HEALTH AND SAFETY OF RADIOPHAGHERS AND RADIOLOGICAL TECHNOLOGISTS WITH SPECIAL FOCUS ON MUSCULOSKELETAL DISORDERS AND BURN-OUT SYNDROME

A project report for the World Health Organization and the International Society of Radiographers and Radiologic Technologists

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Health and safety of Radiographers and Radiological Technologists with special focus on Musculoskeletal (MSK) disorders and Burn-out syndrome.

Preface

This research has been conducted on behalf of the International Society of Radiographers and Radiologic Technologists for the World Health Organisation. It comprises elements of work undertaken as part of a higher degree in research by the author.

This research and subsequent report has been undertaken to highlight the challenges experienced by medical radiation science professionals internationally.

Executive Report

There is a paucity of literature examining the effects of musculoskeletal disorders and burnout in medical radiation science practitioners globally. This study aims to identify whether there is a relationship between burnout and musculoskeletal injuries experienced by practicing medical radiation practitioners internationally, and the impact of this relationship on clinical practice.

This project was completed in collaboration with The International Society of Radiographers and Radiological Technologists, an international professional body (ISRRT), and the World Health Organisation (WHO).

An ethically approved quantitative online survey was conducted during 2021. The survey was distributed to all 84 ISRRT society/member countries.

739 individuals accessed the survey, with a total of 133 completing the survey instrument completely. Individuals from at least 17 different countries responded, reflecting the medical radiation science profession in four of the six ISRRT regions. The results suggest that medical radiation practitioners internationally experience feelings of discomfort specifically in the neck, upper and lower back, and expressed medium to high levels of exhaustion and disengagement which are the hallmarks of burnout.

Introduction/Background

Universally, healthcare workers provide services to care for the health of patients and populations. Healthcare workers are highly trained in their individual specialities and strive to deliver the best care possible to their patients. However, there are many factors affecting the healthcare worker in
the delivery of the best outcome for the patient. Healthcare provision comes at an economic cost to the healthcare system which is already under much stress.\textsuperscript{2} Resources available to healthcare practitioners are shrinking and job demands compounded by high workloads are contributing to high levels of stress in the workplace.\textsuperscript{3} These emotionally demanding working conditions can affect physical and psychological health.\textsuperscript{4}

The World Health Organisation is acutely aware of the necessity for good occupational health measures to be instituted for health care workers.\textsuperscript{1} The outbreak of the COVID 19 pandemic globally in 2020, highlights the types of occupational hazards experienced by healthcare workers daily in busy, stressful clinical environments. These hazards range from exposure to infection, fatigue, occupational burnout and physical and psychological exhaustion.\textsuperscript{1,5,6}

Healthcare workers include doctors, nurses, and allied health professionals. Allied Health professionals are university qualified practitioners that have specialised expertise in preventing, diagnosing and treating a range of conditions and illnesses.\textsuperscript{7} Amongst the allied health professionals are medical radiation science practitioners. This profession includes radiographers, radiation therapists, and nuclear medicine technologists. Radiographers are responsible for producing high quality medical images that assist medical specialists and practitioners to describe, diagnose, monitor and treat a patient’s injury or illness.\textsuperscript{8} Nuclear medicine technologists use small, targeted doses of radiation to create images using different scanning methods to highlight organs and tissues of the human body to trace disease and abnormalities.\textsuperscript{9} Radiation Therapists are responsible for the design, accurate calculation and delivery of a prescribed radiation dose over a course of treatment to the oncology patient.\textsuperscript{8}

For these professionals, the major occupational hazard is the close proximity to a patients’ face and body, creating a high risk for transmission of infectious diseases such as COVID 19.\textsuperscript{10,11} Compounding this are the occupational hazards of long working hours, shift work, low salary, lack of motivation, lack of training and development, lack of protective devices and minimal well-being activities.\textsuperscript{3}

To date few studies have been undertaken globally looking at the physical and psychological challenges for the medical radiation science professional, resulting from their occupational environment.

This project focuses on the physical and psychological challenges facing the medical radiation science professional in the workplace on a global scale.

It investigates the prevalence and predictors of burnout and the extent and severity of musculoskeletal discomfort experienced and seeks recommendations on interventions that can be
implemented, in collaboration with management to foster occupational health and safety of the medical radiation science professional. This will result in better quality care for the patient community.

