

**STUDY OF LONE WORKING MAGNETIC RESONANCE TECHNOLOGISTS IN WESTERN AUSTRALIA**

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**Running title**

Lone Working Magnetic Resonance Technologists

**Key words**

Australia, Lone working, Magnetic resonance imaging safety, Magnetic resonance technologist, Occupational health

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## **Abstract**

### *Objectives*

It is recommended that magnetic resonance (MR) technologists should not work alone due to potential occupational health risks although lone working is legally acceptable. The objective of this study was to investigate the current situation of lone working of MR technologists in Western Australia (WA) and any issue against the regulations.

### *Materials and Methods*

A questionnaire regarding the issues of occupational health of lone MR technologists was developed based on relevant literature and distributed to WA MR technologists. Descriptive (percentage of frequency, mean and standard deviation) and inferential statistics (Fisher's exact, chi-square and t tests, and analysis of variance) were used to analyse the responses of the yes/no, multiple choice and 5 point scale questions from the returned questionnaires.

### *Results*

The questionnaire response rate was 65.6% (59/90). It was found that about half of the MR technologists (45.8%, 27/59) experienced lone working. The private magnetic resonance imaging (MRI) centres were more likely to arrange technologists to work alone ( $p < 0.05$ ). The respondents expressed positive views on issues of adequacy of training and arrangement, confidence and comfort towards lone working except immediate assistance for emergency (mean: 3). Factors of existence of MRI safety officer ( $p < 0.05$ ) and nature of lone working ( $p < 0.001-0.05$ ) affected MR technologists' concerns.

### *Conclusions*

Lone working of MR technologists is common in WA especially private centres. The training and arrangement provided seem to be adequate for meeting the legal requirements. However, several areas should be improved by the workplaces including enhancement on immediate assistance for emergency and concern relief.

## Introduction

Working alone is an occupational health concern. The risk of injury would be increased as a lone worker may be unable to get immediate support when any emergency happens [1]. Although the regulations governing lone working vary across different countries, it is generally acceptable if risk assessment and establishment of safe working environment (including provision of adequate training) are completed by an employer before assigning an employee to work alone [1,2].

In some high-risk working environments such as magnetic resonance imaging (MRI) departments, recommendations have been provided by their corresponding professional bodies such as American College of Radiology (ACR) [3] and The Royal Australian and New Zealand College of Radiologists (RANZCR) [4] for few years to discourage magnetic resonance (MR) technologists working alone because of the high potential risks. MRI was recognised as one of the top 10 health device technology hazards by the ECRI Institute (previous collaborating centre of World Health Organisation) in 2010 [5].

Some potential occupational health risks related to lone working MR technologists include fatigue, projectile, quench, patients' aggressive behaviours and anxiety [6]. Fatigue is a potential risk since MR technologists are required to operate MRI machines [1]. Improper operations would lead to serious consequences to personnel in the vicinity including the lone MR technologists [3]. There was a case that a MR technologist did not check hair pin removal for a patient before letting her to enter a MRI scanning room. One of her pins became a projectile under the influence of the strong magnetic field of the scanner and penetrated through the patient's body into her stomach which could also happen to the MR technologist [7]. Liquid helium used for maintaining the electromagnet of the MRI machine becomes gaseous when a magnet quench (shutdown) occurs. Some of the helium gas will displace oxygen in the scanning room leading to asphyxiation to MR technologists if ventilation for the helium has any problem [3,6-9]. A small portion of patients may present aggressive behaviours to medical imaging technologists [6,10,11]. Patients' anxiety which can be triggered by, for example, high-level acoustic noise during MRI examinations [3,7,12] would fuel their aggression [11]. The lone MR technologists would also feel anxious when facing patients' aggression [10] which in turn may affect the technologists' mental healthiness [13]. Although these occupational health risks could happen to any MR

technologist, technologists' attention to safe operation procedures would be affected more easily with lone working leading to increased chance of risk happening [4]. The characteristic of working alone, i.e. inaccessible to immediate support would also increase the risk severity to lone technologists [1].

Before the introduction of the MR safety guidelines [3,4], MR technologists required to work alone was not uncommon [6,14]. It is important to investigate the current situation of lone working of MR technologists in Western Australia (WA) and any issues that may go against the general regulations such as training and arrangement for safety of lone working MR technologists [1,2].

### **Materials and Methods**

A total of 17 public and private MRI departments in WA metropolitan and rural areas were asked to take part in this study in June 2012. These included all (14) public and private centres providing MR examinations fully subsidised by the government authority, Medicare Australia and 3 partial Medicare eligible departments run by the private groups who also provided fully subsidised MR scanning in other centres. This arrangement covered a range of departments from large public hospitals to small private radiological clinics [15]. Within these centres only MR technologists who had at least 3 months of experience were invited to participate. A questionnaire regarding the issues of occupational health of lone MR technologists was distributed to each participant in person and collected through the same channel two weeks later. Their participation was voluntary and they could withdraw at any stage. This study was approved by the institutional ethics committee.

