A Survey of Radiography Educator Opinions about Patient Lead Shielding during Projection Radiography

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Aims and objectives

The background to the research is summarised in Fig. 1 on page 4

In projection radiography, lead rubber aprons and shielding (all termed lead shielding in this poster) are applied both within and outside the collimated field [1].

Opinions on the efficacy and necessity of such shielding vary in peer reviewed literature. During pelvic radiography, lead shielding has been reported to reduce radiation exposure of the female and male gonads when used within the primary beam [2,3,4], and also to provide patient reassurance [4]. However, several authors advise against shielding the ovaries during pelvis radiography because of the risk of retake due to inaccurate positioning, anatomical variance and the potential negative impact on automatic exposure control [1,2,5,6,7]. Shielding outside of the collimated beam is reported to convey dose savings to the breast and ovaries during chest and spine radiography, particularly in scoliosis imaging [8,9,10,11,12]. However, one empirical study suggests that the gonadal dose levels are so low anyway that lead shielding is not warranted [13].

The premise from which lead shielding of the gonads developed was that these organs carry greater risk of adverse effects from radiation exposure due to the potential for genetic effects. One way of considering relative risk of organs is to consider their relative radio-sensitivity. This concept is implicit in the tissue weighting factor (Wt): any factor greater than 0 indicates higher than average radio-sensitivity, and the weighting factors of all the body tissues add up to 1 [14]. However, in 2007, the International Commission on Radiological Protection (ICRP) reduced the gonadal Wt from 0.2 to 0.08 [14], mainly because of the "reduced significance" attached to genetic effects [15]. In the same guidelines, the ICRP note the increase in breast Wt from 0.05 to 0.12, mainly because of the "focus on cancer incidence in detriment calculations" [15].

This context of mixed opinion and changed advice on tissue radio-sensitivity provoked consideration of what actually is good practice in the application of lead shielding during projection radiography. The initial basis for good practice and application of the ALARA principle has to be what radiographers learn in their pre-registration education [16].

The aim of the current study was therefore to establish what is being taught as good practice in the placement of patient lead shielding through an international survey of radiography educators.

The objectives were to:
• Establish radiography educators’ opinions about lead shielding;
• Establish what is taught about lead shielding by radiography educators;
• Establish how the use of lead shielding is addressed during student assessment.
Fig. 1: Summary of Research Formulation

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Methods and materials

The methodological process is summarised in Fig. 2 on page 7

Strategy

An online questionnaire was designed in commercial software (Survey Monkey ®) and distributed to a purposive sample of 44 radiography educators across 15 countries. No personal data were gathered. The study had institutional ethical approval.

Questionnaire

Evidence gathered from a literature review concerning lead shielding was incorporated with knowledge of clinical practice locally to develop the questionnaire. There were sections investigating opinions about lead shielding, what is taught about lead shielding, how the use of lead shielding is assessed, what influences the curriculum and general demographic information. Generally questions requiring categorical or Likert scale type responses were augmented by the opportunity to offer open text responses in explanation.

Survey sample

Purposive sampling was followed to draw a sample of educators from third level institutions with inclusion criteria of least a three year programme encompassing some clinical placement, and where the educators speak sufficient English to be able to complete the questionnaire. An overall population was not established. The indicative sample of 44 educators was found through a combination of internet browsing and institutional associations, and the research supervisor reviewed that the level of practice of radiography was similar across all. Clearly there are limitations to the non-random sampling process, however the findings represent an initial attempt to establish opinions on this topic across an international cohort of educators.

Survey administration

In December 2016, a lecturer in each institution with an accessible e-mail address was contacted and asked to forward the participant invitation to one academic lecturer and one lecturer teaching in clinical practice. To improve the response rate from the pilot study, a reminder email was sent after two weeks.

