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Nurses' Knowledge of Ionizing Radiation in Northern Gauteng State Hospitals in South Africa

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A B S T R A C T

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Nurses are part of the team that often visits the radiology department and often participates in bedside procedures during mobile radiological examinations. Researchers observed that nurses often withdrew assistance during radiological examinations, standing behind curtains in wards without adhering to radiation-protection measures. To assess nurses' knowledge of ionizing radiation, the researchers conducted a quantitative, cross-sectional, descriptive research study. More than 50% (n = 123) of nurses lacked basic knowledge on principles of radiation safety, and 63% of nurses were never taught or attended a workshop on radiation safety. Radiation safety should be included as basic knowledge in nursing curricula, and radiation-safety guidelines are needed in radiography suites.

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Introduction

Ionizing radiation is a high-frequency electromagnetic wave with energy potential to damage deoxyribonucleic acid (DNA) strands of human cells (Bushong, 2013; Harrison and Day, 2008). In living cells, ionizing radiation may cause stochastic or deterministic damage (Goodman and Amurao, 2012). Deterministic damage occurs when the set exposure threshold is exceeded (Bushong, 2013) and the severity of the damage increases as the dose increases. Deterministic damage includes abnormalities such as cataracts and skin erythema (Dance et al., 2014). Stochastic damage occurs when doses are exceeded but without a threshold dose. Stochastic damage is associated with pathologies such as infertility and cancer (Yurt et al., 2014).

Although ionizing radiation can be harmful, it is used for diagnostic and therapeutic purposes (Harrison and Day, 2008; Matthews and Brennan, 2008). Although insight into the dangers of ionizing radiation has grown, the fundamental principles of radiation safety lag behind (Keijzers and Britton, 2010; Kiah and Stueve, 2012). Radiation safety is important for professionals working in radiation environments, who are constantly exposed to the dangers of ionization radiation (Alotaibi and Saeed, 2006; Blevins, 1994; Goodman

and Amurao, 2012; Mathivha, 2002). Nurses are part of the team that often visits the radiology department and participates in bedside procedures during radiological examinations (Dianati et al., 2014). Despite being involved with patient care during these examinations, nursing staff do not know enough about radiation safety (Dianati et al., 2014; Paulinus et al., 2016).

In many cases, critically ill patients are unable to visit radiology suites, necessitating mobile X-ray radiography at the bedside (Blevins, 1994; Bushong, 2013). During mobile radiography, both nurses and radiographers participate in the immobilization, communication, and positioning of patients to acquire images of diagnostic value. Importantly, nurses know the condition and nature of illness of the patient, and their input is indispensable for acquiring quality images (Dianati et al., 2014; Paulinus et al., 2016).

In this study, researchers observed that nurses rarely adhered to radiation-protection measures, especially during mobile radiography. In the ward, nurses would withdraw assistance during the radiological examination and stand behind a curtain for protection. The World Health Organization recognizes ionizing radiation as a carcinogenic substance (Amis et al., 2007; Yurt et al., 2014). Nurses, who are integral to the medical team, will benefit from a basic understanding of radiation protection and radiation safety, ultimately enhancing diagnosis and improving patient care (Badawy et al., 2016). In this study, researchers investigated the level of knowledge among nurses working in Northern Gauteng hospitals to assess if radiation safety measures and education are needed in this setting.

This publication has no conflict of interest.

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Research design and methods

The researchers used a quantitative approach with a cross-sectional descriptive design (De Vos, 2011; Key, 1997; Luk et al., 2010). The researchers expressed the outcomes using frequencies and proportions (Mackenzie and Knipe, 2006).

Study setting

This study took place in Northern Gauteng hospitals in South Africa. These hospitals include Steve Biko Academic Hospital, Tshwane District Hospital, Pretoria West Hospital, Mamelodi Hospital, and Kalafong Hospital.

Sample and sampling

The target population consisted of 150 participants. Participants were selected from a convenience sample (Kothari, 2004; Welman et al., 2009). The researchers delivered questionnaires by hand to various nursing departments in the hospitals and waited to collect completed questionnaires. Nurses completed the questionnaires during tea and lunch breaks (Brink et al., 2018). The questionnaire comprised of three sections; section one had demographic details, section two had application of basic principles of radiation protection, and section three had training on radiation-safety questions.

Ethics clearance

The University of Pretoria ethics committee approved the study (no.: 262/2017), and permission was granted by the hospitals. The participants' anonymity was ensured by keeping names, age, and working location of respondents confidential (Burns and Grove, 2005). Before completing the questionnaire, participants had to sign an informed consent form. The data collected have been kept private and confidential.