Yes/no, multiple choice (MC) and 5 point scale questions were developed for the questionnaire to obtain participants' demographic and departmental information, situations of lone working and perceptions on issues of occupational health in relation to this area. The contents of the questions were based on literature regarding lone working and MRI safety [1,3,4,6,10,14]. The questionnaire was piloted prior to distribution.

Descriptive and inferential statistics were applied to analyse the questionnaire data. The frequency was obtained for each choice in the yes/no and MC questions. Cross tabulations were used to determine any relationship between categorical variables. A Fisher's exact (for 2 × 2 contingency table) or chi-square test (for

larger table) was applied to determine the significance of any identified relationship. Means and standard deviations (SD) were calculated for interval data obtained from the 5 point scale questions. Responses were also divided into cohorts based on the demographic and departmental information (e.g. male and female) to calculate the individual means and SDs for each grouping. Mean values between cohorts were compared through either a t-test (for 2 groups) or one way analysis of variance (for 3 cohorts or more). GraphPad InStat 3 and Microsoft Excel 2007 were used in data analysis. A p-value less than 0.05 obtained from inferential statistics was considered statistically significant.

## Results

A total of 90 questionnaires were distributed to the identified WA MR technologists and 59 were returned yielding a response rate of 65.6%. Table 1 summarises the current situation of lone working in WA MRI departments. The majority of respondents (76.3%, 45/59) work in private MRI departments. Around one third of their workplaces (35.6%, 21/59) do not have MRI safety officers. Working as the only qualified MR technologist with other healthcare personnel in the vicinity is popular (83.1%, 49/59). More than half of them (55.1%, 27/49) also experience lone working in the departments. These situations commonly happen before and after normal working hours for at least half day per week. MR technologists from private sectors are more likely to be required to work alone and the relationship between type of workplace and experience of lone working is statistically significant (Table 2).

Table 3 shows the MR technologists' perceptions on issues of occupational health related to lone working. Positive views are noted in the areas of adequacy of training and arrangement, confidence and comfort towards working alone except the item of immediate assistance for emergency (mean: 3). However, they also expressed concerns in relation to safety of individuals and accident happening in the vicinity, and prefer to work with another qualified MR technologist (mean: 3.8). Statistically significant variables that influence MR technologists' perceptions on these issues are demonstrated in Table 4. MR technologists working in the private sector have less positive view on the adequacy of arrangement for lone working and consider immediate assistance for emergency being inadequate (question 1). Existence of MRI safety officers and other healthcare personnel in the workplaces affect their safety concern (question 2).

## Discussion

The findings presented in Table 1 show that lone working of WA MR technologists is common. Around half of the respondents (45.8%, 27/59) indicated they have this experience. Normally, they are required to work alone for at least half day per week. Although recommended by ACR [3] and RANZCR [4] that MR technologists should not work alone, it seems it would be difficult to change the situation because of shortage of MRI specialists [16,17]. However, according to Department of Education, Employment and Workplace Relations, Australia, neither MR nor medical imaging technologists are recognised as shortage occupations [18]. When considering MR technologists is a small community, the importance of this issue in relation to occupational medicine and environmental health might be overlooked. Nonetheless, its prevalence appears to be high as shown in this study. Most importantly, the consequence of lone working in MRI departments has been identified as catastrophic, for example, asphyxiation caused by cryogen in spite of rare likelihood [9,19]. A significant risk is associated in this working situation [19]. It is expected this study could increase the awareness of clinical community especially employers.

Table 2 demonstrates that there is a statistically significant relationship between the type of workplace and experience of lone working, and the tendency of MR technologists from the private sector required to work alone would be higher than those employed by the public hospitals. It appears lone working in WA MRI departments may be due to the type of workplace. The private MRI centres always have the financial incentive to arrange MR technologists to work alone. The pattern of lone working noted in this study (Table 1) is also similar to the situation reported by Bertermann and Martin [14]. In their study about workflow improvement for the private MRI centre in Germany, around half of their opening hours (52.2%, 6/11.5) only had one MR technologist to conduct MRI scanning and each MR technologist was required to work alone for 3-3.5 hours in a shift (i.e. around half day) either from 7am to 10am or from 3pm to 6:30pm [14].