This project was executed in partnership with, and to inform, the International Society of Radiographers and Radiological Technologists (ISRRT) and the World Health Organisation (WHO). The ISRRT is “the only organization representing all disciplines of Medical Radiation Technologists internationally”.\(^{12}\) The role of this not-for-profit organisation is to improve both the standards of delivery and practice of medical imaging, nuclear medicine, and radiation therapy worldwide.

**Literature Review:**

**Occupational Hazards**

It is acknowledged that productive and engaging work is the key to developing resilience, providing invaluable social connections, as well as fostering emotional support and self-satisfaction in workers.\(^ {13,14}\) When work is disrupted through injury or illness (mental or physical), workers are unable to readily access resources to assist them maintain their psychological well-being. Workplaces have a responsibility to ensure that their workers are able to be rehabilitated and returned to work safely.\(^ {13,14,15,16}\)

Work can be disrupted as a result of occupational hazards in two key areas. The first is related to physical hazards, and the second is psychological hazards. Physical hazards are those that involve a heavy physical workload, such as lifting and moving of heavy items and repetitive manual tasks.\(^ {1}\) Injuries and musculo-skeletal disorders can occur as a result of repetition over time, or it may occur suddenly.\(^ {16}\) Psychological hazards are those that are related to organisational factors or the context of the work environment. These can include factors such as job demands,\(^ {17}\) working hours, high workloads, poor job design, low levels of job control, high pace of work, conflicting work demands, communications with management, being valued, health and safety culture, and relationships with colleagues and supervisors.\(^ {1,18}\) These factors collectively can add to occupational stress. Medical radiation science professionals work in health, which is a field, engaging with science, technology and humanity. Irrespective of whether the medical radiation science professional works in a public or private organisation, the nature of their job demands requires considerable physical and mental effort to undertake daily tasks.\(^ {17}\) The premise of the Job Demands-Resources (JD-R) model is when job demands are high and job resources/positives are low, stress and burnout increase. However, the effects of high job demands can be mitigated by job positives such as organisational support and resources, leading to better performance and staff engagement.\(^ {19}\)
**Stress**

There is enough evidence to suggest that prolonged exposure to job stress is associated with several types of chronic conditions, including cardiovascular diseases, musculoskeletal deterioration and psychological disorders.$^1,20$ Increasing job stress increases the risk of back and upper-extremity musculoskeletal disorders.$^{21}$

Stress can lead to burnout and when left unchecked, can contribute to a multitude of health conditions. Medical radiation science professionals are exposed to much occupational stress on a daily basis. This report focusses on MSK disorders and Burnout in medical radiation science professionals.

**Psychosocial hazards**

Psychosocial hazards that increase the risk of work-related stress can be the result of poor design or management of work. These hazards can contribute to a stress response when experienced continuously and over a prolonged timeframe.$^{22}$ Examples of common hazards are listed in table 1.

**Table 1 – Common Psychosocial hazards**$^{22}$

<table>
<thead>
<tr>
<th>Psychosocial Hazards</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High/Low job demands</td>
<td>Poor workplace relationships</td>
</tr>
<tr>
<td>Low job control</td>
<td>Low role clarity</td>
</tr>
<tr>
<td>Poor support</td>
<td>Poor organisational change management</td>
</tr>
<tr>
<td>Poor organisational justice</td>
<td>Low recognition and reward</td>
</tr>
<tr>
<td>Remote work</td>
<td>Violent or traumatic events</td>
</tr>
</tbody>
</table>

These psychosocial hazards can lead to work-related physical and psychological injuries (mental illness).

**Physical Hazards - MSK**

Musculoskeletal conditions affect muscles, tendons, ligaments, joints, peripheral nerves and supporting blood vessels.$^{23}$ This presents as persistent pain, and consequently reduces the function of the anatomical structure,$^{21}$ in turn reducing a person’s ability to work and carries a significant cost to both the clinician and the workplace.$^{22}$ Example costs include absenteeism, lost productivity, medical expenses and reduced quality of life.$^{25}$ Exposure to occupational hazards and risk factors daily contributes to these injuries.$^{23}$ Information on European workers demonstrates that a third to a quarter report MSK pain, with certain occupations demonstrating a higher level due to the nature of physical risk factors encountered.$^{24,25}$ Although modern equipment has been provided to reduce
hazards in the workplace, medical radiation science professionals still undertake a large amount of manual handling in their jobs. Literature investigating MSK discomfort specifically in radiographers demonstrates a range of MSK problems. These include multiple episodes of backache, neck and shoulder pain and upper extremity pain.26,27,28

