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Session 1

Justification in the use of radiation in
medical imaging

REVIEW OF RADIATION SAFETY ISSUES DURING INVENTORY OF RADIATION SAFETY ISSUES DURING INVENTORY OF RADIATION EMANATING EQUIPMENT

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Abstract

Nepal, one of the least developed countries with population of 26.6 million people is the most populated country without a regulatory body [1]. Newer modalities and latest radiological equipment are being introduced, but lack of control and inventory system is a serious problem. The aim of this study was to start inventory of radiation emanating equipment used in medical field and also to find out radiation safety issues and challenges. This study was done for first the time in Nepal to start inventory system. Questionnaire was designed to find out actual number of equipment among with the date of installation, source number, number of staff and their qualifications. Questionnaire was also designed to find out radiation safety issues like personnel radiation dose monitoring, commissioning and quality control tests. Altogether, 296 institutions in Kathmandu were inspected. Inventory was made for diagnostic radiology, nuclear medicine, radiotherapy and dental X-rays. Commissioning and quality control program have not been practiced in most hospitals, and few only have a maintenance contract with vendor. Sixty percent of workers have never been monitored for radiation exposure. There is an urgent need to establish regulatory authority to regulate radiation used in medicine.

1. INTRODUCTION

As we all know that radiation is a fact of life because in every aspect of our life we have to encounter some form of radiation. Nepal, one of the least developed countries with population of 26.6 million people is the most populated country without a regulatory body [1]. Due to lack of laws and regulations in Nepal radiation protection survey and quality control (QC) of radiation emitting equipment are not even "recommended" and only some institutions have voluntarily established QC systems [3]. In Nepal, radiation-emitting equipment is mainly used in diagnostic radiology, radiotherapy and nuclear medicine [2]. We are using ionizing radiation in the form of X -rays and gamma rays in the diagnosis and treatment of many diseases. Though we are using radioisotopes in medicine, but still, we do not have any formal regulations to record import and use of these radioisotopes in the country [2]. So, it is sought that an inventory or record of radioisotopes and equipment should be made in Kathmandu Valley which consists of three different districts, Kathmandu, Lalitpur and Bhaktapur.. This record is very important in a country like ours, where there is no institution or organization to look after radiation safety and the safety of radioisotopes itself[3][4].

This study contains the first hand information provided by different institutions on current status and radiation safety infrastructure.

The main objective of this study is to start inventory process and to find out present status of radiation emanating equipment being used at different hospitals in Kathmandu Valley. The other objectives are to find out radiation safety issues and challenges.

2. METHODS

To implement this program, questionnaire was prepared. Survey team was constituted and prepared them to visit the site to inspect the room and to complete the questionnaire. The questionnaire consists of questions seeking information regarding professional responsibility, qualifications, safety and security, personnel dose monitoring, commissioning and quality control (QC) tests. Background radiation was only measured at the centers, which have radioactive materials and radiopharmaceuticals.

3. RESULT & DISCUSSION

All together 296 institutions were monitored in Kathmandu Valley including three districts Kathmandu, Lalitpur and Bhakatapur. More than 450 radiation producing equipment were monitored and made an inventory. The following graph shows the distribution of institutions monitored to make an inventory of radiation emanating equipment.

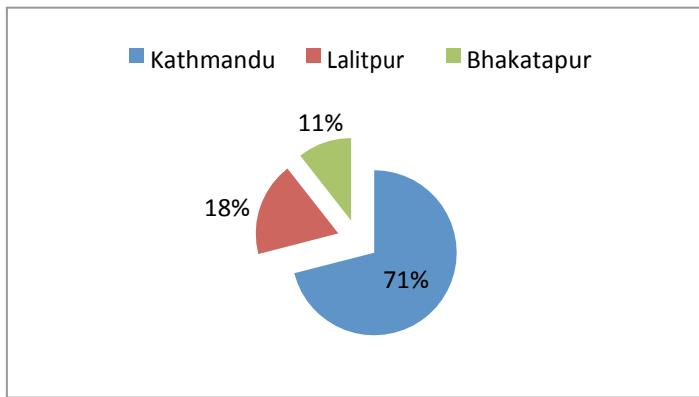


FIG. 1. Distribution of institutions monitored in Kathmandu Valley.

Study shows that more than seventy percent of the radiation emanating equipment used in medical field are being used in Kathmandu district. Respectively, 18% of the equipment is being used at Lalitpur and 11% at Bhakatpur. According to the census, population of Kathmandu Valley is more than 2.5 million and almost 1.7 million live only in Kathmandu district. That might be the main region behind equipment, which is mainly confined to Kathmandu district.

It is found that most of the radiation workers, working in the field of diagnostic radiology, radiotherapy and nuclear medicine are well qualified. Only, 5 medial physicists/ Radiation Safety Officer are working at four different cancer centers. It is noticed that dental clinics are being operated without qualified staff.

Study shows that, there is a window at some X-ray room but was closed temporally. At thirty centers, there was no radiation symbol outside the X-ray room. Only seventeen centers have information on radiation for patients. We have found open window at twelve dental clinics with plywood and aluminum partition. We have noticed that most of the staff working at dental clinic has limited knowledge and less information on dental X-ray.

The following figure shows district wise distribution of Diagnostic Radiology, Radiation Therapy and Nuclear Medicine

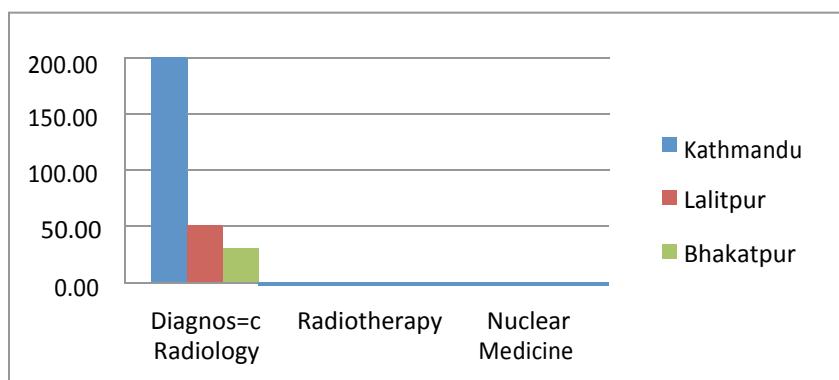


FIG. 2. District wise distribution of Radiology, Radiotherapy and Nuclear Medicine.

Radiotherapy and Nuclear medicine is not in the priority of institutions in Kathmandu. The main reason behind this is might be the cost of equipment and technical manpower. But, if we compare to our earlier survey radiotherapy and nuclear medicine is progressing but with slow pace.

The following figure shows distribution of equipment used in diagnostic radiology at Kathmandu Valley

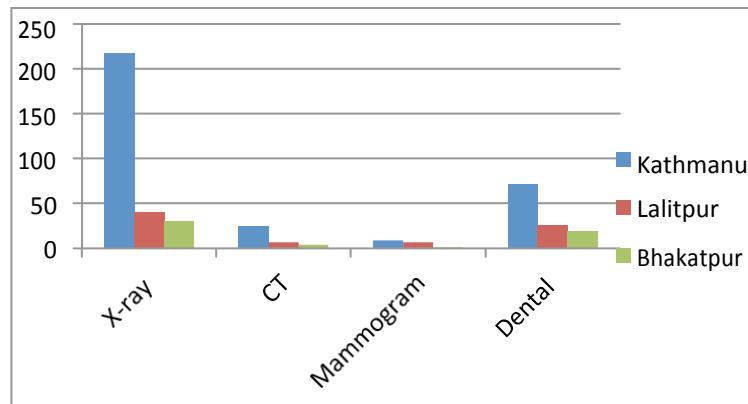


FIG. 3. Distribution of Equipment used in Diagnostic Radiology and Dental Clinic.

Regarding personal radiation dose monitoring, more than ninety seven percent of the institutions are not monitoring their radiation workers. Most of the institutions, using personal radiation belong to the institutions having either radiotherapy or nuclear medicine facility. The main reason behind this is because of the medical physicist / Radiation Safety Officer. Recently, busy institutions has just started personnel radiation dose monitoring through National Academy of Science & Technology (NAST), which has started its service with the help from IAEA, Technical Cooperation (TC) project. But, according to them, personnel radiation service from NAST is still not smooth and continuous.

Study shows that more than ninety five percent of institutes have never done radiation survey before starting radiation treatment expect radiotherapy facility and few centers with diagnostic radiology. There is no Quality Control (QC) program in diagnostic radiology but there is a QC program in Radiotherapy facility centers. Regarding further information on QC in diagnostic radiology, there are some maintenance contracts with the supplier company at few institutes.

Background radiation was also measured around at three cancer centers. Well calibrated survey meter was used to measure Cobalt-60 area and HDR Brachytherapy area and was found within limit as background level. Background radiation was also measured in three Nuclear Medicine facilities and found within safe limit.

Study also shows that there are few unqualified radiation personnel working in this field. We have noticed, some workers are over-conscious on radiation.

4. CONCLUSION

Altogether, 296 institutions in Kathmandu were monitored. Inventory was made for diagnostic radiology, nuclear medicine, radiotherapy and dental X-rays. This study has initiated to start inventory system in Nepal. Through proper education and training and regularly organized seminars people are becoming more and more aware of the benefits of radiation and its uses in medicine [5]. The provision of such services at the national level does not detract from the ultimate responsibility for radiation protection and safety borne by the legal persons authorized to conduct the practices. Those, especially the radiation workers, are very much careful and conscious about the safe handling and use of radiation sources to protect public and environment. By establishing basic safety standard and Radiation Regulatory Authority, Rules and Regulations can be enforced in the country effectively and efficiently [3].

ACKNOWLEDGEMENTS

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HERCA EUROPEAN ACTION WEEK – RESULTS OF A COORDINATED INSPECTION INITIATIVE ASSESSING JUSTIFICATION IN RADIOLOGY

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Abstract

Justification is a fundamental principle in radiation protection and has to be carried out before any individual exposure, according to the European Basic Safety Standards Directive. However, there are strong indications that up to 20-30% of medical imaging exposures are unjustified in many economically developed countries. Heads of the European Radiological Protection Competent Authorities (HERCA) has recognized that the regulatory bodies have an important role in promoting and ensuring that the principle of justification is properly implemented at medical imaging facilities. HERCA performed a coordinated European Action Week on inspection of justification in radiology in November 2016. The aim was to identify the main challenges in the justification process. 17 European countries participated in the Action Week, and 148 inspections were carried out. All inspections were performed according to a common inspection template. Main weaknesses identified were: 1) lack of written procedures describing the justification process, 2) lack of availability, awareness and use of referral guidelines, 3) lack of national or local procedures for performing clinical audits and 4) incomplete referrals from referring practitioners. HERCA has identified a need to increase the awareness of justification among health professionals and facility management in follow-up actions in 2017 and 2018.

