Chapter

Nurse Practitioners "Insider" and "Outsider" Roles and Responsibilities Enabling a Quality Managed Delivery of Contemporary Medical Imaging Services

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Abstract

Nurse practitioners (NPs), as key healthcare professional, play a critical role in the provision and coordination of care, prevention of adverse events, health service throughput, and patient outcomes. Patient experience is considered as one of the pillars of quality in healthcare, along with patient safety and clinical outcomes. Based on the aforementioned, nurse practitioners have a vital role in providing clinical nursing care to patients within or outside of the immediate medical imaging (MI) working environment. Their evolving role expansion in medical imaging is documented in the literature. The purpose of this chapter is to create further awareness of the nurse practitioner in medical imaging.

Keywords: quality, management, contemporary, services delivery, nurses

1. Introduction

In health care organizations, nurse practitioners (NP) play a pivotal role in serving as a liaison between multi disciplines including the temporary team membership in medical imaging (MI) enabling patient care management that strives to achieve consistent, high-quality care [1]. The principle of quality is implicit in healthcare and includes aspects of accessibility, appropriateness, affordability, availability, effectivity, efficiency, integratedness, and safety [2]. Additionally, the continuity of care and wellbeing concept which goes beyond the healthcare complex is essential. Continuity is conceptualized as multidimensional, encompassing three specific domains—relational, management, and informational continuity—with emphasis placed on their interrelations. Continuity of care (CoC) is an important aspect of quality, safety and efficient manner. CoC implies the delivery of services in a coherent, logical, and timely fashion [3]. These NPs form an integral part in the continuity and holistic care

using the nursing process of assessment, diagnosis, planning, implementation, and evaluation. Including nursing care to individuals' families, communities, or populations by using critical thinking, skill, professional competence, and evidence-based knowledge.

MI technology is a healthcare resource intertwined and shared across the multilayered healthcare delivery, medical specialties, and patient care. Their services are crucial in the management of various diseases contributing toward CoC, ranging from primary prevention, timely detection, and diagnosis to treatment and post-therapy rehabilitation or palliative care and as well as for fluoroscopic real-time visualization of different types of pathology and image-guided diagnostic tumor sampling for pathology work-up and therapeutic interventions. It aligns with the recent endeavor on the role of medical imaging in value-based healthcare. Including the timely diagnosis highly reliant on the accessibility, effectiveness, efficiency in utilization of the imaging technology [4, 5]. It consists of both ionizing and non-ionizing imaging modalities. The ionizing modalities are general radiography, fluoroscopic imaging examinations, mobile radiography, portable radiography, mammography, computed tomography, angiographic and interventional angiographic imaging examinations, diagnostic nuclear medicine whereas non-ionizing imaging modalities include diagnostic ultrasound and magnetic resonance imaging. The different examination types with its respective imaging modalities and the interpretation of the imaging series are used to diagnose, monitor, or treat medical conditions [4, 6]. From an NP perspective technology form an integral part of the nursing profession and it is expected of them to have that specialized knowledge and insight to recognize, prevent and care for possible complications related to MI examination types [7].

The purpose of the chapter is to provide a bird's eye view of the roles and responsibilities of the NP in MI as an "insider" and "outsider" as the patient journeys through the various points within the healthcare system.

2. The nurse practitioner's scope of practice and diagnostic decision-making processes

Quality of care improvement within a healthcare team differs in terms of education, expertise, and competencies. For example, a rich mix of qualified staff with postgraduate qualifications is associated with better clinical outcomes. Globally, there is a widening gap between the supply and demand of healthcare workers indicating a need for an urgent response. Within the bigger picture at the global level bridging, this gap is complex and complicated. Several factors impact the balance of demand and the supply of timely and appropriate care. Within this context, the number of healthcare professionals is only one aspect impacting access to care. In this regard, NPs are positioned in settings such as government roles, public health, academia, clinical care, leadership, and private industries with the ability to develop a creative and effective network to respond to multifaceted problems. Dynamic NPs practicing to its full scope can assist in addressing health system demands [8].