Pilot Study
In a small scale version of the actual survey, the questionnaire was sent to one academic and one clinical lecturer from two centres with request to return same within two weeks: this constituted approximately 10% of the proposed sample, which is acceptable for a survey of this type [17]. The purpose was to gather feedback on any lack of clarity, to establish how long the questionnaire took to complete, the potential response rate, and approximately how long it took for the questionnaire to be returned. A response rate of 25% (one participant) led to a decision to send reminders in the main study to enhance the response rate.

Analysis

Descriptive statistics were applied to establish the frequency of specific opinions about the use of lead shielding. Likert scale responses were evaluated by establishing median Likert scores. Open text responses were subject to simple thematic analysis to establish more common opinions or practices, although these must be appreciated in the context of the relatively small number of responses.
Fig. 2: Summary of the Methodological Process

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Results

The response rate was 61% (27 of 44 invited participants), with 24 participants providing geographic information as presented in Table 1 on page 10.

All respondents had worked as a clinical radiographer during their career, 74% (n=20) had been teaching for more than five years. Most respondents (65%, n=18) were teaching as an academic lecturer, with 35% (n=9) holding a clinical teaching position. As can be anticipated not all questions were answered by all respondents and therefore reported percentages are calculated from the number of responses to each question.

Opinions about lead shielding

Educators reported their agreement with a series of opinion statements on a balanced five point Likert scale from strongly agree (scoring 5) through neutral (scoring 3) to strongly disagree (scoring 1). Median Likert Scores (MLS) across all respondents are presented in Fig. 3 on page 10. While educators agree (MLS = 4) that lead shielding should be used over organs with higher radio-sensitivity, opinions are neutral (MLS = 3) on whether lead shielding is more important for the gonads (Wt = 0.08) than the female breast (Wt = 0.12), and in disagreement (MLS = 2) that lead shielding is more important for the colon (Wt = 0.12) than the ovaries (Wt = 0.08). These comparisons are relevant if the aim of using lead shielding is to offer protection. In all examinations, elements such as the direction of the beam and position of the patient must be considered. However, all other elements optimised, the point is simplistically made that if lead shielding is going to be used, it should be used over organs that have higher than average radio-sensitivity.

What is taught about lead shielding

Placement

For five broad categories of examination, educators reported whether they would teach students to shield the gonads or breast for reasons of any of protection, image quality or patient reassurance. Not all respondents answered all questions, the responses given are summarised in Table 2 on page 11, where it is noteworthy that depending on the examination, 12 - 35% of respondents would not protect the gonads at all. Generally, placement of lead shielding is taught across all patient types, although a small number of respondents (always # 3) reported teaching gonadal lead shielding mainly for female, paediatric and/or pregnant patients. For the breast, the proportion teaching not to use lead shielding rose to 59 - 71%, depending on examination type. However, 40% of respondents would teach breast shielding for female patients during examinations of the abdomen, spine and pelvis.
Reasons

Summarising responses across all examinations and patient types, radiation protection was the reason most frequently reported for teaching the use of lead shielding (Fig. 4 on page 12), although in open comments, four respondents specifically proposed that improvements in collimation and digital detectors reduce the validity of using lead shielding for radiation protection.

How is lead shielding addressed in student assessment

Student use of lead shielding is assessed by a variety of coursework including written, practical and clinical tests. In explaining how an assessment grade would be affected if what was taught about lead shielding was not applied (Table 3 on page 13), 28 of 38 comments (respondents offered multiple comments), implied at least a grade reduction, and eight of these comments indicated the possibility of an automatic fail of clinical assessment. Several of these comments were received from educators who agreed that minimal dose reduction would accrue. Such contradictions between taught theory and applied assessment criteria are not conducive to either deep learning or eventual good clinical practice.

Six further comments suggested a case by case consideration, with students being judged on their ability to justify whether to apply lead shielding or not. In light of the low literature consensus, it seems this is a better approach to assessment. Only four educators reported that grades would not be affected at all.

