The importance of a good radiation safety culture is becoming increasingly recognised, and has been the subject of a number of international initiatives over recent years, with some specific focus in healthcare applications. Work in this area has been undertaken in the UK by a national working group and has involved both assessment of current radiation safety culture, utilising a widespread staff survey, and development of strategies for improving this culture. Developments have been from both a top-down and bottom-up perspective, and have resulted in a ten-point assessment tool, including a number of measurable indicators for each point. The ten point assessment complements existing international guidelines and provides a practical framework for both internal audit and external inspection.

Radiation safety culture is becoming a topic of increasing importance globally. On an international level, the International Conference on Radiation Protection in Medicine: 'Setting the Scene for the Next Decade' held in Bonn, Germany, in December 2012 led to the Bonn Call for Action [1] and concerns improvement of radiation safety specifically for patients. A global initiative, launched by the International Radiation Protection Association (IRPA) on culture, resulted in publication of a set of guiding principles [2] in 2014. More recently, a joint initiative by IRPA together with the World Health Organisation (WHO) and the International Organisation of Medical Physics (IOMP) has been launched to develop a framework document to support the establishment and maintenance of a radiation safety culture in healthcare facilities, as an integral component of safety culture programmes in medical settings. This ongoing project includes a series of workshops to collect feedback from key stakeholders in different regions of the world.

Within the UK, the Society for Radiological Protection (SRP) first set up a working group to look at radiation protection culture in 2011 [3] and more recently have developed this to form four sector-specific working groups looking at assessment and development of RP culture in the UK workplace. One group deals specifically with the medical sector and includes representation from a range of professional groups within healthcare. The work of this group was presented at the IRPA14 Congress in Cape Town, and subsequently published in the Journal of Radiation Protection Dosimetry [4].

Radiation safety culture has some very specific challenges within the medical sector primarily because, with the focus of healthcare on diagnosis and treatment of patients, there are many other safety issues that tend to take precedence, resulting in radiation safety potentially being viewed as being of relatively little concern. However, with the rapid development of radiation technology for imaging and treatment, there is a growing awareness of the need to be vigilant over patient doses, including the justification of examinations, with exposure of paediatric patients often of particular concern.

SURVEY OF UK STAFF ATTITUDE TO RADIATION SAFETY

Part of the remit of the Medical Sector Working Group was to assess the current state of radiation safety culture in UK hospitals. To investigate this, a survey was carried out of hospital staff attitudes to radiation safety. The survey was aimed at all staff groups within both NHS and private hospitals, including both radiation and non-radiation workers. It consisted of a series of multiple choice questions, some of which were specific to role, and included questions on knowledge of both staff and patient doses and risks; awareness of, and compliance with, radiation safety policy and procedure; and levels of training received.

The results of the survey have been described in detail [4] and comprised data from almost 3700 individuals, covering all geographical areas of the UK, and across the spectrum of roles within the hospital. It was encouraging that approximately 80% of all respondents considered that radiation safety was given adequate importance within their organisation, and also that they had received adequate training in radiation protection. Wearing of personal protective equipment and personal dosimetry were also reported to be at a high level of compliance, although this may have been influenced by the voluntary nature of participation in the survey.

The areas of the survey that raised some concern were chiefly concerning specific knowledge on radiation dose and risk. Around 30% of respondents felt they had insufficient knowledge of their own risk, and 40% lacked understanding of that to patients. There were also questions raised concerning referral guidelines, as the majority of respondents claimed to be using local rather than national professional guidelines for referring patients for X-ray.

PROMOTING IMPROVEMENT TO RADIATION SAFETY CULTURE IN UK HEALTHCARE

The second part of the remit of the working group was to investigate ways of improving the current radiation safety culture in the UK. The first approach was 'top down' and involved engaging with managers and management organisations, regulators and inspectors. Discussions with management representatives from both the NHS and the Association of Independent Healthcare
Organisations (AIHO) considered issues such as the radiation safety information available on relevant web sites, and how related communication to senior healthcare management could be improved. At a local level, drivers for safety culture primarily relate to national healthcare standards, and it was recognized that the inclusion of radiation safety culture metrics within these would have a beneficial effect. Culture metrics have also been discussed with regulatory groups, with a view to their more comprehensive inclusion within future inspections of healthcare organisations.

In order to provide a starting point in culture metrics, the working group has developed a ten point assessment tool for radiation safety culture, which comprises a list of ten relevant topics, each with a number of measurable indicators associated with it [Table 1]. The use of measurable indicators is important as it allows for a semi-quantitative assessment to be made at a point in time, which might serve as a baseline against which future improvements can be assessed, in addition to facilitating a performance rating for departments. The framework has potential for use both in formal inspections and as an internal assessment tool, in addition to use in training or standards.