Before this can occur, a clearer understanding and national application of the NP scope of practice is required [9]. Any ambiguity surrounding the practice scope of NP impacts the profession's ability to respond to health system challenges. NP scope of practice is defined and regulated among others by their education, training, clinical experience, registration standards, endorsements and notations, positions of employment, clinical protocols, and guidelines. Efforts to recognize new professions

or modify the scope of practice for existing health professions usually require the enactment of or amendment to state law, a process that is typically slow and, at times, adversarial. For example, in the United States of America, states often solicit input on proposed changes from stakeholders, including professional associations and, to a more limited extent, consumer groups [10]. According to Gleason et al. the scope of practice laws is not the barrier as perceived to be [11]. These authors advocate that NPs to be prepared and accountable for playing an active role in the diagnostic process, not that they assume accountability for making medical diagnoses. However, a challenge is a false perception that scope of practice laws prohibits NPs from participating in the diagnostic process. The lack of consistency across states' scope of practice laws and terminology used to describe the role of NPs in medical diagnosis could contribute to the confusion. Therefore, encouraged to adopt clear and common regulatory language that contributes to the medical diagnostic process, is within the NPs scope of practice [11].

However, the reality is that these professionals significantly contribute to the medical diagnostic process, in terms of observations, diagnostic thinking, clinical judgment, reasoning, and interpretations of findings. Gleason and others believe that NPs are essential members of the diagnostic team. Though there is a clinical medical diagnosis by medical healthcare professionals assigned based on a syndrome or disease based on a set of signs, symptoms, and other findings. One could argue that a nursing diagnosis is based on a clinical judgment based on a holistic approach not only isolated to their health conditions but expands beyond the immediate clinical context including family members and community. However, these practitioners also function in acute, chronic, and high-pressure critical medical environments and expectation to identify and intervene through an action plan. This process of diagnostic decision-making encounters includes diagnostic tests like medical imaging encounters that NPs are directly or indirectly involved [11].

From a MI quality management perspective, MI service refers to an understanding of the importance of quality as a determining factor in competitiveness such as globalization, technological evolution, increased competition, changes in the profile of patients in these services [5]. Like any health service, it is an open system and suffers the action of the environment that constantly changes, while it contributed to the emergence of a new way of seeing its internal and external relations to meet new demands of imaging service. Quality of services that occupy an important place in health care is imbued to seek excellence and sustainable development with a focus on risk management, quality of exams, reports, and patient safety improvements [12]. Nursing influences and adds value to the practice in radiology and imaging diagnosis by incorporating assessment skills and initiatives of evidence-based practices, and the nurses' specialization in MI is recognized. Disseminating this specialty and producing knowledge, as well as the methodology of nursing accreditation in this space, require attention, as they are associated with the redefinition of the roles of NPs and other members of the health team [6].

The quality of service regarding the CoC for instance includes on-MI NPs who are responsible for the handoffs and safe transition of patients between inpatient wards and MI departments. CoC occurs through verbal and written reports. That CoC was disrupted because of breakdowns in verbal and written communication. In a study by Carley and others several participants echoed the limited communication about what happened in the MI procedure during handoff. Information shared verbally between the sending and receiving nurses varied. To overcome this shortcoming, a suggestion was to focus on the specifics about the procedure when interacting with medical imaging NPs [13].

3. Nurse practitioner referrer and medical image interpreter role

MI studies usually come from referring clinicians during a medical encounter who seek radiological input, and directly receive the output (reports). Referring clinicians can be considered as "intermediate customers". Similarly, it is not unusual for NPs to complete a request order, initiate an imaging referral, varying from country to country. For example, within an Australian primary healthcare context, NPs scope is limited to completing referrals for chest and pelvis radiographic examinations. Restrictions also apply to other imaging examinations such as Dopplers and Dexa scans. These are essential for NPs to be able to access if they are to provide appropriate primary health care and address often urgent health needs without the delay. For example, there are legislative changes proposed by the Australian Capital Territory Government with regard registered NP registered by the Nursing and Midwifery Board of Australia with regard to advanced practice. Like working independently and collaboratively within the ambit of expert critical care context. Includes among other like core activities, such as diagnosis and treatment of medical conditions, prescribing medicine and requesting and interpreting diagnostic examinations (e.g., blood tests and MI examinations) [14].

One of the arguments is the fear of over or under diagnostic tests that would or would not have been ordered by the medical officer. Though the potential benefits of NPs in terms of saving time and satisfaction, there are also excessive requests that could potentially result in additional time, additional expense and increased resource utilization, unnecessary radiation exposure, and potential morbidity. Risk of additional tests following the physician's examination. Additional projections of the same/adjacent or different regions can be ordered because the first projection did not demonstrate the problem, or another injury was discovered during the consultation. The "to and froing" like unnecessary trips to imaging become necessary, resulting in both the time constraints for treatment and the inconvenience to the patient [15, 16].