1. INTRODUCTION

Justification is one of the fundamental principles in the international radiation protection framework established by the International Commission on Radiological Protection [1]. The intention behind the act of justification is to ensure that the benefit of the exposure outweighs the associated potential radiation detriment. To ensure the appropriate use of medical imaging, justification has to be carried out at an individual level before the exposure takes place. The necessity for individual justification is reinforced in the new European Basic Safety Standards Directive and the International Basic Safety Standards [2, 3]. However, there are strong indications that up to 20-30% of medical imaging exposures are unjustified in many economically developed countries [4]. Therefore, the International Atomic Energy Agency (IAEA) have introduced the “Triple A” initiative, promoting Awareness about radiation risks; Appropriateness to ensure that those referred for radiological examinations really need them; and Audit to check the effectiveness of the referral and related processes [5]. The need to enhance the implementation of the principle of justification is also addressed in the joint position statement “Bonn Call for Action” by the IAEA and World Health Organization (WHO) and in the council conclusions on justification by the European Commission [6, 7].

Heads of the European Radiological protection Competent Authorities (HERCA) has recognized that the regulatory bodies have an important role in promoting and ensuring that the principle of justification is properly implemented at medical imaging facilities. Consequently, HERCA has published a position paper on justification of individual medical exposures for diagnosis to provide clarity on the regulatory framework for justification [8]. HERCA highlighted that justification is not just one action, but a process that includes a number of events from initial presentation of the patient to the radiology department to the final authorization for an exposure to take place. During the European Inspection Workshop organized by HERCA in 2015, it was revealed that very few radiation protection authorities actually inspected the justification process in depth [9]. HERCA identified an urgent need to improve the implementation of justification in medical exposure situations and decided to support this through a coordinated European Action Week on the inspection of justification, focussing on radiology departments. [10].

2. METHODS

A European Action Week, with the scope of performing coordinated inspections of justification in radiological medical imaging facilities across Europe, was undertaken by HERCA in November 2016 [11]. The aim was to assess whether justification takes place in the facilities and to identify the main challenges in the justification process. All HERCA countries were invited to take part in this Action Week and to perform inspections in a representative number and type of imaging facilities. All inspections were notified in advance and performed according to a common inspection template provided by HERCA Working Group on Medical Applications (WGMA). Requested documentation was, in most countries, submitted to the competent authorities prior to the inspections. The inspection template collected information about the regulatory framework and the competent authority and inspection teams of the participating countries in addition to the results from each inspected medical imaging facility. Questions addressed during the inspections were aimed to identify if and how justification was implemented in the daily workflow. Availability of written procedures for the justification process, assignment of tasks and responsibilities, daily processes for assessment of justification and appropriateness of referrals, general practice to handle incomplete or unjustified referrals, availability and use of referral guidelines together with performance of clinical audits were among the examined topics. The overall quality of 10 referrals (5 for CT and 5 for conventional X-ray) per inspected facility was also reviewed to check if there was sufficient information for the radiological practitioner to assess if the referred examination was justified and appropriate.

3. RESULTS

In total, 17 countries participated in the Action Week and 148 inspections were carried out. The participating countries and number of inspections performed per country are shown in FIG. 1. The mean number of inspections per country was 9 (range: 1-19). 44% of the inspected facilities were public and 56% were private. The inspections were carried out by one, two or three competent authorities in 76%, 18% and 6% of participating countries, respectively. Radiation protection competent authorities were mainly the responsible authority for medical exposures. The inspection teams generally consisted of medical physicists and radiographers and/or engineers, but in some countries physicians or radiologists were also part of the inspection teams. Key personnel to be interviewed were typically the facility management, radiological practitioners and radiographers. Additional staff such as medical physicists, radiation protection officers and responsible persons for the quality assurance system, were also interviewed in some countries.

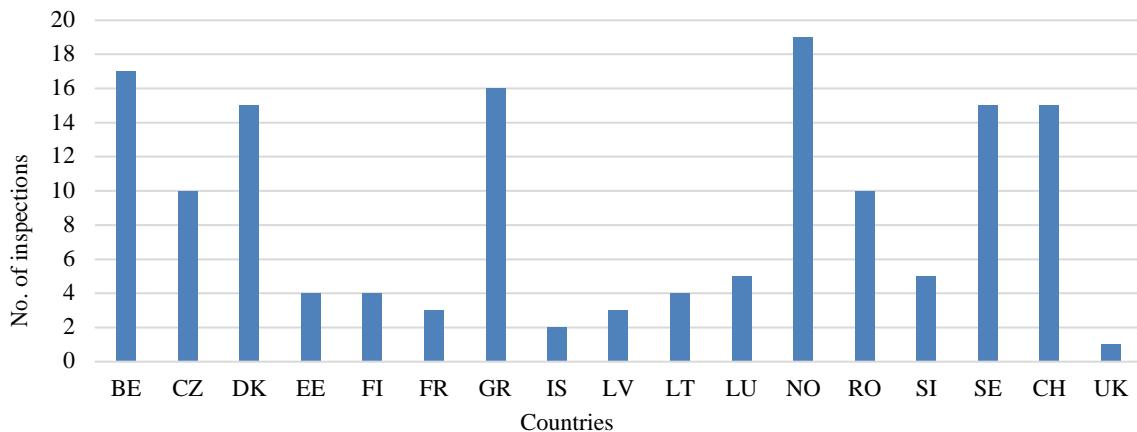


FIG. 1. Overview of participating countries and number of inspections performed per country. BE: Belgium, CH: Switzerland, CZ: Czech Republic, DK: Denmark, EE: Estonia, FI: Finland, FR: France, GR: Greece, IS: Iceland, LT: Lithuania, LU: Luxembourg, LV: Latvia, NO: Norway, RO: Romania, SI: Slovenia, SE: Sweden, UK: United Kingdom.

Results regarding the availability, knowledge and content of procedures for the justification process are shown in FIG. 2.A. Written procedures were only available at 55% of the inspected facilities. Even though written procedures were not available in almost half of inspected facilities, many had established processes for justification. About 10% of facilities had no procedures or routines for justification at all. Where procedures and processes were available, the staff involved implemented these in daily practice. They were frequently revised and updated in about 70% of facilities. Most topics identified by HERCA as important to ensure proper justification process were covered by 60% to 80% of facilities, while information to patients about risk and benefit,

a requirement of the latest Euratom Basic Safety Standards Directive, was only addressed by 34% of facilities. Allocation of tasks and assignment of responsibilities were clearly defined and documented for referring physicians, radiological practitioner, radiographers and the receptionist in 52%, 65%, 71% and 62% of facilities, respectively. Allocated tasks and responsibilities were known by the staff in 76% of facilities where these were defined, while delegation of tasks was only documented in 52% of facilities.

Results relating to the availability and use of referral guidelines and performance of clinical audits are summarized in FIG. 2.B. Referral guidelines for medical imaging were available in 70% of inspected facilities. The sources of referral guidelines were national (58%), regional (15%) and/or local (28%). These guidelines were made available to the referrers in almost all facilities, but assumed to be implemented in daily use by only 31% of the referrers and 48% of the radiological practitioners. Only 20% of the inspected facilities had local procedures for clinical audits and clinical audits were seldom performed. Less than half of the facilities performed any other type of audit or review (internal or external) covering the justification process.

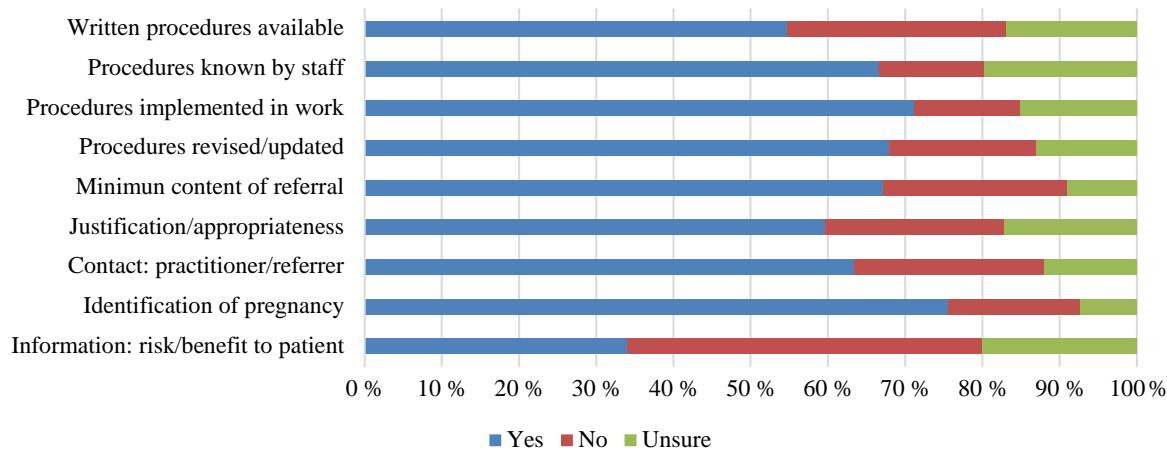


FIG. 2.A: Summary of the results regarding the availability of procedures for justification and their coverage of important topics to ensure for a proper justification process.

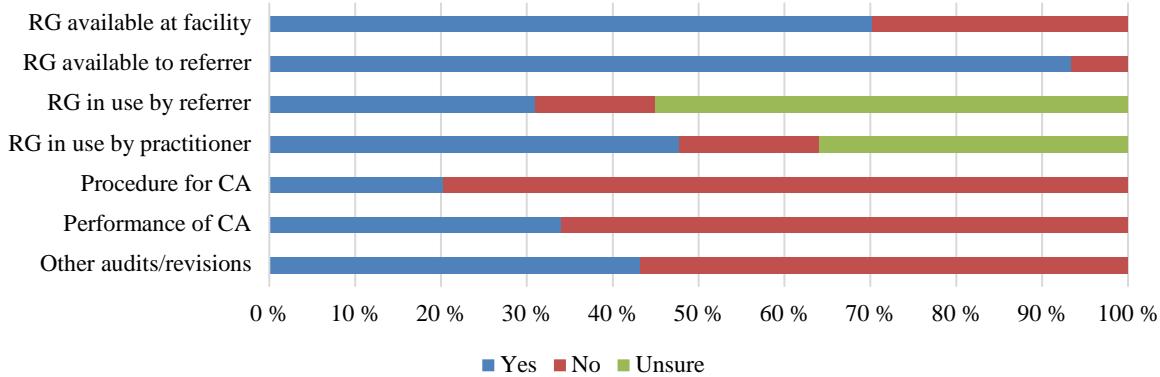


FIG. 2.B Summary of the results regarding referral guidelines (RG) and clinical audits (CA).

Many of the inspected facilities had established good practice for evaluation of the referrals before the examinations were performed, as shown in FIG. 3.A. However, as many as 26% of facilities did not perform a satisfactory evaluation of the referral before the examinations were performed and even more did not reject unjustified examinations (31%) or fully prove that the examinations were authorized by the radiological practitioner (35%). The presence and overall quality of the referrals are summarized in FIG. 3.B. Referrals were available for almost all examinations (99%). Information about the patient, referrer, date and signature of the referral was satisfactory in over 90% of referrals. Clinical information was sufficient and contained the clinical question to be answered in 86% and 81% of referrals, respectively. Information about previous examinations and identification of pregnancy was only included in 54% and 63% of referrals, respectively. Education and training, covering the justification process, was documented in only 60% of the inspected facilities.