Data analysis

Data were captured using Excel 2007 (developed by Microsoft Corporation and released on November 03, 2006) and analyzed

using the statistical software STATA 14 (developed by StataCorp and released on April 07, 2015). Frequency tables were generated and represented using graphs.

Findings

Out of 150 potential respondents, 123 returned the completed questionnaires.

Demographic information

Out of the 123 respondents, 94% were female nurses and 5% were male nurses. Almost half of the respondents (46%) had worked for 10 years and longer, and 11% had worked between 1 and 2 years after qualifying (Figure 1). Most of the respondents were between aged between 40 and 49 years (37%), and 15% were aged between 20 and 29 years (Figure 1). Half of the respondents held diplomas, and 26% held a certificate qualification (Figure 2). Few nurses held further qualifications including B.Tech (2%), Bachelor's (11%), Honors (4%), or Master's (2%) degrees (Figure 2).

Application of basic principles of radiation protection

This study found that 80% of the respondents could not identify radiopaque devices, 54% could not identify radiosensitive organs in the human body, and 81% do not know the radiation-safe distance. Almost half of the respondents do not use dosimeters in the radiology suite.

Perceived training need and training received on ionizing radiation

Most of the respondents (91%) did not receive any form of training on radiation safety, and 63% of the respondents were never taught radiation safety at college or university. Overall, 93% of the respondents felt that there was a need to be trained in radiation safety either via workshops or the curriculum.

Discussion

In this study, the researchers established the level of knowledge about radiation safety among nurses working at public hospitals in

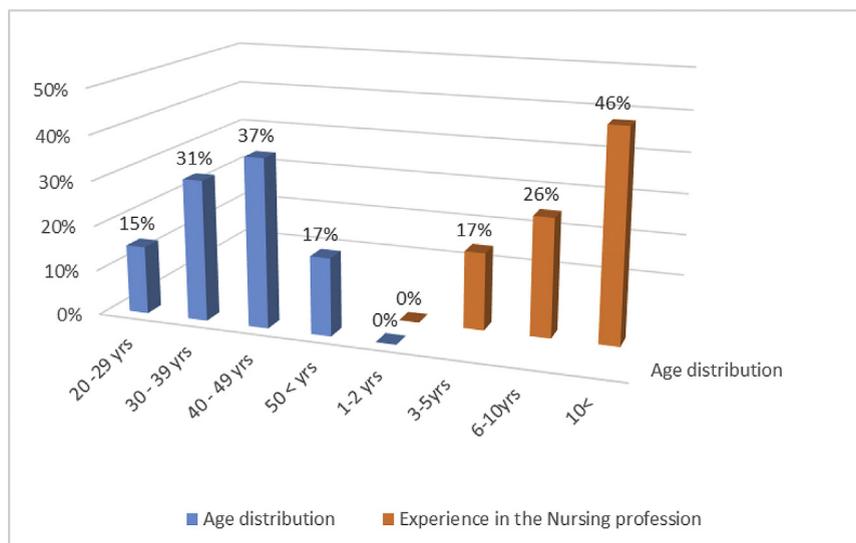


Figure 1. Demographic details including age and experience of nurses who filled out a questionnaire measuring knowledge of radiology safety in North Gauteng hospitals in South Africa.