The request order is an effective and efficient medium of communication between the refer and the recipient on behalf of the patient. The request order is an essential part of the justification for the examination, a medico-legal requirement, provides the cue for the type of MI examination through verification and confirmation with the patient, the planning of the MI examination, compiling a radiological interpretation and report triggering an action plan and form part of the medical record keeping. For example, often MI services are rendered outside of the immediate MI section, such as intensive care units, emergency and trauma settings, and ward settings. In these instances, the justification expands beyond the imaging justification principle. These requests ideally are restricted to patients on life-support machines or those with medical conditions where nursing care and treatment could be seriously affected if transported to the imaging section. If the examination requested could be done in the MI section with a better outcome, the MI team should consult the referring doctor and nurse looking after the patient regarding the advisability of moving [17]. In other words, the referring doctor should always consent to any changes to the mobile imaging service requested. A chore in the element is quality of the information and processing the referral in a timely manner in achieving a high impact quality MI outcome. Bearing in mind that multiple patients and patient acuity levels can prevent the attentiveness needed to process orders in a timely manner. A good working relationship between the doctor, radiographer, and nurse is cardinal in acquiring quality diagnostic images [18].

In most instances, the refer could make a request electronically through the radiology information system (RIS) or paper-based and especially in an emergency by telephone and or bleep system. Digital patient records enable and ensures seamless communication between the departments. If this record is not available and configured in a way that the MI professionals can access and utilize. Inaccessibility and timely access could result in errors, impact safety, compromise the quality of examination, accuracy of results, or potential for delays. It is essential for NPs as referrers to liaise with all involved parties in establishing the information that should be shared at this stage. For example, documenting not only the presence of an intravenous line but also the size of the line can be essential information for MI sections like contrast media-related imaging examinations. Considerable time can be lost if MI staff must track down the referring NP to find out if an intravenous line is capable of the high flow required for some intravenous MI contrast agents.

With modern MI computer science and technological advancement, a chore component of clinical practical applications such as medical diagnosis, treatment planning, and for instance surgical navigation [17, 19]. Including a wide array of technological networks among other social media and e-health data use has resulted in a massive progression in the way MI services are delivered [20]. An essential element throughout these processes is the filtration of the quality documented information in the delivery of quality, evidence-based nursing practice. Since NPs accountability, roles, and responsibilities expand across settings from the micro-level clinical bedside to an administrative office role at the meso and or macro level in an organization. According to Zadvinskis et al., and Abuzaid and others recognise the value of artificial intelligence (AI), like health information system, electronic health records; and digitised order entry and decision aid support in medical imaging and robotics. These cognitive technologies are less invasive and more accurate tools for diagnosis and treatment. The recommendations are for organizations to invest in these technologies, refine the policies and align with nursing practice and integration into nursing education and professional development [21, 22]. Clinical data provide a holistic and collaborative understanding of the clinical condition and the management of patient care. Digital management systems can be of value in terms of data storage which can be transformed into stored electronic clinical data for utilization to provide safe and effective patient care. The design of these clinical systems should address workflow and must be done on a continuous and iterative approach based on identified needs. Good record-keeping is an integral part of patient care. Documentation should extend beyond the confines of the diagnostic report. An integrated "event details" section would allow important information to be recorded through an integrated clinical environment platform. As part of the patient clinical notes and discharge summary, thus reducing the risk of conflicting information between patient information held on the RIS and information in the patient notes. Thereby, maintain consistent continuity of patient care and help to inform future decisions regarding patient management and MI examinations [23].

The professional NPs in a study by Makanjee et al. were eager to expand their scope of practice, specifically to include the interpretation of radiographs [24]. Based on their wish to provide feedback to patients who are anxious or in transition between MI and another point of contact and to compile evidence-based nursing notes. NPs are usually the first to prepare the patient for MI examinations, read the radiological interpretation report, and provide the interpretation to the clinician. Hence, it is very important for the NPs to have a basic understanding of Chest radiographic findings to sharpen their assessment skills, promote patient safety, and alter their actions to

benefit the patient [25]. Several studies have shown evidence that NPs can interpret plain radiographic, CT, and ultrasound images through experiential learning or formal training [25, 26]. The evolving nature of this role has occurred in response to emergency departments' necessity to discover innovative ways to improve service delivery also linked to other subspecialties within the hospital is the timeliness of the accessibility and delivery of these images. A solution could be to device process metrics to provide an indication on aspects of the value of delivery in terms of the timeliness of the information delivery and its applicability to appropriate levels of specialization and subspecialties to interpret [5].