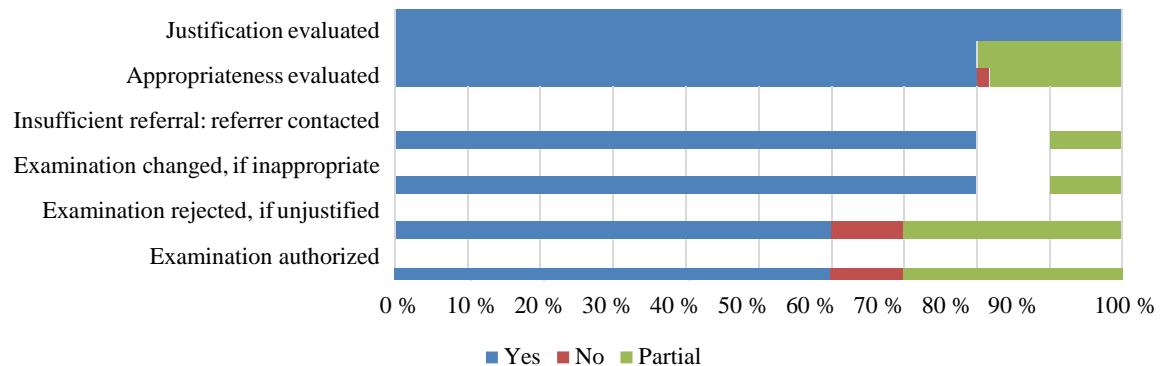


FIG.3.A: Summary of the results regarding the daily practice on evaluation of referrals prior to the performance of the examination.

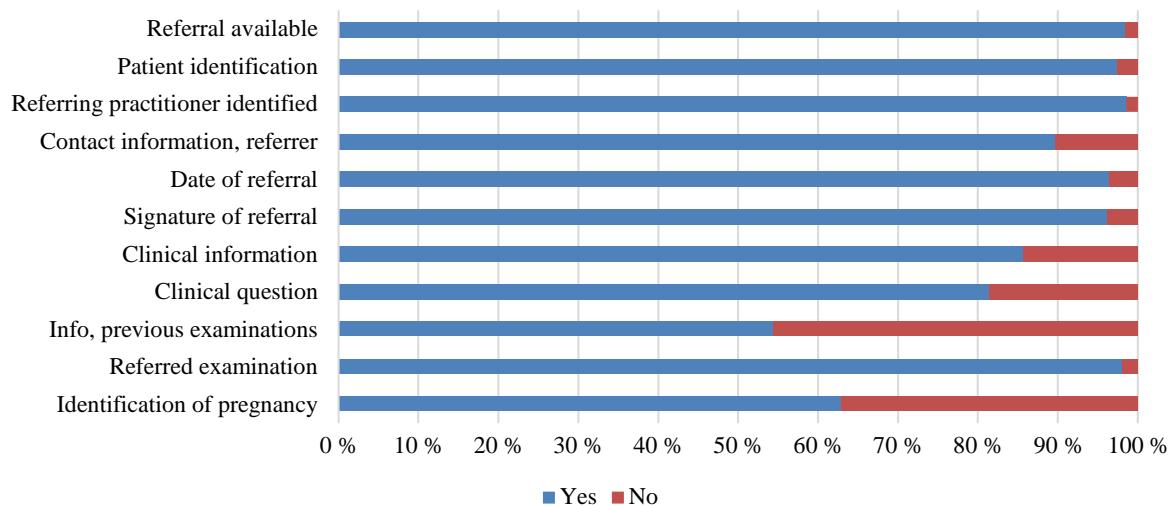


FIG. 3.B: Summary of the results regarding the presence and overall quality of the referrals. In total, 1367 referrals (for X-ray and CT) were evaluated.

4. DISCUSSION AND CONCLUSIONS

The European Action Week was supported by all HERCA countries and 53% of countries participated. Half of the countries (53%) performed less than 10 inspections and the results may not be representative of the real situation in some of these countries. Results from the inspections were mainly based on interviews and reviews of documentation. Differences in the interpretation of some questions in the inspection template by different inspectors were observed, and areas for improvements identified. Even though this Action Week must be considered as a pilot study, the results obtained provide strong indications of the weak links in the justification process.

Implementation of the principle of justification varied among countries. Often, justification was only covered in general terms by the quality system and the justification process was not formally described and documented in procedures. However, established routines covered, to some extent, important steps in the justification process in most countries. Radiologists are mainly involved in the evaluation of referrals for CT, MR and “high-dose” or complex examinations, while radiographers are often allocated this task for many conventional X-ray examinations. In such cases it is usual to find examination appointments are arranged before referrals are evaluated. Radiographers almost always evaluate the referrals and check for pregnancy and other contraindications at the time of appointment, and immediately before the examination is performed. In this respect, radiographers carry out the key aspects of the justification process whether formally or informally, as a responsibility or as a delegated task. It is important that the different steps and associated tasks and responsibilities

are recognized by management, formalized in procedures and that involved staff receive proper training to take on the assigned tasks and responsibilities. Despite the presence of procedures and routines, steps in the justification process are sometimes not followed in daily practice. Lack of time, payment per procedure/examination, reimbursement systems and loyalty towards the referrers were given as reasons for this situation.

Reviews of the referrals indicated a need for improved quality, more structured referrals and harmonized guidance on minimum information to be included. Generally, the quality of referrals was worse among general practitioners, but large variations were observed among participating countries. Many inspection teams found it difficult to evaluate the quality of the referrals due to lack of expertise and the involvement of a radiologist in the team is highly recommended. Use of referral guidelines is modest and in many countries the only referral guidelines available are those covering standardized pathways for cancer and information about the radiation dose or risk is seldom included. The inspections revealed that the concept of clinical audit is not fully understood and rarely performed within medical imaging. Review of national regulatory frameworks among the participating countries also indicated that referral guidelines and clinical audits were not fully implemented at a national level.

Conclusions from the European Action Week: There is still a need to increase the awareness and to reiterate the importance of the justification process. Inspection is a good tool to address justification and HERCA will follow-up the identified weak links by providing targeted key messages to involved stakeholders on how they can take responsibility to act on the different aspects of the justification process.

ACKNOWLEDGEMENTS

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NATIONAL AUDIT ON THE ADEQUATE COMPLETION OF MEDICAL IMAGING REQUEST FORMS IN LUXEMBOURG

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Abstract

The high frequency of radiological procedures in Luxembourg results in an overall total collective effective dose per caput that is among the highest compared to other European countries. For this reason the Ministry of Health and the Ministry of Social Security decided in 2015 to put in place an action plan in order to reduce the number of unjustified radiological procedures. The first part of this action plan was a national audit on the adequate completion of medical imaging request forms. The aim of the audit was to evaluate the quality of the requests and the compliance of the requests with Luxembourgish legislation. For this audit the adequate completion of 200 requests was evaluated per radiology department. The audit was carried out in all 10 radiology departments of Luxembourg. The results of the audit clearly show that the compliance rate of requests for medical imaging in Luxembourg is overall unsatisfactory. Of the 2000 requests audited only one single request included all mandatory information. 42% of the requests were in conformity for the presence of the items "clinical background" and "question to be asked", while 39% had only one of these two items and 19% had none of these items. From the results of this audit it is clear that there is a need for improvement of the quality of the requests in Luxembourg. This can be achieved mainly through the education and training of the referrers.

1. INTRODUCTION

Two fundamental principles of radiation protection according to the International Commission on Radiological Protection system are the justification of medical radiological procedures and the optimization of their dose [1]. According to the principle of Justification as described in the International Basic Safety Standards [2] and the European Basic Safety Standards Directive [3], the medical exposure from a radiological examination shall show a sufficient net benefit weighing the total potential diagnostic or therapeutic benefits it produces against the individual detriment that the exposure might cause. These principles are anchored in the Luxembourgish legislation [4]. The principle of Justification is difficult to implement in the medical field, in particular because of the multiplicity of different stakeholders involved in the process of justification: the patient, the referrer, the practitioner and the undertaking.

In 2000 and 2009, the European Commission carried out a project with the objective to collect data on doses received by patients following radiological procedures in the European Community [5]. The results of these projects showed that the frequency of medical radiological procedures in Luxembourg is among the highest in Europe and is continually increasing. This results in a high overall total collective effective dose per caput due to radiological procedures in Luxembourg. In principle, any medical radiological examination should be justified by the expected medical benefit for the patient, but studies in other European countries have shown that the proportion of unjustified examinations can reach 20-30% or more [6-8].

In this context the Minister of Health and the Minister of Social Security adopted on 18 December 2015 an action plan to promote the use of referral guidelines in medical imaging and in particular to reduce the number of unjustified radiological procedures [9]. The first phase of this action plan consisted of a national audit on the conformity of medical imaging requests. It was considered that the long delays for obtaining an appointment for imaging modalities such as MRI or ultrasound could be a contributing factor to the high frequency of CT imaging. For this reason it was decided to carry out the audit on all types of medical imaging requests received by radiology departments, and not only on requests for medical imaging procedures using ionizing radiation. This paper describes the results and conclusions of the audit, the purpose of which was to

verify whether the requests for medical imaging examinations included all the information according to current legislation and standards of good practice.

2. METHODS

The method used for this audit was based on that proposed in the publication “ Clinical Audit in Radiology100 + recipes” [10]. According to this method a standard has to be established and local practice is evaluated using collected data items and an indicator. The findings are then compared with the standard.

The standard used for this audit was based on the Luxembourgish legislation. According to this legislation all requests for medical imaging examinations using ionising radiation must include the following mandatory items: surname and name of patient, patient identification number, age or date of birth of the patient, sex of the patient, name of the referrer, contact details of the referrer, date of the request, type of examination requested, question to be answered, clinical background, information on previous examinations, information on a possible pregnancy, validation signature of the referrer and validation signature of the practitioner. The adapted standard for this audit was defined as the presence of each of these items on all types of medical imaging requests. The indicator was the percentage of request forms with adequate items. The data collected were for each request the presence or absence of the mandatory items in the standard. The audit was carried out in 2016 on 200 requests for medical imaging examinations per radiology department. All 10 radiology departments of the Luxembourg hospitals participated in the audit. This audit was carried out by two auditors from the Ministry of Health who verified the presence of the mandatory items according to the standard. In order to further refine the results of the audit by sub-group, the following additional information was also retrieved: the identification of the radiology department, the type of specialty of the referrer, the type of imaging modality for the requested examination.

The data collected was analysed and the following global statistics were extracted: percentage of presence for each type of mandatory items and percentage of requests for which all mandatory items were present. These statistics were also refined according to the following subgroups: radiology department, type of referrer specialty and type of imaging modality for the requested examination. The auditors prepared a national summary report of the results, which included these statistics. The report was transmitted to each of the participating radiology departments. The radiology departments held meetings to discuss the findings of the audit and to propose changes in order to improve the completion of the request forms.