The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) designed by the Human Factors and Ergonomics Laboratory at Cornell University29 is a data tool used to elicit information regarding frequency, severity and work interference of musculoskeletal discomfort (MSD) across 20 body parts.30 This tool was originally used to evaluate office workers31,32 and has also been used in the assessment of MSK in nursing personnel,33 radiologists34 and healthcare personnel.35 The CMDQ is a tool that has been utilised for assessing work performance outcomes, and the extent of MSK issues in the working population.

1.2. Aims and Research Questions

Objectives:
The objectives of this project are to:
1. Identify the leading causes of health care workers’ health and safety issues (in addition to radiation protection issues) in particular musculoskeletal issues, psychological burden for facing terminally ill patients, and violence at work.
2. Investigate whether the “burn-out” among radiation health staff has affected imaging and therapy practices.

2.1. Methodology

This study utilised a quantitative approach to obtain an understanding of the different factors that may be contributing and affecting well-being and health and safety of the medical radiation science professional. This review will also investigate what practices can counteract and manage these stressors to facilitate and contribute to the development of a strong, healthy (mental and physical) work force.

2.2. Participants

The participants consisted of male and female medical radiation science professionals of different years of qualification and experience, employed in private and public hospitals / clinics/ organisations in the various continents of Africa, Europe, Asia, North America, South America and Oceania (Australia & New Zealand).
2.3 Ethical Considerations
This project was submitted for ethical approval by the RMIT University Human Research Ethics Committee (Project ID: BCHEAN 22395) as per NHMRC guidelines for research involving human subjects. Participation in the study was voluntary, non-compensated and without obligation. Negligible risk beyond participant inconvenience was anticipated. Consent was implied upon questionnaire return.

2.4 Data Collection and Recording Procedures
An online survey was conducted with the Qualtrics Insight Platform software package. Participants were invited via email by the CEO of the ISRRT, with no disclosure of identifying details to the researchers. Responses were recorded in aggregate form, and all individual replies were de-identified. All surveys, complete and incomplete, were analysed. The survey was made available from 24 May 2021 and closed for further participation on 31 July 2021. The survey took 10-15 minutes for participants to complete and was conducted in English.

Once data collection was initiated, only research team members had access to the digital data. Digital components were computer-password protected. Digital data will be destroyed after five years.

2.5 Instrumentation
Quantitative surveys containing questions seeking socio demographic data, the Oldenburg Burnout Inventory and the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) were distributed. These validated tools can be found in Appendix 1.

The Oldenburg Burnout inventory (OLBI) was initially developed as a measure of burnout, containing statements that cover both ends of the exhaustion-vigour and cynicism-dedication continua. The inventory has been extensively used in research to measure job and academic burnout. The 16-item questionnaire addressed exhaustion and disengagement items on a 5-point Likert-scale. The survey respondents were asked to indicate a response ranging through Strongly agree, Agree, No Opinion, Disagree and Strongly Disagree. Questions were scored into disengagement and exhaustion categories consisting of both positively and negatively framed questions. Prior to calculation of the final score, negatively framed questions had their scoring reversed. The sub totals
from the two categories were totalled for an OLBI final score. The higher the total final OLBI score, the greater the level of burnout.

The CMDQ seeks information from the participant through self-evaluation in all musculoskeletal areas including the neck, shoulder, upper back, upper arm, low back, forearm, wrist, hips/buttock, thighs, knee, lower leg, and foot. Information was sought on whether the participant experienced aching pain, or discomfort, how often it was experienced, if it was experienced (never, 1-2 times last week, 3-4 times last week, once daily or several times daily), what the level of discomfort was (slightly, moderately or very uncomfortable), and if it affected the ability to work (not at all, slightly or substantially interfered). The total discomfort score was calculated by using the following formula: frequency × discomfort × interference = discomfort score.29

The purpose of this survey was to analyse subjective self-evaluation of burnout and musculo-skeletal discomfort in medical radiation practitioners internationally.

The survey also included a series of questions containing socio-demographic questions, which included questions related to workplace characteristics, and occupational qualifications.