4. NP roles and responsibilities in the immediate MI environment

NPs caring for patients in MI started in the 1970s because of multimodality, cutting-edge imaging technologies. Thereby, the potential to improve efficiency, grow service lines, and improve the visibility of MI departments. A challenge in the immediate MI working environment could be adapting from having stable nursing care plans and routines to the frequency of changing plans when a patient is a switch between modalities. In close collaboration with multidisciplinary teams in imaging services, ensuring also that policies, guidelines, and protocols are complied with and contribute toward enhancing effective improvements [24, 27, 28]. For example, during the general or plain radiographic examination depending on the patient's characteristics, the competency of the radiographer and equipment ensuring the patient's comfort while in the MI examination room, the orienting and supporting the patient's immobility during the exam, interdependent on patient cooperation, such as holding breath for a while. Providing a calm and relaxed environment for the patient is indeed vital. Complexities may arise when patients require sedation, especially in the pediatric population group. Often requires scheduling in coordination with the hospital's specialized nursing care center and medical specialist. According to Ruess and the authors, there were inconsistencies in terms of the method of administration and type of medications. A confounding factor was the variable levels of experience [29]. To resolve this issue representatives from nursing staff and physicians from pediatric radiology, pediatric, anesthesia, and quality services representatives, formed a multidisciplinary team. The review entailed using institutional and national regulatory authorities' guidelines and protocols to standardize the ordering process, pre-sedation history and physical examination, physician training and staffing, and sedation medication protocols. Implementing a sedation pathway enhanced the safety, effectiveness, and efficiency of sedation medication for routine diagnostic imaging procedures [29].

Another area is the fluoroscopic imaging procedures where NPs play a chore role whether it be outside or within the immediate MI section. The Fluoroscopy MI technique uses ionizing radiation to obtain real-time moving and or static images of internal structures and functions on a display screen and guide the procedures [30]. NPs take on numerous roles during fluoroscopically guided interventions (FGI) procedures ranging from working in a radiation environment to operating fluoroscopy equipment where permissible by law. The patient care processes pre-, during post-fluoroscopic examinations. For instance, to improve the quality of the images and to obtain a safe report, before starting the exam, the nursing professional checks if the patient has prepared as requested when scheduling the exam. Fluoroscopic examinations like other modalities such as CT, MRI, and US include the administration of contrast agents associated with the patient's physiological condition. During this process, NPs together

with MI professional team include safe medication management in contemporary clinical practice. Record keeping is central for risk management (e.g., contrast reactions and extravasations) and medico-legal reasons. Knowledgeable of the associated risk with contrast agent administrations include the knowledge of characteristics of the type of contrast agents and its suitability among other in conjunction with the catheter selection, cannulation site, etc. [7]. Occupational risks include radiation exposure, slips, trips, falls, and potential head injuries, along with potential exposure to chemotherapy, bodily fluids, and other pathogens, which are the most common risks faced by multidisciplinary team members including medical imaging NPs [31].

5. Nurse practitioner roles and responsibilities outside the immediate MI environment

Most hospitals are equipped with the provision of MI services away from the immediate MI section. In this section, the focus shifts toward, critical care units, theater, ward MI examinations, and remote mobile MI services [17]. As already mentioned, NPs are vital in the management of patients for ionizing and non-ionizing MI examinations. In the previous section, the role of non-medical imaging NPs was briefly touched upon in terms of handovers and the importance of an effective efficient manner of communication information exchange. An integral component is the competency, roles, and responsibilities of the contemporary multidisciplinary team members in aligning, coordinating, cooperating, collaborating, and communicating in critical decision-making processes and procedures regarding MI examinations protocols in maintaining and sustaining the seamless clinical medical CoC and wellbeing of the persons. For example, peripherally inserted central catheter insertion by NPs under fluoroscopy guidance has been shown to be a safe and suitable alternative to radiologist insertion with similar technical success and similar long-term complication rates. It could have flow-on effects in terms of cost reduction, provision of technical ward support, and allowing radiology medical staff the time to perform other fluoroscopic or angiographic procedures [32]. Central to and interwoven is technology as an enabler, facilitator, and mediating the network of interactional processes in achieving these seamless quality outcomes in patient management. The overarching and golden thread to be considered, is the holistic care and safety culture.