3. RESULTS

A sufficient number of requests were audited in each of the 10 radiology departments. Anonymised data for a total of 1998 requests was collected (two requests were unacceptable). The percentage of presence for each of the 14 mandatory items on the requests, starting with the most present item to the less present item, is shown below in Fig. 1.

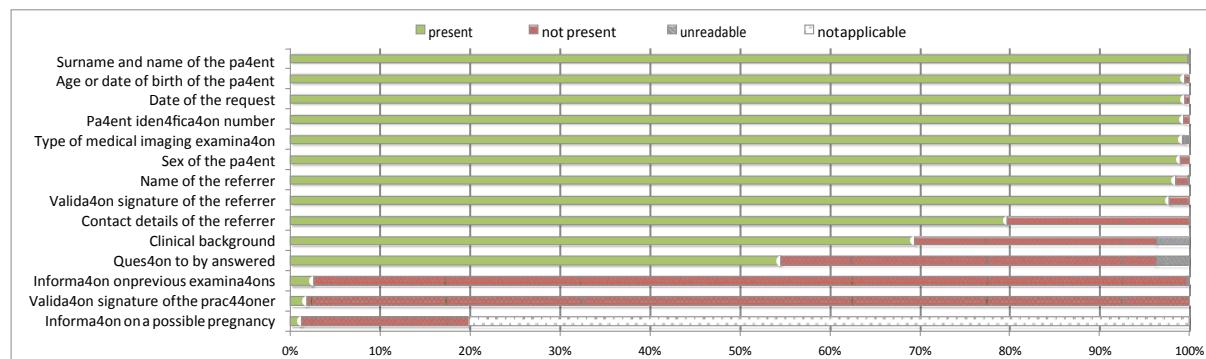


FIG. 1. Percentage of presence of each item on the request forms. “Not applicable” means that a request does not concern a female patient with age between 15 and 55 years old.

The items “surname and name of patient”, “patient identification number”, “age or date of birth”, “sex”,

“name of the referrer”, “contact details of the referrer”, “date of the request”, “type of examination requested” and “validation signature of the referrer” were present on more than 95% of the requests. The items “information on previous examinations” and “validation signature of the practitioner” were present on less than 5% of the requests. The item “information on a possible pregnancy” was present on only 6% of the requests where the sex was female and the age was between 15 and 55 years old. The item “clinical background” was present on 69.5% of the requests and the item “question to be answered” was present on 54.5% of the requests. Of the total of 1998 requests 42% had both of these items, 39% had only one of these items and 19% had none.

The percentage of the presence of the two items “clinical background” and “question to be answered” per radiology department is shown in Fig. 2. It can be seen that there is a difference in the percentage of these items present on the requests for the different radiology departments with three times more requests having both items present for the radiology department ‘h’ compared to the department ‘j’.

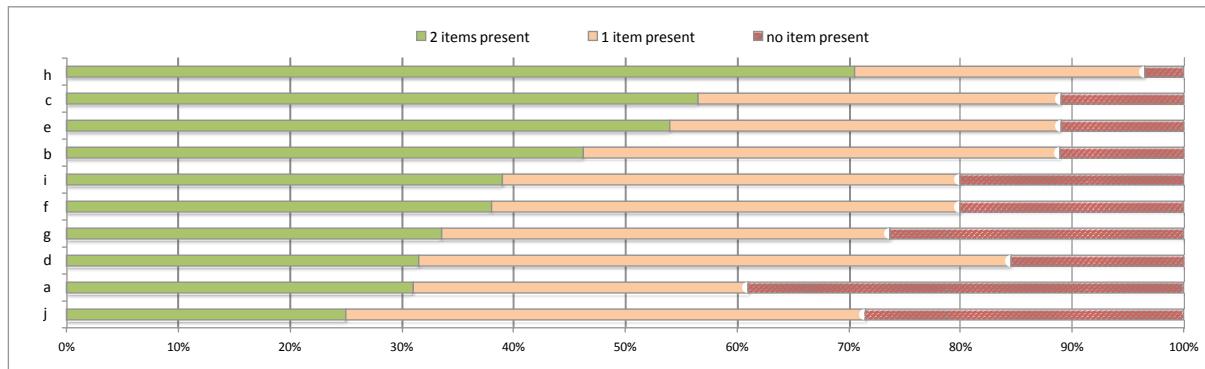


FIG. 2. Percentage of presence on the request forms for the items “clinical background” and “the question to be answered”, for each radiology department. Each radiology department is identified by a letter. “2 items present” means both items are present.

All requests were classified according to the medical specialty of the referrer: general practitioners (643; 32%), specialists (1155; 58%), dentists (35; 2%), undetermined specialties (165; 8%). Fig. 3 shows the percentage of presence for the two data items “clinical background” and “question to be answered” according to the specialty of the referrer. It can be seen that there is a difference on the presence of the two data items depending on the specialty of the referrer.

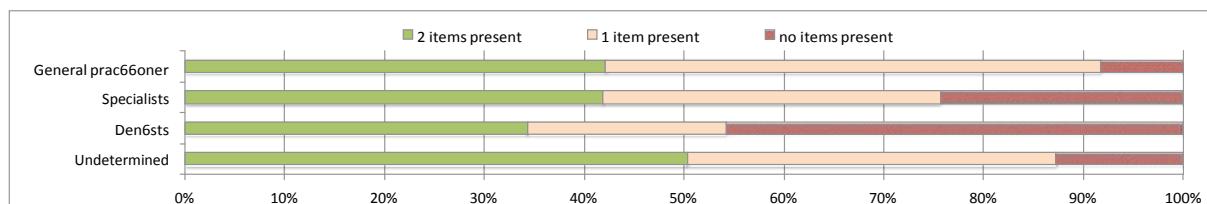


FIG. 3. Percentage of presence on the request forms for the items “clinical background” and “question to be answered” according to the specialty of the referrer.

All requests were classified according to the imaging modality: radiography (924; 46%), CT (438; 22%), echography (378; 19%), MRI (191; 10%), other (67; 3%). Fig. 4 shows the percentage of presence of the two items “clinical background” and “question to be answered” according to the imaging modality. It can be seen that the presence of the two items is greater for the requests for CT examinations than it is for the requests for conventional radiological examinations.

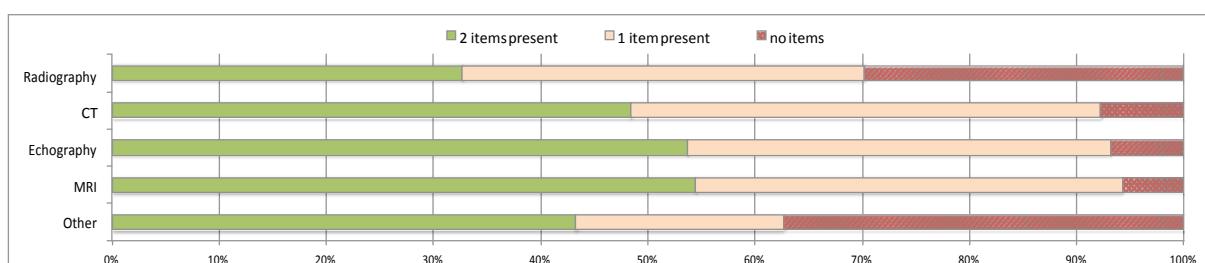


FIG. 4. Percentage of presence for the items “clinical background” and “question to be answered” according to the imaging modality. “other” includes mammography, dental imaging, and undetermined modality.

4. DISCUSSION AND CONCLUSIONS

This national audit was conducted in the 10 radiology departments without any constraint. The results of the audit clearly show that the compliance rate of requests for medical imaging examinations in Luxembourg is overall unsatisfactory. Information concerning “clinical background” and “question to be answered” is necessary for the justification of medical imaging examinations using ionising radiation. This audit showed that this information was not present on a number of requests concerning this type of imaging examinations.

The request form used for medical imaging examinations is not adapted to the needs of today. It is an old style order form. From the audit it is clear that there is a need to develop a new request form specific to medical imaging. The referrers need to be trained and educated on the correct completion of request forms, the use of referral guidelines and on current legislation. The practitioners need to be trained and educated on current legislation. Communication between referrers and practitioners needs to be promoted. Easy access to previous medical imaging examinations should be made available to both referrers and practitioners. Internal clinical audits should be carried out by the hospitals themselves. This audit had as a result to make the radiology departments and the hospital managements aware of the fact that a large percentage of request forms for medical imaging examinations are not compliant with current legislation and has made them take actions to improve this situation. The main action being to send back individual request forms which are incomplete.

ACKNOWLEDGEMENTS

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JUSTIFICATION IN PRACTICE, IS IT WORKING? A MEDICAL PHYSICISTS VIEW

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Abstract

There have been a substantial number of recommendations from the ICRP to the Bonn Call for Action, all suggesting what should be done and what the benefits would be in applying the Principles of Justification. This paper examines the practical implementation of the recommendations and the difficulties faced by Referrers, practitioners, managers and physicists and discusses issues raised for all users involved in the implementation of the justification process. It appears that the difficulties are numerous from providing 'best practice' imaging within finite budgetary resources available to the differing interpretations of how the recommendations are to be implemented. The process of developing and improving awareness and demonstrating its effectiveness, auditing current practice and implementing change where necessary to alter the mind set of referrers with regards to modality and examination of choice for a given clinical need, in the rapidly evolving modern healthcare environment, and a market shift towards cross-sectional imaging which is costly in terms of capital investment, staffing and limited capacity, and the difficulty in justifying such examinations is more complex than would appear on paper and in theory.

1. INTRODUCTION

There has been a continued desire and attempt at justifying the referral of examinations using ionizing radiation; how effective and easy that has been is subject to question. IAEA workshop in 2011 [1] identified the difficulties, identifying the 3 A's (Awareness, Appropriateness and Audit). There have been recommendations from the ICRP since 1960 with updates including the publication 103 in 2007 [2] and the joint position statement by IAEA and WHO 'Bonn call for action' in 2012. The need for justification in the ethical context has been discussed by Malone [3], along with regulatory requirements EURATOM [4], IRMER2000 [5] as well as recommendations from professional societies including RCR [6]. These are great and motivational but how easy are they to implement in practice?

2. REFERRERAL POLICY

In the UK the Royal Collage of Radiologists (RCR) have a software application package called iRefer. The American Collage or Radiology (ACR) [7] have a similar grading system. These provide guidance to the referrer in the selection and justification of examinations, in line with the requirements of the Ionising Radiation (Medical Exposure) Regulations 2000 (IR(ME)R) 2000. Under these regulations, the referrer must supply sufficient relevant information pertaining to clinical need given the patient history, to enable the practitioner to justify the exposure and follow the recognized pathway for referral and investigations. The referrer should request imaging to confirm their diagnosis, not make it, however this is debatable in practice.

