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Title	Competency-based education for training of diagnostic radiographers in percutaneous nephrolithotomy procedure in the operating theatre – An initial experience
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Competency-based education for training of diagnostic radiographers in percutaneous nephrolithotomy procedure in the operating theatre – An initial experience

### **Abstract**

Effective teamwork in the operating theatre (OT) is critical for improving safety of health care. However, newly qualified radiographers often lack confidence in supporting procedures within this challenging environment. This commentary focuses on our experience in introducing a competency-based tutorial educational session to augment apprenticeship learning for radiographers supporting percutaneous nephrolithotomy procedure in the OT. All newly qualified radiographers were invited to attend the 45 minutes face-to-face interactive educational sessions, which consists of core theory components, case-based learning and quiz. The core learning outcome of the competency-based tutorial educational session was established through a need-analysis. Our initial experience suggested that competency-based educational session was well-received by the participating radiographers and can be useful in augmenting apprenticeship learning.

### **Keywords**

Competency-based education; radiographers; PCNL; OT; clinical training; need-analysis

### **Introduction**

Effective teamwork in high-risk environments such as the operating theatre (OT) is critical for improving safety of health care [1]. The OT is different from other work environments in terms of risk, the unique systems, long working hours, and this stressful environment presents significant challenges to healthcare professionals working in it [2].

Fluoroscopic imaging is rapidly expanding in surgery and has become commonplace in many urology surgery procedures [3]. Percutaneous Nephrolithotomy (PCNL) is a minimally invasive approach for management of nephrolithiasis which involves fluoroscopic guided

percutaneous renal access [4]. As a radiographer is required to utilize fluoroscopy, they are an important member of the team – to deliver radiation exposure while adhering to the principle of As Low As Reasonably Achievable (ALARA).

It is now crucial to improve team dynamics, communication and team work to facilitate positive interprofessional working, reducing the potential for human error and negative health outcomes to patients and staff [1, 5]. However, it is not unheard of newly qualified radiographers reporting OT as a challenging environment and they lack confidence in supporting OT procedures which could jeopardise health outcomes [6]. The current training approach for the newly qualified radiographers in the OT is through apprenticeship learning. There were however challenges and limitations associated with the approach of ad-hoc apprenticeship learning [7]. Bimonthly on-going radiographers' engagement sessions highlighted various challenges and limitations from the lack of structure and ad-hoc nature of teaching. Therefore, it was pertinent for educators to bridge the gap.

An educational framework that surfaced and attracted extensive discussion and debate was Competency-based education (CBE). As highlighted in a narrative review by Brydges et al. [8], CBE is an outcomes-based approach to the design, implementation, assessment, and evaluation of medical professionals and their training programmes. It is well documented that CBE enables training to be focused on developing the knowledge, professional skills, and clinical competency – crucial for radiographers to meet the patient and societal evolving needs [9]. Though in our local radiography education, CBE is still in its infancy, experiences from the successful models can be learned. Drawn from the first-hand experience from one of the tertiary hospitals in Singapore, this commentary focuses on narrating our initial experience in conducting a competency-based tutorial educational session to augment the current apprenticeship learning.

## Competency-based tutorial education session

Firstly, a need-analysis was conducted to establish the core learning outcome of the competency-based tutorial educational session. Since the bimonthly engagement sessions involve only the trainees, the need-analysis included only the trainers and those who have completed their training. The competency-based tutorial educational sessions were conducted in 2019 at Radiography Department, Singapore General Hospital. All newly qualified radiographers were invited to attend the 45 minutes face-to-face interactive educational sessions, which consists of core theory components. Case-based learning and an interactive quiz were embedded within the session. It was clear that the intent of such approaches was to encourage active involvement of radiographers. Indeed, active involvement has demonstrated to enhance learner's level of understanding and ability to integrate and synthesize information [10]. Moreover, it improves the learner's conceptualization of systems and increases their level of knowledge retention [10]. Table 1 summarizes the contents of the education session.

**Table 1:** Contents of the education session

	Topics	Quiz questions
1	Indications and contraindications	
2	Risk and complications	
3	Operating theatre machine layout	<ul style="list-style-type: none"><li>• Where is the position of the C-arm for a right prone PCNL procedure?</li><li>• Where should the C-arm monitor be always positioned?</li></ul>
4	Step to step guide for PCNL procedure	<ul style="list-style-type: none"><li>• What is the first step before needle puncturing?</li><li>• What is the name of the catheter in which contrast will be injected?</li></ul>
5	After care	
6	Image orientation	<ul style="list-style-type: none"><li>• For prone PCNL, do you need to flip and save the control image taken during the retrograde pyelogram?</li></ul>

		<ul style="list-style-type: none"> <li>How would you label this image for a right PCNL?</li> </ul>
7	3 ways to do PCNL	

Theory components were specially developed to address knowledge gaps highlighted during the needs-analysis. Different urologists' preferred technique and approach for PCNL procedures were also collated to bridge the knowledge gap. Table 2 summarizes the findings of the needs-analysis.