Pros could be ease of access where transferring a patient to the MI section could result in compromised care in terms of their unstable medical condition affecting both the treatment and nursing care. Also, requires careful consideration in terms of radiation safety and the quality of the completeness of an MI examination. For example, one needs to ensure that the physical environment is radiation safety compliant, like the thickness of the walls in theater and critical care units. Considerations include radiation protection control measures during mobile radiography such as bed distancing and protecting patients, themselves, and members of the public visiting the ward/unit. So, the timing of an MI examination, if possible, can be negotiated to avoid unnecessary exposure to the public unless critical. Some of the most common MI examinations performed is the chest radiographic imaging examinations. The most common indications for performing portable MI examinations are to check for positions of tracheostomies, nasogastric tubes (NGs), central lines or central venous catheters (CVCs), trauma injuries, pacemakers, and other medical conditions of patients who require special care. Other MI examinations can also be performed, but dependent on the type of MI equipment and its characteristics, the quality of radiographic images, and safety [17].

Prior to commencing a MI examination, a written MI request should be made. Apart from the medico-legal requirement and justification aspect, the radiographer needs to plan the imaging examination, select an appropriate image receptor, ensure the equipment is optimally functioning and appropriate imaging exposure parameters are selected and may require additional accessories such as immobilization aids. Assess the patient's condition in liaison with the NP. The NPs are responsible for the patient knowing condition and patient's needs. The radiographer and NP collaboratively coordinate the immobilizing, positioning of the patient, and the image receptor device to acquire the required radiographic projection of the body part of interest. At the end of the imaging examination, the NP or referring doctor should be informed of when the outcomes of the imaging examination are likely to be available [17].

6. An overview of shared roles and responsibilities on safety culture

An important aspect throughout any MI examination is aspects of infection control and cross-contamination. Any infection control measures should be communicated to the MI professionals and infection control protocols always be adhered to. Include the MI equipment and its accessories and radiation safety protective gear. For instance, theater and mobile MI equipment and its accessories should ideally be dedicated units kept on site. During an imaging examination, it is advisable to cover the image receptor with a suitable cover material (double-bagged if required) to prevent contamination from body fluids. Also, take into consideration that the material used will not create an artifact and is radiolucent. As would compromise the quality of the MI examination and risk the safety of the patient. When dealing with highly contagious infections wear appropriate personal protective equipment (PPE). All contaminated gear such as the covers and PPE placed in the correct waste bins. Occasionally, NP would be required to assist in the imaging of these patients. The principles of barrier nursing techniques of infection control are necessary. During this process, the role and responsibility of the radiographer and NPs knowledge of body part positioning, aligning of the image receptor, and following instructions from the radiographer is important in ensuring that safety is maintained without compromising the quality of the MI examination.

Following the MI radiation safety guidelines are significantly important. NPs should be knowledgeable about radiation safety rather than learning on the job from hearsay. Practical errors and feedback and annual training on radiation protection and safety and should be included in an occupational dose monitoring program. Basic radiation protection principles can be summarized as, time, distance, and shielding. All radiation protection strategies are fundamentally related to one or more of these rules. Using personal dosimeters ensures the management of the duration of stay in an area with high radiation levels and the monitoring of accumulated doses. Use radiation protective gear such as lead aprons, thyroid shields, and lead glasses. Justified by the role of the NP during fluoroscopic guided intervention who is in proximity monitoring the patient, an advocate for the patient, and reporting back all pertinent information related to potential safety concerns. A mobile lead shield that is transparent, at least on the upper half, can be used to create a protected area at the nurse workstation. NPs who take on the role of a procedure assistant will move around the room and therefore will require the same thickness apron in the front and back. Ceiling-suspended shields are also very effective at reducing radiation dose to the upper body and the lenses of the eyes [17, 33].

Like their MI professional counterparts, medical imaging NPs who are pregnant or planning to become pregnant do not need to modify their duties related to working in radiation environments [34]. Pregnant radiation workers should declare their pregnancy to a radiation safety officer and acquire a fetal dosimeter in addition to the occupational dosimeter worn under PRE at the level of the conceptus, used to monitor the dose to the conceptus. The dose to the conceptus is restricted to a much lower level than that of the worker [31].

7. Conclusions

In conclusion, this chapter provided a snapshot of the NPs integrated roles and responsibilities as part of the contemporary MI team both within and outside of an evolving technological medical imaging environment and service delivery. This chapter adds to the contribution, performance, and recognition of their work. Essentially, MI professionals (radiologists and radiographers) should acquaint themselves with the scope of practice of NPs and vice versa to achieve an optimal quality outcome for the patient. This could be achieved through sharing teaching, research, continuous professional development, evidence-based practice forums; working collaboratively in developing quality management improvement plans, protocols, and guidelines in the management of the patient. Lastly, at the regulatory professional level, the scope of the profession and practice to enhance the capabilities and standards of practice, and to provide Continuing Professional Development (CPD) to NP to keep up-to-date with any developments in the safety area.

Conflict of interest

None.

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