3.1 Results

739 respondents consented to participate in the study, of which a total of 406 completed the survey. Only 133 respondents completed the full Oldenburg Burnout inventory and Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) in its entirety including demographic data. 222 participants did not complete (69), or partially completed (153), the CMDQ, whilst 51 completed the CMDQ and did not complete the demographic section of their survey responses.

Therefore, this analysis is based on the 133 medical radiation practitioners who completed the entire survey instrument. It is unknown how many prospects were sent this survey, as this information was not able to be provided by the individual member societies which sent the survey to their respective memberships. Of the respondents who did engage with the survey, there was a completion rate of 33%.

3.1.1 OLBI Analysis

The OLBI measures components of exhaustion and disengagement. For the purposes of this analysis, the scores have been broken into the categories of low (<17), medium (17 – 21) and high (Exhaustion >21/ Disengagement >22).
Table 2 – Burnout component scores

<table>
<thead>
<tr>
<th>Burnout Component</th>
<th>Level</th>
<th>Range scores</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaustion</td>
<td>Low</td>
<td>&lt;17</td>
<td>12</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>17 - 21</td>
<td>69</td>
<td>51.9</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>&gt;21</td>
<td>52</td>
<td>39.1</td>
</tr>
<tr>
<td>Disengagement</td>
<td>Low</td>
<td>&lt;17</td>
<td>28</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>17 - 22</td>
<td>88</td>
<td>66.2</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>&gt;22</td>
<td>17</td>
<td>12.8</td>
</tr>
</tbody>
</table>

From these results in Table 2, of the 133 respondents, 51.9% experienced moderate levels of exhaustion and 66.2% experienced moderate levels of disengagement.

Total Calculated OLBI Burnout scores can be found in Figure 1. This survey instrument is also a self-evaluation from the respondents regarding their level of burnout that they are experiencing. Responses highlight that there is a moderate severity of burnout being experienced by this cohort of participants. Higher total final OLBI scores represented a greater level of burnout.

3.1.2 CMDQ Analysis

During the time that this survey was conducted, 98.5% of participants experienced aches, pain and discomfort in all body regions (Table 3) with 62.4% experiencing pain in the neck 1-2 times week or more with 33% reporting slight discomfort with 21.8% stating that it interfered with their work slightly. The two other areas which participants reported as affecting their work was the upper back (51.1%) and lower back (68.4%) with both generating slight discomfort (30.8%) with slight interference to their work; upper back (15.7%) and lower back (19.5%). Continuing in the upper torso, discomfort is experienced in the right (44.4%) and left (36.8%) shoulders however this only causes slight discomfort and interference with work. The body regions with the least discomfort are the left and right lower legs (11.3%) and the right foot (11.3%).
When calculating the total discomfort score, the greatest areas of concern were in the neck and the lower back.
Figure 1: Total Calculated OLBI Burnout scores
Table 3 – Participant’s self-reported levels of discomfort