**Table 2:** Findings of the needs-analysis

Current State	Desired State	Identified Gap	Gap due to knowledge, skill and/or practice	Methods used to identify professional practice gap
Radiographers are unfamiliar with the various techniques and the impact on practice	Radiographers know the various PCNL techniques and how the approaches differ and adapt their practice accordingly	Radiographers had not been educated about the PCNL techniques	Knowledge	Direct observation by core trainers; comments from urologists and voluntary feedback from radiographers
Radiographers are unaware of the urologists' preferred technique, set up of equipment are delayed in the process	Radiographers know the urologists' preferred technique for PCNL procedure to set up equipment accordingly	Radiographers did not know the urologists' preferred technique for PCNL procedure	Knowledge	Comments from urologists and voluntary feedback from radiographers
Ad-hoc apprenticeship learning limits opportunity for hands-on	Radiographers complement and assist urologists in PCNL procedures effectively	Insufficient PCNL procedures to hands-on during on-job-training duration	Skill/Practice	Voluntary feedback from radiographers and core trainers, feedback from bimonthly engagement session

The educational sessions took reference from the principles for developing competency-based programs by Sally and Louis [11]. Learning materials were uploaded to the institution intranet and E-learning platform (Wizlearn Technologies Pte Ltd, Singapore) to ensure that learning resources were available at any time. Radiographers were in tandem added to a WhatsApp (WhatsApp Inc, California, United States of America) group for the facilitator to provide 'just-in-time' assistance when required. Indeed, just-in-time training was a valuable workplace-based training strategy that had demonstrated to meet learners' needs as a memory refresher [12]. Moreover, the strategy was beneficial for busy radiographers just before or at the time of patient contact.

In this initial experience, a total of 12 radiographers attended the educational session. Online pre and post self-assessments were administered to gather voluntary feedback from radiographers. The pre-assessment provides feedback on the radiographers' confidence level and practical knowledge, while the post-assessment provides similar feedback with the addition of degree of preparedness and comments/suggestions. After completing the educational session, majority of the radiographers had provided feedback on an increase in practical knowledge (n=11/12:92%) and confidence level (n=10/12:83%). In fact, all radiographers agreed that they were more prepared to assist urologists in PCNL procedures.

The open-ended sections gathered further insights of the radiographer's perceptions of the educational session whereby they appreciate the interaction with the facilitator. Similarly, they valued the presentation of cases and the sharing of individual urologists preferred PCNL techniques. It was also highlighted that the session was helpful and substantial in further improving their competence and confidence. In tandem, the radiographers also highlighted some suggestions for improvement – greater number of case presentations. Additionally, a significant number of radiographers (n=7/12:59%) suggested incorporating simulation to reinforce their learning.

While most previous studies evaluating radiographers working in the operating theatre identify lack of clarity in communication as an important issue in the operating theatre [13-14], this initial experience employed a needs-analysis that establish a clear learning gap in the current training system for radiographers in PCNL support. Opportunities for competency development were identified, and strategies were created with the clinical leaders, enabling enhancement of knowledge and skills radiographers needed to support urologists in PCNL procedures [15]. Moreover, regular check-ins with the radiographers and additional feedback from the urologists provided valuable data to direct the development of the educational session.

Through this initial experience, we identified deficiencies in two competency domains – lack of knowledge about the different PCNL techniques and urologists preferred technique for PCNL procedure. Indeed, these were crucial knowledge for the radiographers. There were multiple patient position for various renal access, which will affect how radiographers set up and maneuver the fluoroscopic units. Coupled with the limited and varying experience of the newly qualified radiographers, they often experience lack confidence in supporting urologists in the complex and volatile OT environment. In fact, the lack of confidence could also be attributed to the skill/practice deficiency as a result of insufficient PCNL procedures to hands-on during the on-the-job training duration.

## **Conclusion**

It is undeniable that radiography is both a skill-based and hands-on profession. Therefore, though the educational session provided the radiographers with much needed knowledge to support the urologists, they were unable to put theories into practice. Incorporating simulation to future programme allows the radiographers to build on their skillsets and increase their preparedness when they face actual clinical settings in the OT [6]. Inarguably, simulations allow reproducible of different scenarios (Supine / Prone PCNL procedures) for practice and

assessment which could mitigate radiographers having insufficient PCNL procedures to hands-on [16]. In fact, the paradigm shifts towards outcome-based in medical education, simulation-based mastery learning would form a rigorous approach to CBE [17].

To conclude, this initial experience demonstrated that, competency-based educational tutorial session enhanced the radiographers' knowledge, confidence and preparedness. It was well received by the radiographers and facilitated the development of transferable as well as radiographer-specific skills. Our experience suggests that it could be useful in augmenting apprenticeship learning. At point of writing, we have secured an educational grant to further develop the programme. Presently, work is in progress to incorporate simulation in the development of a competency-based curriculum for radiographers supporting PCNL procedures in the Urology OT. We look forward to sharing our findings with all readers soon.

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