As part of the referral policy there will be a statement giving the radiographer/operator the right to question and refusal of the exam due to any contraindications. Radiographer awareness of the national and local dose reference levels (NDRLs, LDRLs), using them as a guide in keeping doses as low as reasonably achievable (ALARA), this has the potential to become a controlling factor in both justification and optimisation and the individual radiographers' experience and level of authority has a significant impact on the application of this safeguard.

3. DIFFICULTIES

Referrers, or practitioners who are able to referrer examinations are defined by the hospital and can vary from GP's, to other doctors, dentists and other health care professionals, they are generally registered and experienced individuals. They possess a core of knowledge in radiation protection; this knowledge may have been acquired a long time ago and the frequency of updates is questionable. A bigger concern is that the quality of such training is difficult to assess as there is no standardization. As the referral is pathology guided, knowledge of the modalities capability is integral to that process and without updates and constant refreshers on what the technology is capable of this becomes a limiting factor in the justification process. Keeping up to date with the functionalities available on all modalities is not only time consuming, but costly and in a limited financial climate can be one of the first options to be dropped. The financial cuts required to maintain patient services, along with the constant addition of new system capabilities by the manufacturers to get ahead in the market mean that physics support is stretched to its limit and sacrifices are made. Such sacrifices can include time and effort spent on optimisation and improving the justification process where showing the benefit is not easily proven.

Making changes to formatting, policies and training needs are extremely difficult due, not only to the bureaucracy involved, but inevitably the idiom of 'if it's not broke, don't fix it'. The important factor in meeting the requirements becomes 'Are we within the NDRLs, do we need to report it to the Care Quality Commission (CQC) or Health and safety executive (HSE)? In the national health service (NHS) maintaining the approval of CQC is a determining factor in the ability to provide a service, in the private sector the fear of investigation sometimes has a positive impact on implementing the justification process.

4. WHAT HAPPENS WHEN IT GOES WRONG?

An internal audit of the implantation of the OTTAWA rules in the referral of CT ankle examinations, it was discovered that even though the instructions were present and criteria clearly laid down, only 5% (2/42) of the referrals were justified under the rules. However, radiographers were unable to question and reverse the decision due to hierarchy and seniority and in all 95% cases not following the rules, the remote possibility that it could have shown a fracture was enough to justify the exam. At a different site an audit of the confirmation of the area of examination with the patient showed a 72% (364/505) compliance. Recent publication by Faggioni et al [8] concluded that radiology residents and radiography students have limited awareness about radiation protection and understanding of real radiation doses of examinations. Which leads to the question of where does justification start and finish? The answer is complex and requires investment of time, money and manpower therefore unlikely to be a high priority.

When an examination is unwarranted but the dose and risk does not meet the criteria for reporting due to not being outside the multiplication factor according to the CQC, are these to be ignored and the justification process remain unchanged? The answer goes back to ‘if it’s not broke, don’t fix it’. The increasing use of electronic requesting may lead to improvements in the referral process but it does increase the concern over authorization and responsibility. In law the justification process is descriptive and not prescriptive enough to make prosecution almost impossible. If there is no potential threat of the law, why spend time and effort on it?

5. CONCLUSIONS

The principles of justification are well accepted and seen as a great idea. There have been great improvements in the guides to referrers in the justification process but it is still far too easy to justify any request whether needed or not. In the practical world the implementation is seen as both difficult and costly. The key issues include: training and education of doctors and future referrers, the newly qualified doctors may have had little training in appropriate radiological requesting and image interpretation; the perceived hierarchy can prevent radiographers from vetoing examinations when contraindications are present; the need for all involved to be up to date with the advancing technology and the potential benefits; the communication of risk in a simple and easily understood format remains a concern; the lack of clarity of auditing and the role of medical physicists needs improving. Some practical guidance on auditing, methodology of implementation and more enforcement powers for relevant authorities for poor implementation may improve the justification process.

6. ACKNOWLEDGEMENT

V. DEAN Reporting Radiographer.

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MEDICAL IMAGING AND RADIATION PROTECTION IN ALGERIA

CHALLENGES AND PERSPECTIVES

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Abstract

In Algeria, largest country in Africa, the investment in the health system by introducing new technologies in medical imaging transformed how health care is delivered, giving more people in remote areas access to better care.

Even with these strides, however, the healthcare system faces big challenges to match the safety practice due to an insufficient awareness of radiation protection by the professionals.

So the access to the international requirements and recommendations as outlined by the Bonn Call for Action helps both health professionals and policymakers make better-informed decisions about how to continue to improve and perform the system, to provide an efficient response to a good medical practice, ensuring that the benefits outweigh risks in all radiological medical procedures.

Progress in Algeria is well illustrated by several actions already taken as revising the sanitary law, the establishment and implementation of regulations to standardize with the development of policies, guidelines, and a launch of a cancer plan (2015-2019).

The topic of radiation protection is ongoing concerning the knowledge, the skills and also the chapter of culture related to the safe use of radiation.

1-INTRODUCTION

Since its independence (1962), Algeria has made enormous efforts to promote and defend health in the last fifteen years in the field of the non-communicable diseases as cancer.

In terms of resources, Algeria, largest country in Africa (2381741 km²), with a total population of 41,6 M (2017), a life expectancy at birth M/F of 74/78 , a total expenditure on health per capita in \$ of 932 , a total expenditure on health as % of GPD of 7.2 (WHO, 2014) has invested large resources in financing, infrastructure, equipment and human resources.

2-MATERIAL and METHODS

-Participating institutions:

Ministry of Health: Ministry of health (MSPRH, Algeria), Atomic Energy Commission and Nuclear Research Centre of Algiers (Regulatory body COMENA and CRNA, Algeria)

- Evolution of the health system

Linked to several factors (demographic and epidemiological transition, economic and social factors) four critical periods are defined, ranging from 1962 to 1972 marked by a dramatic shortage of health workers; 1973 to 1986 important measures as the free care, reform of university, education in medicine and the sanitary law 85-05; 1987 to 2003 the reforms of the health system devoted to a concept of hospital-technical platform ; and since 2004 the new approach for the development of the health organization system.

-Infrastructures and human resources

In terms of infrastructure, Algeria has a very wide coverage of the territory provided with a high number of establishments ranging from the care room to the university hospital.

Algeria currently has in the public sector 15 university hospitals, 481 regional hospitals, 75 hospitals specialized, 1659 polyclinics, and 5077 treatment rooms; 01 hospital and 299 clinics in the private sector.

Algeria has a medical density of 01 M.D for less than 600 inhabitants. Medical and paramedical staff have adequate operating standards.

Medical imaging is covered by more than 1400 radiologists, 2500 paramedics, using more than 574 CT, 150 MRI, 2800 X rays, 281 mammographs, 120 fluoroscopic devices, 2165 ultrasounds, with an introduction of a large scale of digital modalities.

Since 2011, the medical physicist is recognized as a health professional. A potential of approximately 100 medical physicists works in different radiation medicine departments and in research sectors. Presently, 59 medical physicists having received an adequate training practising in radiotherapy departments, 12 in nuclear medicine departments and only 04 in medical imaging. 12 medical physicists are in the research sector. Recently, in 2015/2016, a training of 16 of radiation protection officers (RPO) has been organized by the Ministry of health and the regulatory body with a project to extend the number will cover the major departments.

-Legislative, statutory and regulatory framework of radiation protection

The health sector is governed by Act No. 85-05 of 16 February 1985 on the protection and promotion of health, amended and supplemented, and by a number of regulatory instruments organizing public institutions under tutorship, public and private institutions, as well as prevention and care activities

The Presidential Decree 05-117 fixes the general rules of protection against the risks of the ionizing radiations. It fixes also exclusions and exemptions, regulates the professional exposures, the potential exposures, the medical exposures, the exposures of the public and the emergency situation.

To strengthen the capacities of radiation protection two new decrees was published on 2015 related to the medical supervision of workers exposed to ionizing radiation, the optimization and the DRL's. The decrees include several sections related to justification, control quality, and assurance quality.

The Atomic Energy Commission (COMENA) created by decree 96-436 of December 1996, is the authority as regards protection against ionizing radiation.

The Nuclear Research Center of Algiers (CRNA), created by decree 99-86 of April 1999 and placed under supervision of the COMENA, provides the technical support related to radiation protection

3-RESULTS

Today, profound changes have affected all the health system due to the demographic and epidemiologic situation and impose the draft of a new law introducing reforms as the strengthening the rights of citizens, the development of the health organization scheme, promoting good practices in medical activities, modern management tools and new technologies.

It obviously integrates institutional, social and economic changes at the level of all sectors. It also takes into account the emerging issues within international health institutions.

The organization of care in Algeria is based on the principle of a pyramidal hierarchy allowing a continuum of the care of patients from community structures to referral centres.

The pyramidal organization of care include the private sector, without forgetting the role of loco-regional structures whose coordination should be organized, which is foreseen in the future health law.

The decision by the authorities to set up a "National Cancer Plan" for the period 2015-2019 aims at gathering and organizing, in the face of this scourge that is cancer; where medical imaging plays an important role in all phases of cancer management. This is dependent on technological means which are costly and in constant progress; which requires standardization of equipment, adapted and scalable training of staff to ensure quality care, by the reinforcement of equipment for medical imaging services in sufficient quality and quantity, putting in place a policy of regular maintenance of these equipment; the development of biomedical engineering; the improvement of the safety for the radiation protection of the practitioners and the professionals of radiation departments including medical imaging services and nuclear medicine services the institutionalization of medical physics in medical imaging to strengthen radiation protection, quality assurance and safety programs; the compliance with quality assurance and safety standards.

Nuclear medicine is part of the group called Imaging Medical because it is subject to the same rules of practice and procedures with a more prescriptive and regulatory, in particular due to the use of radioelements.

Today the new technology is transforming how health care is delivered in Algeria. Contemporary discussions in radiation protection entail a systematic articulation of the health system as well as the explanation of how the professionals apprehend reality and interpret their experiences. The emergent notion of justification and optimization in the context of radiation protection, need to be strengthened taking in consideration the weakness in the field and related to the culture and the knowledge of the professionals.

At the international level, the technical cooperation program 2016-2017 covers all the field of human health.

The technical cooperation activities of Algeria with the IAEA recorded in the National Framework Program (NCP) 2012-2017 are illustrated by the activities implemented illustrated as follows:

- As part of the national cancer control program and with the support of the IAEA, new diagnostic modalities in nuclear medicine such as Positron Emission Tomography(PET) as well as new treatment techniques and in radiotherapy such as tomotherapy.

- The integration of quality assurance programs in medical services has been privileged, with the training of qualified medical physicists.

- The recommendations of phase II of the mission Im PACT carried out in Algeria were the subject of an action plan allowing the setting up of all the new anti-cancer centres being received in the different regions of the country, in accordance with standards and good practices related to the use of ionizing radiation.

In December 2015, the NCP achieved a completion rate of 92%.

In addition, Algeria has contributed with the IAEA (AFRA , RAF project) to the organization of a large number of regional courses and workshops in the field of medical physics, radiotherapy, nuclear medicine and medical imaging.