<table>
<thead>
<tr>
<th>Body Parts</th>
<th>Never</th>
<th>1-2 times last week</th>
<th>3-4 times last week</th>
<th>Once every day</th>
<th>Several times every day</th>
<th>Slightly uncomfortable</th>
<th>Moderately uncomfortable</th>
<th>Very uncomfortable</th>
<th>Not at all</th>
<th>Slightly interfered</th>
<th>Substantially interfered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>50</td>
<td>38</td>
<td>14</td>
<td>16</td>
<td>15</td>
<td>44</td>
<td>29</td>
<td>10</td>
<td>52</td>
<td>29</td>
<td>8</td>
</tr>
<tr>
<td>Shoulder_R</td>
<td>74</td>
<td>34</td>
<td>3</td>
<td>10</td>
<td>12</td>
<td>31</td>
<td>20</td>
<td>8</td>
<td>36</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Shoulder_L</td>
<td>84</td>
<td>25</td>
<td>6</td>
<td>7</td>
<td>11</td>
<td>25</td>
<td>18</td>
<td>5</td>
<td>34</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>Upper Back</td>
<td>65</td>
<td>40</td>
<td>13</td>
<td>6</td>
<td>9</td>
<td>41</td>
<td>23</td>
<td>4</td>
<td>44</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>Wrist_R</td>
<td>103</td>
<td>16</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>23</td>
<td>7</td>
<td>1</td>
<td>27</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Wrist_L</td>
<td>110</td>
<td>14</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>19</td>
<td>5</td>
<td>1</td>
<td>26</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Lower Back</td>
<td>42</td>
<td>49</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>41</td>
<td>36</td>
<td>13</td>
<td>54</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td>Forearm_R</td>
<td>111</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>15</td>
<td>7</td>
<td>1</td>
<td>23</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Forearm_L</td>
<td>117</td>
<td>11</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>23</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Wrist_R</td>
<td>93</td>
<td>22</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>23</td>
<td>14</td>
<td>3</td>
<td>25</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Wrist_L</td>
<td>110</td>
<td>15</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>18</td>
<td>2</td>
<td>3</td>
<td>22</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Hip/Buttock</td>
<td>96</td>
<td>18</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td>23</td>
<td>13</td>
<td>1</td>
<td>27</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Thigh_R</td>
<td>113</td>
<td>12</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>19</td>
<td>1</td>
<td>0</td>
<td>23</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Thigh_L</td>
<td>114</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>17</td>
<td>2</td>
<td>0</td>
<td>20</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Knee_R</td>
<td>99</td>
<td>17</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>22</td>
<td>11</td>
<td>1</td>
<td>18</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Knee_L</td>
<td>101</td>
<td>22</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>22</td>
<td>7</td>
<td>1</td>
<td>22</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Lower Leg_R</td>
<td>118</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>14</td>
<td>2</td>
<td>1</td>
<td>18</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Lower Leg_L</td>
<td>118</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>13</td>
<td>3</td>
<td>1</td>
<td>20</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Foot_R</td>
<td>118</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>18</td>
<td>13</td>
<td>3</td>
<td>30</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Foot_L</td>
<td>101</td>
<td>20</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>18</td>
<td>11</td>
<td>3</td>
<td>30</td>
<td>10</td>
<td>1</td>
</tr>
</tbody>
</table>
3.2 Demographic Characteristics

Data provided by respondents demonstrates representation from practitioners working across 17 different countries. Participants represented four of the six global regions of the ISRRT and represented 71% female, 29% male, and 1% not declared, Figure 2. Most professionals undertaking this survey were radiographers (76.7%) Figure 3. Survey respondents represented the age bracket of 31 - 39 years (24%) Figure 4, have been working for 1-5 years (30.5%) Figure 5, and hold a bachelor’s degree (49.6%) Figure 6.

Figure 2 – Respondents by Gender
Figure 3 – Respondents in professional modalities

Figure 4 – Respondent Age brackets
Of the 133 medical radiation practitioners 46.6% undertake shift work (Figure 7), and 79.7% work normal shifts (Figure 8).
49.6% have 100% direct contact with patients daily, whilst 15.8% of medical radiation science professionals have less than 50% of patient interaction daily (Figure 9).
See Appendix 2 for additional information regarding the represented nations that contributed to the survey responses.

4.1 Discussion
This study is one of the first studies across four continents investigating the challenges faced physically and the impact on well-being of the medical radiation science professional in relation to job stress in the clinical environment. Of note, this study was undertaken 15 months after the world was first informed of the COVID19 virus.\(^5\)

Medical radiation science professionals are at the frontline of healthcare, dealing with not only a change in the work environment (change in occupational risk from potential viral exposure) but also a significant disruption to both psychosocial and physical hazards.\(^3^8\) Imaging examinations, nuclear medicine imaging and radiation therapy treatments continued during this time with the addition of personal protective equipment (PPE). The combination of manual handling of patients and materials with donning and doffing of PPE compounded the occupational risk.

Exhaustion, heightened anxiety, stress and burnout has been a common theme during this period of time.\(^3^9,4^0\) This has the potential to lead to staff turnover.\(^4^1,4^2,4^3\) Whilst the sample size in this study...
was relatively small, it does provide an insight into the outcomes of working clinically in the healthcare industry for even a short period of time. With 91% of respondents expressing moderate to high exhaustion and 79% expressing moderate to high disengagement, this is cause for some consideration. Data from respondents reporting neck and lower back discomfort in this study, have also been identified by Kumar et al. who highlighted a significant range of musculoskeletal problems in x-ray technologists.