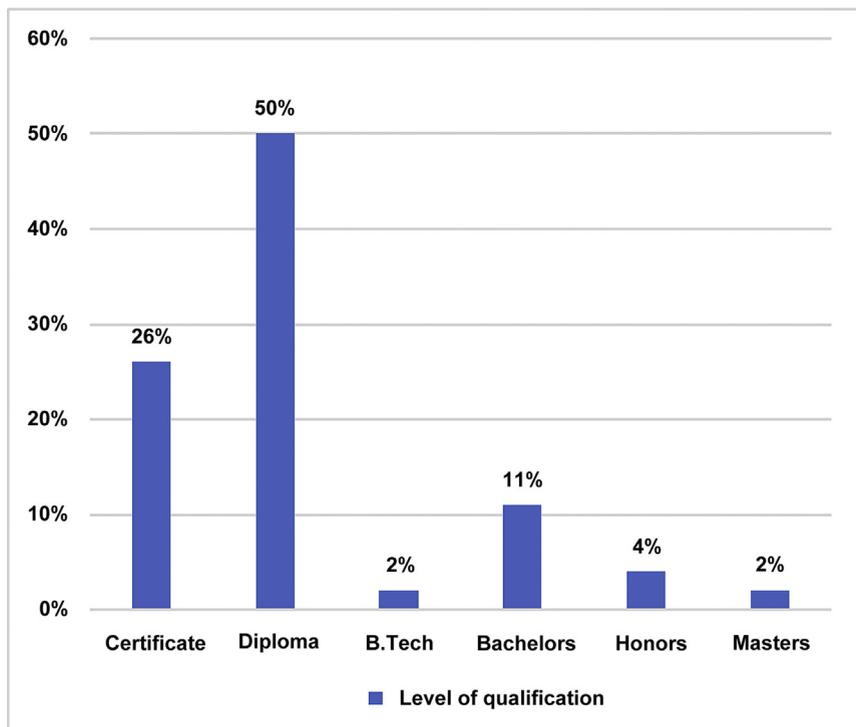


Figure 2. Level of qualification of nurses who filled out a questionnaire measuring knowledge of radiology safety in North Gauteng hospitals in South Africa.

North Gauteng. Most of participating nurses working in this setting did not have further degrees and had been working for more than 10 years. Most of these nurses did not know enough about the basic principles of radiation protection and had little training on radiation safety.

The large proportion of experienced and mature nurses working in public hospitals could possibly influence the level of knowledge of radiation safety. Almost half (46%) of the participants were experienced nurses, having worked for at least 10 years. Eleven percent of the participants had practiced for between one and 2 years. Similarly, most of the respondents were aged between 40 and 49 years, and few were aged between 20 and 29 years. Of the nurses who had worked in this setting for more than 10 years, 17%

were aged 50 years and older. According to our sample, newly qualified nurses do not seem to be working in the public sector. This is problematic for the shortage of nursing staff in the public sector, which will become more severe when older, more experienced nurses eventually retire (Thambura et al., 2014).

In this study, most (76%) nurses had not attained postdiploma qualifications, with half of the respondents holding diplomas and 26% attaining a certificate qualification. In South Africa, nurses are trained in public universities and private institutions (Affleck et al., 2013; Mulaudzi et al., 2014). The public health sector in South Africa is plagued by a shortage of recently qualified nurses, which is driven by migration from the public to the private sector and emigration to countries such as Canada, Australia, and the United Kingdom

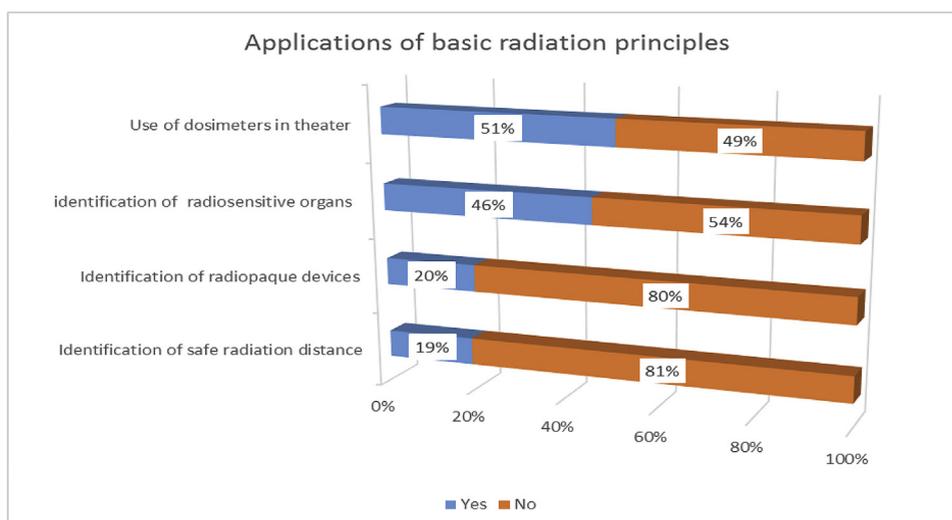


Figure 3. Nurses' (n = 123) application of the principles of radiation protection in North Gauteng hospitals in South Africa.