The WA MR technologists indicated the lone working training and arrangement provided by their workplaces adequate, and are confident and comfortable to take up this responsibility (question 7, Table 1 and questions

1-5, Table 3). Apparently, the current situation does not go against the legal regulations governing lone working [1,2,10]. A closer look at findings from Table 3 and 4 reveals several potential issues need to be addressed. Statistically significant differences are noted between private and public MRI departments in the area of adequacy of arrangement for lone working including emergency guidelines and immediate assistance for emergency, and the mean values from the private sector are lower than those from the public hospitals (question 1, Table 4). The issue of immediate assistance for emergency is even considered as inadequate in the private MRI departments (mean: 2.8, question 1b, Table 4). Also, the respondents expressed concerns in relation to safety of individuals in the vicinity and accident when working alone (mean: 4, question 6, Table 3). These concerns may become a source of anxiety and affect the employees' mental healthiness [13]. Although the findings are only their perceptions and may not totally reflect the real situations, the employers should have the responsibility to improve these issues [1,2,10].

Two potential ways to address the MR technologists' concerns about lone working could be identified from question 2, Table 4. Their concerns would become lower when departments have MRI safety officers or they can work with other healthcare professionals. Nonetheless, the position of MRI safety officer is normally not required in a general MRI department [4]. This also explains only around two third of respondents' workplaces having MRI safety officers (question 6, Table 1). Although working as the only qualified MR technologist with other healthcare personnel such as nurse and assistant should not be considered as working alone, in the situation of workers required to carry out their duties without close or direct supervision is also classified as lone working in the healthcare discipline [10]. When having other healthcare personnel to work with the only qualified MR technologist, this could provide immediate assistance to the lone technologist in case of emergency addressing the issue noted in question 1, Table 4 as well. Although these two arrangements would increase the running cost of the MRI services and might not be feasible in the private sector, their effects are statistically significant (question 2, Table 4). A more financially viable approach could be to just provide a MRI assistant to each MR technologist required working alone [20].



This study only investigated the current situation of lone working in WA MRI departments based on the inputs from MR technologists through a self-report questionnaire. A further study should be conducted to obtain views from other related healthcare professionals such as radiologists and clinicians on this issue. A field study would be useful to provide more objective assessment on the situation verifying the findings from the current study. Also, the study could be extended to other Australian states and countries. Evaluation on the effectiveness of MRI assistants in addressing the concerns of lone MR technologists could be another direction for future study.

In conclusion, about 1 in 2 WA MR technologists have experienced lone working. Technologists from the private sector are more likely to be required to work alone. The training and arrangement provided by their employers seem to be adequate generally and hence able to meet the legal requirements. However, several areas should be improved by the workplaces (especially the private sector). These include enhancement on immediate assistance for emergency and concern relief.

### **Acknowledgments**

The authors would like to thank all WA MR technologists who participated in this study for their contributions of time and effort.

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**Table 1.** Current situation of lone working of WA MR technologists

Question		Frequency (%)
<b>Demographic and department information</b>		
1. Gender (n=59)	Male	25 (42.4%)
	Female	34 (57.6%)
2. Type of workplace (n=59)	Private	45 (76.3%)
	Public	14 (23.7%)
3. Position (n=59)	Full-time	35 (59.3%)
	Part-time	24 (40.7%)
4. MRI experience (n=59)	< 1 year	5 (8.5%)
	1-3 years	16 (27.1%)
	4-10 years	20 (33.9%)
	> 10 years	18 (30.5%)
5. MRI qualification (n=57) <sup>a</sup>	Unqualified	10 (17.5%)
	Level one accreditation	34 (59.6%)
	Level two accreditation	13 (22.8%)
6. Existence of MRI safety officer in the department (n=59)	Yes	38 (64.4%)
	No	21 (35.6%)
7. Incident reporting system in place in the department (n=59)	Yes	58 (98.3%)
	No	1 (1.7%)
<b>Situations of working alone and as the only qualified MR technologist<sup>b</sup></b>		
8. Experience of working as the only qualified MR technologist (n=59)	Yes	49 (83.1%)
	No	10 (16.9%)
9. Length of working as the only qualified MR technologist per week (n=49)	Less than an hour	2 (4.1%)
	Half day	15 (30.6%)
	One day	20 (40.8%)
	More than a day	12 (24.5%)
10. Time of day working as the only qualified MR technologist (n=49)	Before normal working hour	31 (63.3%)
	Morning	17 (34.7%)
	Lunch time	21 (42.9%)
	Afternoon	15 (30.6%)
	After normal working hour	40 (81.6%)
11. Experience of lone working (n=49)	Yes	27 (55.1%)
	No	22 (44.9%)
12. Length of lone working per week (n=26) <sup>a</sup>	Less than an hour	6 (23.1%)
	Half day	14 (53.8%)
	One day	2 (7.7%)
	More than a day	4 (15.4%)
13. Time of day working alone (n=27)	Before normal working hour	15 (55.6%)
	Morning	8 (29.6%)
	Lunch time	6 (22.2%)
	Afternoon	8 (29.6%)
	After normal working hour	13 (48.1%)

Questions 9-11 are only required for respondents answered 'Yes' in question 8 and questions 12 & 13 are only applicable to those chosen 'Yes' in question 11.