The involvement of the Ministry of Health, the Ministry of Higher Education and the Atomic Energy commission (COMENA) is ongoing for the implementation of a program of radiation protection, which will be part of the implementation of the ten actions identified in the Bonn Call for Action (IAEA/WHO 2012) and a support is given to the radiation protection awareness campaign, such as Arabsafe or Afrosafe . As part of this campaign, Algeria was selected by the IAEA to pilot a project to adapt the use of the clinical imaging guidelines

The cooperation and the assistance of the IAEA in strengthening member state technical capabilities in medical radiation protection in compliance with requirements of the new International Basic Safety Standards (BSS) are expressed through several projects (RAF 9033,RAF 9044, RAF 9057,RAF 9059,RAF 6048), and actions as local DRL's in radiology and cardiology (published in radiation protection dosimetry,168 (1), 55-60,2016), and in mammography and CT(work ongoing)

4-DISCUSSIONS

Today, profound changes have affected all the activities of the political, economic and social life of the country

Algeria remains confronted with both the health priorities of developing countries and those of developed countries, including an increase in non-communicable diseases.

In its successive constitutions, it has enshrined the right of citizens to the protection of the health, realized by a gigantic effort with the development of national health programs, massive training in the medical and paramedical fields, infrastructure and equipment.

Health planning involves an equitable distribution of human, material and financial resources, as well as the organization of activities and the development of human resources; while specifying the complementarity of prevention, care and rehabilitation activities; the most efficient diagnostic and therapeutic approaches, technological innovation; and the research.

Medical imaging occupies a prominent place with involvement in three outstanding health system issues. First, the hospital reform launched in 2002 to respond to the changes brought about by the various demographic, epidemiological transitions, which defined the concept of hospital - technical platform; followed by the implementation of the Cancer Plan 2015-2019, with the main objective to provide access to an adequate and appropriate care; the draft of the sanitary law which will be adopted deals with all aspects of an effective health care system .

Thus, the national health policy and system base the principles of health protection by involving all institutions, and the society in the promotion and the prevention of medical conditions considering the growing advances linked to the technological progress and the development of science and medicine in order to ensure the best access to diagnosis, care and quality services including the safety chapter taking into account the benefits and the risks in the use of ionizing radiation.

Unfortunately, until now weaknesses for a safe use of ionizing radiation are reported.

Medical imaging growth quickly with the availability high-tech medical imaging equipment such as multi-slice helical computed tomography (CT), single photon emission tomography (SPECT) and positron emission tomography (PET), as well as hybrid systems that allow the fusion of morphologic and functional information. The number of medical physicists is sharply insufficient for all the structures considering several important centres of medical imaging with the strong technological overhang which requires medical physicist presence.

. The radiation dose delivered to the patients during those medical procedures must be closely monitored by dosimetric tests performed by medical physicists. It is necessary to have a sufficient number of clinically qualified medical physicists in Medical imaging to ensure patient security and for the establishment of QA/QC programs. Professional accreditation or registration with a competent body such as Ministry of Health or professional body is strongly needed to ensure and permit medical physics services.

The lack of the awareness and the poor knowledge of the professionals concerning the radiation protection is due to the curricula, radiation protection is not included in the education program on graduate or post graduate.

The establishment and implementation of regulations to standardize the development of policies, as clinical decision support and guidelines for the safe use of radiation is required.

The implementation of the BSS, and the Bonn Call for Action guided by the principles of justification and optimization must be driven for a good and safe medical practice.

The objectives of the future sanitary law are to adapt our health care system to the country's socio-economic environment and the advances of medicine in the world. The law introduces the right to health protection by establishing the principle that health actors must use all available means to implement it and for the benefit of all persons.

The health policy will cover the whole field of health, such as protecting the population against risks, whether related to the environment, food, toxic products or the health care system, the continuity of care and health security.

The implementation of a profound dynamics involving a revision of the laws and the health policy with the national plan of cancer (2015/2019) inscribed in a multi-sectorial approach take in consideration all the aspects related to the security and makes it possible to prejudge a certain future for the development and the perennity of radiation protection in Algeria.

The perspectives consists to strength the traditional programs; the launch of new programs for early diagnosis of non transmitted diseases; the worth, qualification and promotion of personnel; logical use of human potentialities; the rational and safe use and availability of equipment taking, the efficient chain of cares and the financial aspects (resources, management and best health cost control).

The reforms of the programs of education for the professionals and the implementation of a culture of safety for the public could be directed in the future.

5-CONCLUSIONS

The international and national context is the source of social, economic and cultural changes imposing constraints specific with the aggravation of dysfunctions in the quality of care due to the demographic and epidemiological transition.

In order to guarantee equity in access to care for the population, an important program to increase and improve care capacities with a comprehensive development plan, strengthening and upgrading the system is embarked.

With the emergence of new techniques, the medical use of ionizing radiation continues to intensify. The number of facilities continues to grow and applications are constantly diversifying, and the extent of radiation exposure has increased.

The cancer plan 2015/2019 and the new sanitary law will ensure the success of a safe and secure policy, with a constant concern for the safety of the professionals and the patients.

The goal is to enhance the capabilities related to the prevention, diagnosis and treatment of diseases using medical imaging.

Radiation used must be delivered in the most effective and safest way.

Considerable efforts have been made by the IAEA through the AFRA program to support the efforts in the development of infrastructures and the training of human resources, to ensure adapted solutions for the safety as in medical imaging.

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THE ROLE OF RADIOGRAPHERS AS GATEKEEPERS IN THE JUSTIFICATION PROCESS

Project initiative and possible impact

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Abstract

The contribution of radiographers in the process of justification can improve the quality of care, and facilitate radiation protection as well as the resource utilisation in radiology. The paper present a project aimed to develop the skills of the radiographers in assessment of medical imaging referrals. It involves survey of the expectations on roles from a professional and management point of view, identifying knowledge gaps, and the design of new courses on bachelor and master level, implementation on selected university radiographer colleges in Europe and Australia, and research to evaluate the outcome. The project ideas are shared as input to the next IAEA action plan for radiation protection in medical sector.

1. INTRODUCTION

Diagnostic imaging is a core element in modern medicine; most other medical disciplines would be almost unrecognisable in the absence of these services. Radiological services is needed to exclude and detect diseases, and to assess responses to therapy. It also expands beyond diagnostic purposes by supporting or replacing traditional treatment technologies. The increased demands for services combined with a lack of radiologists, are reasons why the radiology department can become a bottleneck in health care [1]. We are challenged by inappropriate and unjustified imaging, i.e. examinations that are not medically useful, necessary or indicated (i.e. overutilization). The proportion of unjustified CT examinations is estimated to be 20 - 30% [2, 3]. Inadequate referrals is a substantial problem causing unjustified imaging, and the quality of the information in the imaging referral is the centre of this problem [4, 5]. The negative consequence in shape of ineffective use of health care resources is obvious. The other main problem involved is the potential hazards from exposure to ionising radiation. The principle of justification applies to three levels [6], of which justification of a procedure for an individual patient is of special interest here. Excessive utilization and unnecessary examinations also represents a practical and moral challenge for radiologists and radiographers [7], partly due to radiation protection considerations.

Measures to ensure appropriate investigations for each patient delivered in a timely manner will therefore be beneficial for many reasons. The referral is the key source of information that enable radiographers and radiologists to provide good quality services i.e. to conduct appropriate examinations (using proper modalities and techniques) and provide appropriate radiology reports [8]. This means that vetting and justification of referrals need to be a team work including radiographers, radiologists and referring clinicians. Radiologists play a critical role in justifying and accepting examination requests as, by virtue of their medical training, to ensure the clinical question is answered. However, increasingly [in UK] these roles are shared with radiographers and delegated to other team members that have undertaken appropriate training [9]. A study of Norwegian radiologists show that they act upon inadequate referrals regularly, mainly by searching for more information [4]. Nevertheless, the radiographers' contribution to vetting and justification of referrals is largely on unknown. As they are the first and often only health care professional interacting with the patient in the radiology department, they are in a good position to recognise cases of duplicate examinations, questionably indicated examination, and patients undergoing multiple similar examinations [10]. Radiographers are responsible for notifying the radiologist in cases suspected unjustified referrals, and their role can be to discuss imaging requests with the referring clinicians [11]. The referral process is illustrated in FIG. 1 showing the various actors involved. – The question is if the tasks and responsibilities for vetting and justification of referrals can be shared between health professions in a more efficient manner, and what preparation, precondition and premises this would require.

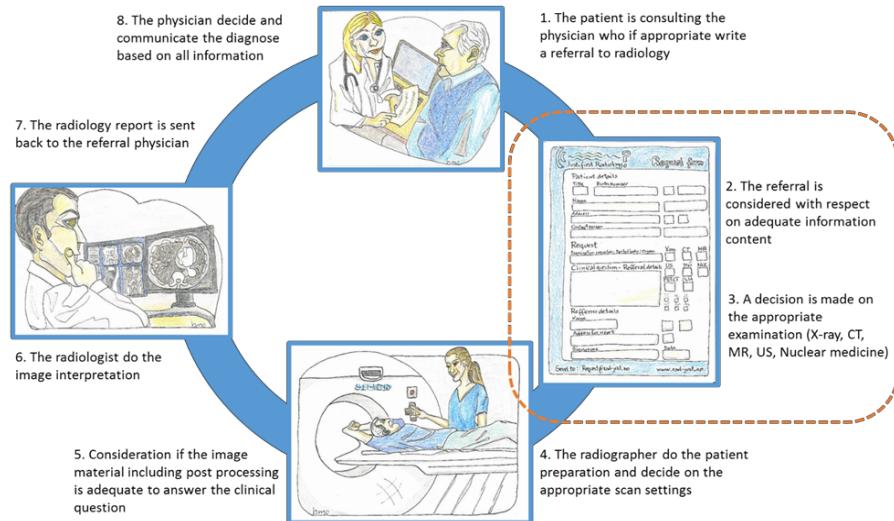


FIG. 1. The referral process explained in eight steps – the project proposal concerns step 2 and 3.

1.1. Research aim and objectives for the project abbreviated RAD-JUST

The primary objective is to develop the role of the radiographers as gatekeeper for referrals to the radiology department; to ensure the radiographers are sufficiently skilled and trained to contribute in the process of vetting and justification of radiological examinations, and by that improve the quality of services and the resource utilisation in radiology and health care services as a whole. The secondary objectives are (FIG 2):

- To understand how actors in the radiology department perceive the current situation on roles, responsibilities and collaboration in the referring processes (WP1)
- To evaluate the radiographers perceived abilities and preferences in vetting of referrals (WP2)
- To survey the content of justification issues in the syllabuses in radiographers education, and design tailor-made training on bachelor and master level in the education of radiographers (WP3)
- To evaluate the initiative with respect to how it will increase the radiographers ability and confidence when contributing in a multidisciplinary team with physicians and radiologists to ensure the quality of the referrals, and give advice on the appropriate choice of examination (WP4)

2. APPROACHES AND CHOICE OF METHOD

2.1. The role of radiographers and radiologists in the referring process (JUST-ROLES)

The initial study will make use of qualitative focus-group interviews; groups of radiographer, radiologists and leaders in Norway, recruited based on variations in professional positions, education, age and gender, as well as covering different locations, medium sized radiology departments, delivering various common examinations. The outcomes of the initial focus-group study will feed into the construction of the questionnaire to survey the radiographers' attitudes and experiences of vetting and justification of referrals. Members of the radiographers association in Norway and Sweden will be invited (6000 possible respondents).