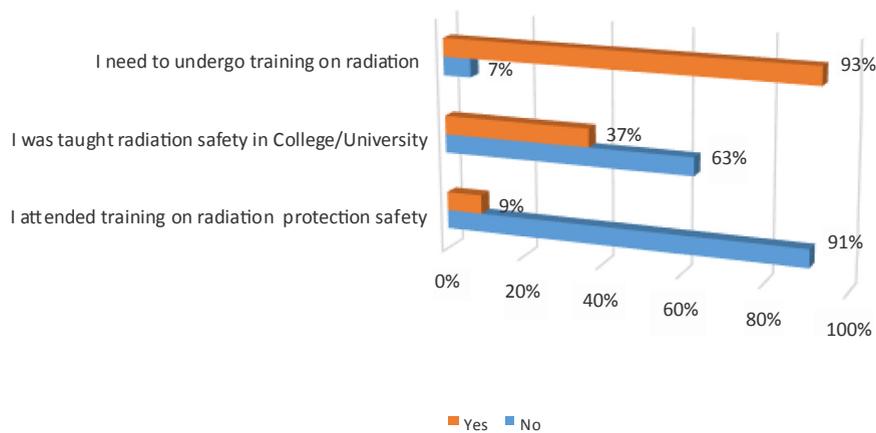


Figure 4. The level of training on radiation safety of nurses (n = 123) in North Gauteng hospitals in South Africa.

(Thambura et al., 2014; Rispel et al., 2014). South African nurses choose to leave public hospitals due to unattractive working conditions, underdeveloped career prospects, and better pay in western countries and the private sector (Thambura et al., 2014). Currently, the South African government does not seem to have strategies in place for training nurses to promote career progression or enhance retention in hospitals in the public sector, which has limited funding opportunities and unattractive pay (Mokoka et al., 2011; Thambura et al., 2014).

In this study, the older age of the nursing population and basic level of education may be linked to the observed lack of knowledge about radiation safety and lack of up-to-date training. Most of the respondents (80%) could not identify radiopaque devices, 54% could not identify radiosensitive organs in the human body, and 81% do not know the radiation-safe distance (Figure 3). Similarly, nursing staff in Jeddah did not know enough about radiation safety and hazards (Alzubaidi et al., 2017). In Iran, most intensive care nurses would leave the ward during mobile radiological examinations, whereas a small proportion of nurses remained at the work station during radiological examination (Dianati et al., 2014). In this study, almost half of the respondents (49%) did not use dosimeters in the theater. In South Africa, the directorate for radiation control adopted the 2007 recommendations of the International Commission on Radiological Protection. Despite these recommendations, staff working with radiation do not receive dosimeters (Troisi and Ferreira, 2016). Dosimeters are radiation-monitoring devices that measure the amount of radiation reaching the body (Bontrager and Lampignano, 2010). In Brazil, staff who were provided with dosimeters did not use them correctly (Flór and Gelbcke, 2013). Training for nursing staff is thus needed to explain that dosimeters are worn at collar region outside the lead apron during fluoroscopic procedures and at the front by the waist during nonfluoroscopic procedures (Bontrager and Lampignano, 2010; Dance et al., 2014).

Nurses not knowing about radiation safety are not unique to public hospitals in South Africa. In Japan, nurses spent less time in radiology departments and never knew what to do during radiological examination (Ohno and Kaori, 2011). In South Africa, 63% of nurses were never taught radiation safety in college or university, and 91% had no form of training on radiation safety (Figure 4; this study). Subsequently, most nurses (93%) felt that there was a need to undergo training on radiation safety either in the form of workshops or at universities. This training requires a well-structured curriculum for nursing on radiation (Ohno and Kaori, 2011). Nurses' limited knowledge on ionizing radiation can also be attributed to the lack of continuous professional education at

hospitals (Dianati et al., 2014). In South Africa, nurses experience a gap in training due to lack of curriculum standardization and not enough practical exposure (Mulaudzi et al., 2014).

Conclusions and recommendations

In South Africa, the lack of knowledge among nurses can be attributed to the lack of adequate training in basic principles of ionizing radiation. This training should form a part of the nursing curriculum or, in the case of the public sector in South Africa, through in-service training for experienced and older nurses. Radiation safety and hazards should be introduced as basic knowledge in an interdisciplinary curriculum. Radiation-monitoring devices should be provided to personnel who are occupationally exposed to ionizing radiation for regular monitoring.

- In-service training is recommended as an urgent interim measure. Nursing staff should receive continuous professional education because they are routinely involved with nuclear medicine, oncology, and fluoroscopic procedures where radiation doses are high.
- Radiation safety and hazards should be introduced in the nursing curriculum because nurses are exposed to radiation in their daily routine. Health-care workers should be taught general safety precautions before entering clinical practice.
- Hospitals and training institutions should adopt an interdisciplinary approach to learning.
- In South Africa, the government should revise existing career-progression opportunities for nurses to enhance skills and attract and retain recently qualified nurses in public hospitals.

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