RECOMMENDATIONS

It is recommended that medical radiation workplaces strongly consider the long-term effects of occupational hazards on their workforce and engage with their staff to reduce the risks of musculoskeletal injuries and staff burnout. Workplace safety is a dual responsibility for both employees and management. The suggestions below may be a starting point for conversation.

Clinicians

- Identification and reporting to management of physical hazards.
- Regular training and education in preventative measures including debriefing sessions when required.
- Recognising when well-being assistance is required.
- Implementation of a self-care routine which may include healthy eating habits, exercise, mindfulness, and meditation practice.

Management

- Consideration from management to identify and implement improvements in design or management of work to mitigate both psychosocial and physical hazards. The process of continuous monitoring and data collation to ensure the safety and well being of staff is paramount.
- Consultation with staff in relation to improving the ergonomics of the workplace with an action plan on how to reduce the potential for both initial musculoskeletal injury and subsequent aggravation of existing or past injuries.
- Any changes in work practices will need to be effectively communicated with staff.
- Resource provision for staff well-being incorporating strategies for coping with workload, stress and exhaustion.
Limitations

There are a number of limitations identified with this particular study. Both the CMDQ and the OLBI are self-reporting questionnaires so relied on the participants to accurately report. Individual participants may contribute a level of bias to the results. Results may return different response, if this survey was conducted at a different point in time or conducted multiple times. This was a quantitative study only and did not include a physical examination or any diagnostic procedures. CMDQ is only a screening tool, not a diagnostic tool.²⁹

From a logistical perspective, there was no data available on the number of people who received this survey in each of the countries. If future research is to be conducted, it is recommended that a more targeted approach to the individual professional associations be undertaken with specific encouragement to the North American medical radiation science professionals.

There is scope for extending this study, and potentially undertaking a comparative study of country to country using the same tools and process. To obtain further information, the Maslach Burnout Inventory validated tool, may be valuable in providing more in-depth information into emotional exhaustion, depersonalisation and reduced personal accomplishment.

The authors also recommend bringing in a qualitative element to the study to gain further understanding of the specific causes of the burnout and musculoskeletal disorders.

5.1 Conclusion

In conclusion, this study indicated that medical radiation science professional experienced feelings of discomfort specifically in the neck, upper and lower back, and expressed medium levels of exhaustion and disengagement which are the hallmarks of burnout. Further research is needed on the relationship between musculoskeletal discomfort, burnout, specific factors that are contributing to this, and its influence on the quality of patient care.

Acknowledgements

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Appendix 1: Survey Questions

Oldenburg Burnout Inventory

Using a Likert scale from 1 (Strongly Agree) - 4 (Strongly Disagree)

1. I always find new and interesting aspects in my work.
2. There are days when I feel tired before I arrive at work.
3. It happens more and more often that I talk about my work in a negative way.
4. After work, I tend to need more time than in the past in order to relax and feel better.
5. I can tolerate the pressure of my work very well.
6. Lately, I tend to think less at work and do my job almost mechanically.
7. I find my work to be a positive challenge.
8. During my work, I often feel emotionally drained.
9. Over time, one can become dis-connected from this type of work.
10. After working, I have enough energy for my leisure activities.
11. Sometimes I feel sickened by my work tasks.
12. After my work, I usually feel worn out and weary.
13. This is the only type of work that I can imagine myself doing.
14. Usually, I can manage the amount of my work well.
15. I feel more and more engaged in my work.
16. When I work, I usually feel energized.

Disengagement items are 1, 3(R), 6(R), 7, 9(R), 11(R), 13 and 15

Exhaustion items are 2(R), 4(R),5, 8(R),10, 12(R), 14 and 16

Questions marked with an (R) indicates questions that have reversed scoring.
Cornell Musculoskeletal Discomfort Questionnaire (We acknowledge the Human Factors and Ergonomics Laboratory at Cornell University as the source of this instrument)

## Appendix 2: Countries Represented

| ISRRT Region | Total Respondents | Number of Countries represented | Country represented (employment) | Professional Role
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<td>Nuclear Medicine</td>
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<td>Asia</td>
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<td>6</td>
<td>Taiwan, Philippines, Indonesia, Myanmar, UAE, Qatar</td>
<td>Sonographer / Mammographer, Academic</td>
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<td>Sonographer, Radiation Therapy</td>
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<td>Australia, New Zealand</td>
<td>Mammographer, Radiation Therapy</td>
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