2.2. Evaluating the radiographers vetting of referrals (JUST-VETTING)

A number of hypothetical but yet credible patient cases and referrals will be created. The referrals will address issues concerning a) patient data – connected to the executing of the examination b) medical indications – connected to the radiology report and c) diagnostic modality and specification of examination – connected to justification. We will create about five referrals for a number of frequent radiological examinations, such as the examinations of the brain, lungs, abdomen and extremity. We will consult radiologists for validation of these sample referrals. The abovementioned issues of concern will be tested by use of electronical quest back.

2.3. Learning objectives, curriculum and teaching material (JUST-SYLLABUS)

The content of current bachelor curriculums in western countries will be studied as input to the design of a tailor-made syllabus on justification to inspire both bachelor and master level radiographer educations. One master level course will be designed for a digital learning environment to recruit students internationally.

2.4. Implementation at selected radiography schools (JUST-IMPLEMENT)

W4 aims to implement the new syllabus and training programme created in WP3 to selected university radiography colleges and evaluate the initiative. The colleges will be selected in collaboration with the ISRRT; as planned currently this will involve educational institutions in Australia, Norway, Sweden, Turkey and UK. Evaluation from the students' perspective will be done based on focus group interviews in the start, middle and end of the course. An assessment tool organized for the university radiography colleges will be created.

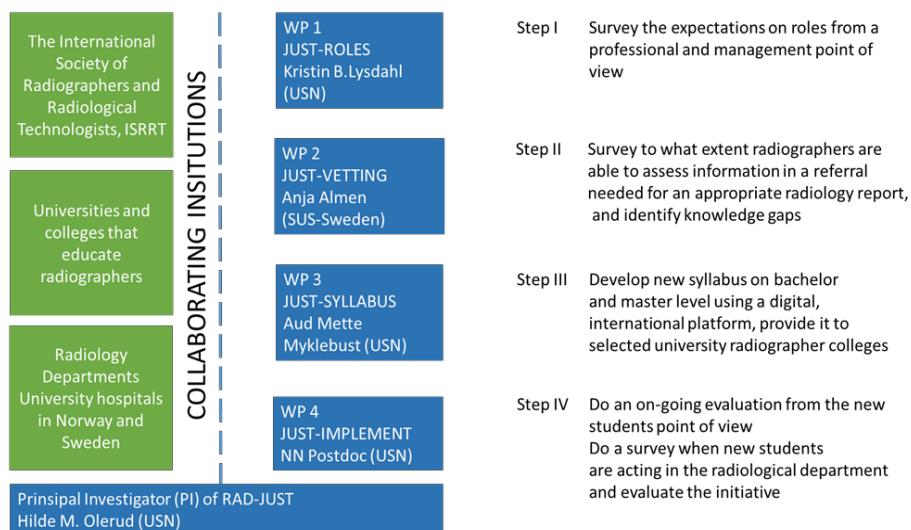


FIG. 2. How the proposed project RAD-JUST are planned in work-packages chaired by experts representing both the University College- and University Hospital sector.

3. PRELIMINARY RESULTS

There are recognized differences in syllabuses between radiographer educations in Europe in the content of justification. The level and length of the education is different, from high school level to bachelor, four - year education to master level. WP3 will therefore provide a long list of topics that other universities can supplement from. Even though the scope will vary between bachelor and master level, the following topics are relevant:

- The normative foundation of justification of medical exposures as addressed by the international organizations in regulations and recommendations
- Typical work flow from doctors office to appropriate investigated patients – health professionals involved in various steps in the flowchart
- Radiological equipment and modalities with pro- and contras on what sort of clinical questions they can answer
- Update technology knowledge: Planar X-ray radiographs and fluoroscopy, angio/intervention, Flat detector CT, Computed Tomography (CT), Magnetic Resonance Imaging (MR), Ultrasound
- Improve anatomy and pathology skills for radiographers
- Referral criteria and guidelines. What are the clinicians' needs, about what are their concerns?
- A good referral – what kind of information should be included. Appropriateness criteria [12]
- The radiographer as gatekeeper for the justification process; how to work in a multidisciplinary team
- Radiation risks and risk communication in a person-centred perspective

4. DISCUSSION

There is a comprehensive use of radiology in western part of the world. When a patient suffers from certain clinical symptoms, the physician may need answers from radiology to decide on diagnosis and further treatment. Several modalities are used in imaging, that is conventional planar X-ray, computed tomography (CT), nuclear medicine, magnetic resonance imaging (MR) and Ultrasound (US); the two latter do not involve ionizing radiation but have other pros and cons. It is obviously of major importance to select the appropriate modality and procedure for the clinical question. Projects like the presented should be part of the next action plan for radiation protection in the medical sector, since it will have impact in all the following three perspectives:

- (a) Insure that the patient are referred to the most appropriate examination and thereby can get the right diagnose
- (b) Reduce the number of unnecessary examinations that will reduce negative health consequences for patients and costs for the public healthcare system, and
- (c) Reduce the radiation dose to individual patients and collective dose to the population.

Despite the many useful applications of ionizing radiation in society there are harmful effects addressed by bodies like the World Health Organization (WHO), the International Atomic Energy Agency (IAEA) and the International Commission on Radiological Protection (ICRP). One issue of concern is the increasing use of radiology and the collective dose burden to the population in western parts of the world [13]. The pillars of radiation protection in medical exposures are justification, optimization and dose limitation. The principle of justification applies to three levels: Justification of a practice, generic justification of a defined procedure, and justification of a procedure for an individual patient [6]. The latter is exactly what this research application address: *how to improve the process of justification of the individual patient procedure in radiology*.

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WAYS OF IMPLEMENTATION OF SCIENTIFIC AND EDUCATIONAL ISSUES OF PATIENT'S AND PERSONNEL'S RADIATION PROTECTION IN GEORGIA IN THE LIGHT OF BONN CALL FOR ACTION

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Abstract

An evaluation of the results of the study of modern post-graduate program of the continuous medical education program "Radiation Protection and Safety" for medical workers were carried out. The study included 200 radiologists from Tbilisi and different regions of Georgia, among them 35% of dentists, 40% of conventional radiology, 15% of CT and 10% of specialists in nuclear medicine. The level of knowledge and skills was checked in the field of Physical principles of medical imaging, Basic radiobiology and radiation risk, Principles of radiation protection, including the competence of "justification" of radiological procedures and National Radiation safety infrastructure. The results of the tests showed the necessity for improvement of the educational curriculum at the level of a bachelor in medical profile universities. The changes required are: the inclusion of a basic radiobiological course in the curriculum of the faculty of medicine and expansion of the medical imaging methods. In addition, in the residency courses we consider to be appropriate to introduce "risk management" elements.

1. INTRODUCTION

In January 2013, on the Conference of the National Academy of Sciences of Georgia "Medical radiation protection issues, the challenges, opportunities, development perspectives", the scientific and educational issues of implementation of the new International Basic Standards in nuclear and radiation safety were introduced. The resolutions of the conference in the form of Recommendations were sent to the relevant government agencies.

On the basis of the above mentioned resolutions in the Laboratory of Problem of Radiation Safety of Beritashvili Center of Experimental Biomedicine the following priority directions for research was developed:

1. Experimental and clinical trials for the development of complex (cyto-genetic, and physiosological) criteria and elaboration of the test-methods of individual radiosensitivity [1].

2. Preparation of methodological basis of assessment of radiation dose and risk in the medical exposition for Georgian population.
3. Preparation of educational programs on radiobiology and radiation protection, corresponding to the new International and European standards for undergraduate Bachelor's, and Master's level in Medical Universities and post graduated training courses for medical professionals [2].

To support this process, Tbilisi State Medical University (TSMU) in collaboration with Georgian National Association of Radiology and Beritashvili Centre of Experimental Biomedicine initiated several activities: postgraduate continuing medical education program “Radiation protection” for medical professionals; syllabus “Medical and biological physics” as a basic course in medical physics for the faculty of medicine (first-year students), syllabus of elective course “Radiobiology and radiogenic health risk” as an elective course in the faculty of medicine (fifth-year students), school-seminar programs for medical students from different regions of Georgia (1–2 year students) and conferences with participation of leading International experts and Georgian specialists, program “Biomedical engineering educational initiative in Eastern neighboring area” (Tempus project) and ongoing preparatory work on Master degree Program in Medical Physics.

The present article describes the analysis of the results of the work which was performed for the purpose of the assessment of learning outcomes of the continuous Medical Education program “Radiation protection and safety in Medical Radiology” for Medical Professionals and determining the ways for its further development.

MATERIALS AND METHODS

The study included 200 radiologists from Tbilisi and various regions of Georgia, including 35% of dentists, 40% of conventional radiology, 15% of CT and 10% of specialists in nuclear medicine. The questionnaire (block of 500 multiple choice questions), (40 questions per listener) was compiled on the Basis of “Guidelines on Radiation Protection Education and Training of Medical Professionals in the European Union” [3], which included five main topics:

- a) Radiation Hazard – the health effects and mechanisms of low and high dose of radiation.
- b) Medical Imaging Physics – characteristics of different types of radiation and mechanisms of their interaction with matter, physical principles of medical imaging, the image quality, techniques constructive elements characteristics, the factors influencing the image quality and its indicators.
- c) Radiation Protection - basic principles, methods and ways of radiation protection, elements of operational radiation protection.
- d) Radiation Risk Management - health risk assessment, ‘benifit–risk balance assessment and competence of justification, understanding of quality assurance program.
- e) Elements of National Infrastructure for Radiation Safety.

For testing the “Appropriateness Criteria” of American College of Radiology was used.

Basic knowledge and skills was assessed by the number of correct answers, according 5-point scale system. The block of 40 multiple choice questions included 8 questions from each above mentioned 5 topics (6 questions of basic knowledge - 0.1 point each, and 2 questions revealing skills (quantitative evaluation skills) - 1.2 points each). Listeners were tested before and after training courses with the same tests questionnaire.

The results were processed by parametric and nonparametric statistics methods (Wilkinson, Kruskal-Wallis H Test, factorial ANOVA).