### Table 1. The Ten Assessment Topics and associated measurable indicators

<table>
<thead>
<tr>
<th>Assessment Topics</th>
<th>Measurable Indicators</th>
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</table>
| 1. Management engagement                              | • Senior management understand their role & responsibility in relation to radiation safety  
• There exists a clear management structure for radiation safety from shop floor to Board  
• The RSP contains clear description of management responsibilities & how these are audited  
• Evidence of communications between management and staff on radiation safety issues |
| 2. Appropriate training                                | • Appropriate radiation safety training/qualifications are included in relevant job description  
• Induction training contains appropriate level of radiation safety training – including general awareness training for non-radiation workers  
• Radiation workers and individuals recognised under IRMER have documented update training at specified intervals  
• Evidence that training complies with best practice guidelines if when available from professional bodies |
| 3. Regular audit of radiation safety procedures         | • Schedule of audits inc: internal compliance audits with LR and IRMER procedures  
• Recent audit results of above compliance audits  
• Independent schedule of audits by e.g. RPA, RWA with reports |
| 4. Appropriate use of diagnostic imaging using ionising radiation | • Documented use of referral criteria  
• Evidence of culture whereby radiologists & radiographers challenge inappropriate requests  
• Availability of non-ionising imaging modalities |
| 5. Appropriate management of radiation generating equipment and radioactive materials | • Documented management system in place  
• Evidence of equipment replacement programme  
• Evidence of service/maintenance contracts  
• Evidence of QA of equipment & SOPs  
• Evidence of action upon QA results  
• Evidence of audit of RAM policy and procedures  
• Disposal records  
• Evidence of compliance with Permits |
| 6. Appropriate appointment and use of Accredited Experts | • Policy statement of their appointment and consultation requirements  
• Evidence of appointment of suitably qualified and sufficient experts [RPA/RWA/MPE]  
• Evidence of action following reports from experts  
• Evidence of existence of Radiation Protection Committee  
• Evidence of appointment of suitable and sufficient RPs  
• Evidence of lead manager for RAM |
| 7. Optimisation of patient dose                         | • Formation of multi-disciplinary ‘Dose Champion’ teams  
• Local DRLs in place  
• Results of audits against DRLs  
• Documented results of optimisation strategy |
| 8. Management of staff doses                            | • Evidence of management system for personal dosimetry  
• Percentage of incomplete dose records monitored  
• Evidence that dose results checked against Investigation Levels  
• Understanding of typical and maximum doses for different staff roles  
• Results of audits of use, checking and storage of PPEs  
• Audits of compliance with LR |
| 9. Appropriate incident handling                        | • Documented procedures for handling incidents  
• Evidence of timely reporting and investigation of incidents  
• Evidence of appropriate management involvement  
• Action plans for lessons learned & implementation of change  
• Evidence of open culture for reporting incidents |
| 10. Effective communication                             | • RP issues on staff meeting agenda  
• Staff have access to managers to raise concerns  
• Staff have access to union safety officers to raise concerns  
• Staff have access to ‘mentors/guardians’ to raise concerns  
• Managers & experts regularly communicate RP performance to relevant staff |

The ten point assessment has been cross-linked to the IRPA Guiding Principles and
Effective training can be realized by incorporating a variety of different techniques, and routinely assessing their impact.

**CONCLUSION**

The importance of a good culture in radiation safety for the protection of both patients and staff is being increasingly recognised, and recent initiatives in the UK complement a number of international projects in this regard. Work has been completed on assessing attitudes to radiation safety through a nationwide survey, and both top down and bottom up approaches to improving safety culture have been established. This includes production of a ten-point assessment tool, with measurable indicators, which complements existing IRPA guidelines on radiation safety culture, and the Bonn Call for Action on patient protection.

**REFERENCES**

4. Claire-Louise Chapple; Andy Bradley; Maria Murray; Phil Orr; Jill Reay; Peter Riley; Andy Rogers; Navneet Sandhu; Jim Thurston. Radiation Safety Culture in the UK Medical Sector: A Top to Bottom Strategy. Radiation Protection Dosimetry 2016; doi: 10.1093/rpd/ncw344

<table>
<thead>
<tr>
<th>Assessment Topics</th>
<th>Mapping to International Initiatives</th>
<th>Bonn Call for Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Management engagement</td>
<td>Developing a Radiation Protection Culture &amp; Criteria of Success (Ch 4) – Strong Leadership The Role of RP Professionals (Ch 6)</td>
<td>Bonn Call for Action 4: Strengthen Radiation Protection education and training of health professionals</td>
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<tr>
<td>2. Appropriate training</td>
<td>Developing a Radiation Protection Culture &amp; Criteria of Success (Ch 4) – Education &amp; Training Assessment of Radiation Protection Culture (Ch 5)</td>
<td>Action 1: Enhance the implementation of the principle of justification</td>
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<td>3. Appropriate management of radiation generating equipment and radioactive materials</td>
<td>Developing a Radiation Protection Culture &amp; Criteria of Success (Ch 4) – Additional factors for Medical Field</td>
<td>Action 2: Enhance the implementation of the principle of optimisation of protection and safety</td>
</tr>
<tr>
<td>4. Appropriate appointment and use of Accredited Experts</td>
<td>The Role of RP Professionals (Ch 6)</td>
<td>Action 3: Strengthen manufacturers' role in contributing to the overall safety regime</td>
</tr>
<tr>
<td>5. Optimisation of patient dose</td>
<td>Developing a Radiation Protection Culture &amp; Criteria of Success (Ch 4) – Additional factors for Medical Field</td>
<td>Action 4: Increase availability of improved global information on medical exposures and occupational exposures in medicine</td>
</tr>
<tr>
<td>6. Management of staff doses</td>
<td>Action 5: Increase availability of improved global information on medical exposures and occupational exposures in medicine</td>
<td></td>
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<tr>
<td>7. Appropriate incident handling</td>
<td>Assessment of Radiation Protection Culture (Ch 5)</td>
<td>Action 7: Improve prevention of medical Radiation incidents and accidents</td>
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<tr>
<td>8. Effective communication</td>
<td>Developing a Radiation Protection Culture &amp; Criteria of Success (Ch 4) – Communication Processes</td>
<td>Action 3: Strengthen manufacturers’ role in contributing to the overall safety regime Action 9: Foster an improved Radiation benefit-risk dialogue</td>
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</tbody>
</table>

**Table 2.** Correlation of the Ten Point Assessment Topics with IRPA guidelines and the Bonn Call for Action