<sup>a</sup>Missing response due to voluntary participation nature of the questionnaire.

<sup>b</sup>Working alone - No other person in the entire MRI imaging area; Working as the only qualified MR technologist - Including the presence of other healthcare personnel such as nurse and assistant in the vicinity.

**Table 2. Relationship between the type of workplace and experience of lone working**

		Type of workplace		Total
		Private sector	Public hospital	
Experience of lone working	Yes	24 (20.9)	3 (6.1)	27
	No	14 (17.1)	8 (4.9)	22
Total		38	11	49

Fisher's exact test,  $p < 0.05$ ; expected frequencies are put in brackets.

**Table 3.** MR technologists' perceptions on issues of occupational health in relation to lone working

Questions <sup>a</sup>		Frequency (%)	Mean (SD) <sup>b</sup>
1. Perceived adequacy of lone working training received in relation to: (n=57) <sup>c</sup>	a. First aid	Yes	50 (87.7%)
		No	7 (14%)
	b. Emergency management	Yes	48 (84.2%)
		No	9 (15.8%)
	c. Patient handling	Yes	50 (87.7%)
	No	7 (12.3%)	
2. Perceived adequacy of arrangement for lone working in relation to: <sup>c</sup>	a. First aid (n=56)	-	3.3 (1.1)
	b. Emergency guidelines (n=56)	-	3.5 (1.1)
	c. Immediate assistance for emergency (n=57)	-	3 (1.1)
3. Ease of reporting incident related to lone working (n=58) <sup>c</sup>		-	3.9 (0.9)
4. Perceived confidence in lone working (n=54) <sup>c</sup>			3.8 (0.9)
5. Comfortable with lone working (n=55) <sup>c</sup>		-	3.6 (0.9)
6. Concern about lone working in relation to: (n=55) <sup>c</sup>	a. Patient safety	-	4 (1.1)
	b. Safety of personnel in the vicinity	-	4 (1.1)
	c. Accident	-	4 (1.1)
7. Preferable to work with another qualified MR technologist (n=58)		-	3.8 (1.2)
8. Concern about working as the only qualified MR technologist in relation to: <sup>d</sup>	a. Patient safety (n=55)	-	3.2 (1.3)
	b. Safety of personnel in the vicinity (n=56)	-	3.1 (1.3)
	c. Accident (n= 56)	-	3.4 (1.3)

<sup>a</sup>At least one missing response is noted in each question due to voluntary participation nature of the questionnaire.

<sup>b</sup>Scale of 1 to 5; from strongly disagree to strongly agree.

<sup>c</sup>Lone working - No other person in the entire MRI imaging area.

<sup>d</sup>Working as the only qualified MR technologist - Including the presence of other healthcare personnel such as nurse and assistant in the vicinity.

**Table 4.** Comparison of MR technologists' perceptions on issues of occupational health of lone working

Question		Mean (SD) <sup>a</sup>		p-value
1. Adequacy of arrangement for lone working in relation to:	a. Emergency guidelines	Private sector (n=43) 3.3 (1)	Public hospital (n=13) 4 (1.1)	<0.05
	b. Immediate assistance for emergency	Private sector (n=43) 2.8 (1)	Public hospital (n=14) 3.5 (1.5)	
2. Concern in relation to:	a. Patient safety	With MRI safety officer (n=37) 3.8 (1.2)	Without MRI safety officer (n=18) 4.5 (0.7)	<0.05
		Lone working (n=55) <sup>b</sup> 4 (1.1)	Working as only qualified MR technologist (n=56) <sup>c</sup> 3.2 (1.3)	<0.0005
	b. Safety of personnel in the vicinity	Lone working (n=55) <sup>b</sup> 4 (1.1)	Working as only qualified MR technologist (n=56) <sup>c</sup> 3.1 (1.3)	<0.0001
		c. Accident	Lone working (n=55) <sup>b</sup> 4 (1.1)	

<sup>a</sup>Scale of 1 to 5; from strongly disagree to strongly agree.

<sup>b</sup>Lone working - No other person in the entire MRI imaging area.

<sup>c</sup>Working as the only qualified MR technologist - Including the presence of other healthcare personnel such as nurse and assistant in the vicinity.