Comparative Analysis

What educators teach about the use of lead shielding (Table 2) was compared with the opinions they reported about lead shielding (Figure 1) and also with their length of experience using Pearson’s Chi-square analysis. No statistically significant associations were found, with p values for the various analyses ranging from 0.22 to 0.81.
<table>
<thead>
<tr>
<th>Country</th>
<th>Number of educators currently working here</th>
<th>Number of educators who trained here</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Canada</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Finland</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
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<td>Slovenia</td>
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<tr>
<td>Australia</td>
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<tr>
<td>Italy</td>
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</tr>
<tr>
<td>New Zealand</td>
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<td>0</td>
</tr>
</tbody>
</table>

**Table 1**: Geographical spread of participants

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**Fig. 3:** Median Likert Scores as indicators of educator opinions on lead shielding during projection radiography

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<table>
<thead>
<tr>
<th>Examination</th>
<th>Response frequency</th>
<th>Reason</th>
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<tbody>
<tr>
<td></td>
<td>Over the gonads</td>
<td>Over the breast</td>
</tr>
<tr>
<td>Upper Extremity</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Skull/Cervical spine/Shoulder</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Chest/Thoracic spine</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>Abdomen/Pelvis/Lumbar spine</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Upper Extremity</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Skull/Cervical spine/Shoulder</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chest/Thoracic spine</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Abdomen/Pelvis/Lumbar spine</td>
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<td>0</td>
</tr>
<tr>
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<td>1</td>
</tr>
<tr>
<td>Lower Extremity</td>
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<td>6</td>
</tr>
</tbody>
</table>

**Table 2:** Reasons for applying lead shielding in different examination categories

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Fig. 4: Reasons for teaching the application of patient lead shielding

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Table 3: Themes arising from open comments concerning how use of lead shielding is addressed in student assessment
Conclusion

Conclusions and recommendations are summarised in Fig. 5 on page 16.

Conclusions

The mixed opinions found in literature concerning the use of lead shielding are replicated in the educator opinions and teaching reported in the current survey.

- Most educators acknowledge that tissue radio-sensitivity should influence the use of lead shielding, yet seem to teach that lead shielding should be applied over the gonads more frequently than over the breast.

- Radiation protection is the predominant reason that the use of lead shielding is taught, although a small number of educators query the validity of this practice, and others offer patient reassurance as the stimulus.

- During written and clinical assessments, students are generally expected to apply gonadal shielding, with a small number of educators expecting students to justify their reasoning based on the individual patient and examination.

- Educators strongly agree that their teaching is based upon literature evidence. However the current study has not found consensus on good practice in literature, nor was any correlation found between educators opinions about lead shielding and what they taught.

Recommendations

This small study does not claim to be definitive of educator opinions and approaches with regard to the use of lead shielding. Rather it presents an indicative vignette from a small number of educators that the reader may decide to take as broadly representative of wider opinion and practice.

A lack of consensus on good practice is apparent in literature and in the opinions and teaching of educators in the current study. Radiographers, radiographer students and patients would benefit from consensus on good practice in the use of patient lead shielding.

A large scale empirical study is therefore recommended to establish a rigourous and valid evidence base for the use of lead shielding across a range a radiographic examinations.
### Summary of Conclusions

| Opinions about lead shielding | • More sensitive organs should be protected  
|                             | • But exposures are low, so lead shielding may be unnecessary |
| Where is lead shielding used? | • The gonads are shielded by around three quarters of respondents  
|                             | • The breasts are shielded by around one third of respondents |
| When is lead shielding used?  | • Generally for all patient types and all examinations  
|                             | • Some increased use of gonad shielding for pregnant, childbearing and paediatric patients |
| Why is lead shielding used?   | • Radiation protection is the main reason  
|                             | • Patient reassurance mentioned by very few respondents |
| What is good practice?        | • No consensus in literature  
|                             | • No consensus in responses to this survey |
| What next?                    | • A large scale empirical study to establish good practice and gain consensus is highly recommended |

**Fig. 5:** Summary of Conclusions

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References


