthropaedics* 8:83-89. doi.10.1007/s11832-014-553-8.

Kuo, C.C., Lun-Lu, H., WuLu, T., Lin C.C., Leardini, A., Kuo, M.Y., Hsu, H.C.(2013). Effects of positioning on radiograph measurement of ankle morphology: a computerized tomography based stimulation study. *Kuo et.al Biomedical Engineering Online.* 12:31.http:/www.biomedical engineering-online.com/content/12-3-131.

ISSN: 2094-5906

Marayuma, T., Yamamoto, H. (2013). Positioning training tool for radiography. *Positioning*, 2913,4,289-300.

Mathias, M.G., Ley, C., Berger, M., Hansson, K. (2012). Evaluation of a positioning method for equipment lateral stifle scintigrams. Grapperon-Mathis et al. *Acta Veterinaria Scandinavica*, 54:38. Retrieved from http://www.actavets.com/content/54/1/38.

Serranheira. F.,& Proenca. J. (2011). X-ray active failures: Behind radiographer's errors. *Health Care Systems Ergonomics and Patient Safety.* Albino et.al. (Eds.). Taylor & Francis group, London 978-0-415-68413-2.

Siljander, M, Knott. P., Thompson. S. & Mardjetko, S. (2012). The effects of patient positioning during radiographs on the resulting cobb angle measurements. *Scoliosis*, 7(Suppli1):012.http://www.scoliosisjournal.com/content/7/S1/012.

The Radiologic Technology Act of 1992. (1992). Retrieved April 11, 2014 from http://www.congress.gov.ph/download/ra_08/Ra07431.pdf

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