RESULTS

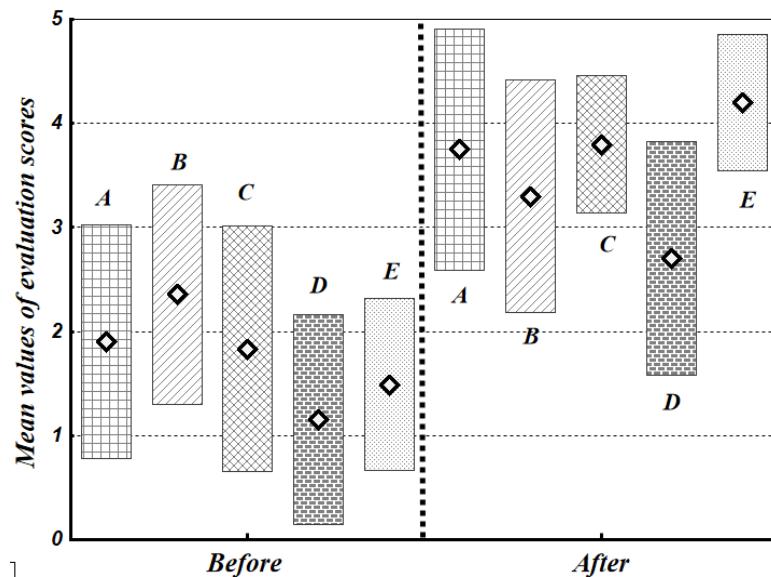


FIG 1. Results of the assessment of medical specialists in the Continuous Medical Education Program "Radiation Protection and Safety in Medical Radiology" (before and after training course). A - Radiation Hazard; B - Medical Imaging Physics; C - Radiation Protection; D - Radiation Risk Management; E - Radiation Safety. Boxes represent 95 % confidence interval of scores

The results of the study represent statistically significant difference between pre- and post-testing results for each group of listeners (Fig 1). Different direction and different level of initial knowledge, skills and competencies was revealed. This differences were also reflected in the high variability of the initial level of knowledge.

Above mentioned clearly indicates the necessity of further improvement of educational programs in Medical Radiology. First of all, it concerns the sphere of medical imaging physics and radiation risk management. It is obvious that the realization of this problem is less likely to be performed within the training courses.

DISCUSSION

The education of medical professionals that complies with the modern requirements of radioprotection and safety is a systemic problem and requires a system solution. Taking into the account the academic curricula in the Higher Medical Schools of Georgia it will be advisable to make the following changes:

- Basic course of Medical Physics for Medical Universities must be strengthened by the module of Medical Visualization Physics (3d year);
- It is expedient to development of integrated module in Radiobiology and Radiogenic and Health Risk for Bachelor's programs in Medical Radiology, Radiation Oncology and Radiation Hygiene courses.
- Radiation Risk Management (justification) module should be included in residency course of Medical Radiology.

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AUDITS OF JUSTIFICATION IN RADIODIAGNOSTICS

Experience from HERCA Campaign on inspection of justification in radio diagnostics in The Czech Republic.

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Abstract

The Czech Republic participated at the HERCA European inspection Campaign focused on justification in radiodiagnostics. The Campaign in The Czech Republic was very successful and worthy. In every Czech inspection team a radiologist evaluated the content of the referrals and the justification of the performed examinations. This highlighted the essential role of the radiologist in the audit teams that are evaluating the justification in radiology and showed that a team without a radiologist isn't able to audit the justification. The Czech Campaign also showed that it is essential not to evaluate only the content of the referral, but whole the justification of the examinations.

1. INTRODUCTION

During the HERCA (Heads of the European Radiological protection Competent Authorities) inspector workshop on November 2015 an initiative to launch the European inspection Campaign focused on justification in radiodiagnostics was created. The HERCA Board of Heads then agreed with the intention and HERCA Working Group for Medical Applications created the common template for the inspection and organized the Campaign.

The Campaign started on the International Day of Radiology on 8 November 2016 and 18 European countries including the Czech Republic participated on it.

10 inspections have been done in our country during the Campaign starting on 16 November 2016 and ending on 31 January 2017.

2. METHODS

The HERCA template for the Campaign included an overview of the regulations and practise of the country in relation to the justification in radiodiagnostics, a template for the inspection at the hospitals about the general overview of the hospital concerning if it follows the rules and good practise in the justification, the statistics of the examinations from the previous week and number of denied and changed referrals, and a template of number of questions that evaluated the content of 10 referrals randomly chosen from the previous week.

Because the Czech radiation protection inspectors aren't allowed to look at the clinical data of the patients (including the referrals), the Czech radiation protection competent authority SÚJB asked the Czech Radiological Society to participate at the Campaign. The Radiological Society then sent one radiologist to every inspection team. The radiologists in the team were evaluating the content of the referrals and they judged the justification practise of the hospital.

We used the advantage of having a radiologist in every team and in 4 hospitals we were not evaluating only the content of the referrals, but whole the process of justification for each and every of the 10 checked referrals and examinations. In these 4 hospitals we added a question in the template: "Was the examination justified (concerning all the information at the referral and all the other information about the examination that the practitioners received from the referrer and patient)?" And the radiologist in the team answered this question for every evaluated examination during every inspection.

We were checking mainly the referrals for general radiography and CT – 5 CT and 5 general radiography referrals in each hospital.

3. RESULTS

The formal columns of the referrals (e.g. patient's identification, age, sex, referrer's identification, his or her signature and contact information, date of the referral) were present in 99 % of cases.

Identification of pregnancy was missing only in 2 % of the relevant cases.

The clinical information (sufficient clinical information / medical history available, information about previous examinations, clinical question asked, type of examination given in referral) were missing at 13 % of cases. 39 % of the referrals didn't contain some of the clinical information. 25 % of the referrals missed one or more of this information: sufficient clinical information / medical history available, clinical question asked, type of examination given in referral. 40 % of the referrals didn't contain the information about previous examinations.

During the inspections when we found that something clinically important was missing in the referral the practitioners explained how they handled with that particular referral. In almost all of the cases they followed the legal requirements: they contacted the referrer and asked him about the patient's clinical data that were missing, insufficient, inadequate or inappropriate. In some cases were the additional data available in the clinical information system. The practitioners of the controlled hospital that were present at the inspection described these procedures in very details, so it was obvious that they truthfully described what they had been really doing in these cases. This was the advantage of auditing the examinations performed during the last week - the practitioners remembered most of them very well and when they were describing them it was easy to recognize

whether they spoke the truth. This way the inspection team could evaluate the overall justification of the examinations.

In the 4 hospitals where we asked an extra question about the overall justification of every examination only 2 examinations (from 40 controlled ones) had a disputable justification and all the others were evaluated by the radiologist in the inspection team as justified. It means that in about 5 % of the performed examinations the justification wasn't sure.

4. DISCUSSION

The percentage of the missing clinical data looks quite high, but it is important to realise two things:

First: Not in every case there is any relevant information about the previous examination or other clinical information (see Fig 1).

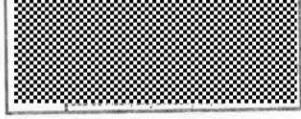
Žádanka RTG vyšetření	
Jméno příjmení [REDACTED]	Provádějící tel. [REDACTED] KZM - KZM - Úsek kon. radiodiag. a ultrasonog.
Identifikace [REDACTED] 1956 Pohlaví M Plátce 111	Žádající tel. [REDACTED] KCH - KCH - JIP
Adresa [REDACTED]	IČP [REDACTED] Odbornost 5T5
Telefon [REDACTED]	Fakultní nemocnice Plzeň Alez Svobody 80, 30460 Plzeň
Diagnóza I259 Chronická ischemická choroba srdeční NS	
Alergie 0	
Identifikace pacienta [REDACTED]	Číslo žádanky 80786865
Hmotnost [kg]: 75	Výška [cm]: 177
Kontrolní snímek S+P 1. pooperační den. Datum a čas vyžádání: 23.5.2017 17:46 Provést nejdříve: 24.5.2017 00:00 WinMedical - nemocniční informační systém ID 80786865	
MUDr. [REDACTED]	
	

FIG. 1. Referral for chest X-ray with sufficient amount of data, but not obviously. Translation of the red framed text is „Follow-up chest X-ray, 1st. postoperative day“. Information about patient's history, previous examinations and clinical question are missing. If it was judged only by radiation protection inspector, it could be marked as unsatisfactory. Radiologist is able to recognize, that the examination was indicated in patient who is one day after coronary bypass and knows that in Chest X-ray is routinely indicated to exclude acute complications in this situation.

It means that not all the cases when the information about the previous examination is missing mean automatically that the referral is incomplete. To evaluate this we would need an extra question that the radiologist in the inspection team should answer: "Could there be any relevant information about the previous examinations in this case?"

Second: Though the referral doesn't contain all the necessary clinical information, it doesn't say anything at all about the justification of the examination. Because it is legally required in almost all the countries that in cases of incomplete, insufficient, inadequate or wrong referral, the practitioner must contact the referrer and get all the necessary information from him. In patients that were referred from the same institution that performed the imaging examination, can be missing data also easily found in the clinical information system. After obtaining all of this important and relevant information the practitioner decides about the justification of the examination: he or she can confirm it, change it, or deny it (in The Czech Republic the radiologist that does not agree with the referral often changes the examination (of course with agreement of the referrer)).

The experience from the inspection Campaign in The Czech Republic clearly showed that though there is a quite high percentage of the non-complete referrals (between 25 – 40 %), only very few of the performed examinations may be unjustified (only several percent).

One another important experience we had from the Campaign: the evaluation of the clinical content of the referrals can be done only by the radiologist – the ordinary radiation protection inspectors aren't able to recognize whether the referral contains all the necessary clinical data. The reason is simple – the text of the referral is written by the physicians (in The Czech Republic only physicians can be referrers) and it is primary

addressed to physicians, so nobody without the full medical education and sufficient practise is able to understand it. There can be two extreme cases when the non-radiologist evaluates the content of the referral completely wrongly:

First: If all the columns of the referral are nicely filled with some text, the non-radiologist evaluates that the referral is complete, but he/she is not able to recognise that the justification of the exposure isn't OK or there are missing some key information for judging it (see Fig. 2). This case doesn't happen too often.

Žádanka CT vyšetření

Jméno příjmení		Pohlaví F Plátce 211	Provádějící tel.	KZM - KZM - Výpočetní tomografie (CT)
Identifikace	1955		Žádající tel.	1IK - 1IK - Iřinka C
Adresa			IČP	Odbornost 1F3
Telefon			Fakultní nemocnice Plzeň Alez Svobody 80, 30460 Plzeň	
Diagnóza	Z039 Pozorování pro podezření na nemoc nebo	Identifikace pacienta	Číslo žádanky	
Ost. dg.	Z039		81088410	
Alergie	intolerance beta blokátorů, warfarin, bromhexin, algifien			
<p>Prosím o CT enteroklýzu u 61 leté nemocné, těžké kardiačky a astmatičky, vyšetřované pro bolesti v pravém podžebří a mesogastru. Dle EGDS nález mírné erozivní gastritidy, která nevysvětlující obtíže, dle vstupního CT vyloučena cholecystitida, patrný pouze nález setřelé struktury hlavy pankreatu, susp. z fokální pankreatitidy, která klinicky nepraviděpodobná, endoUSG bude doplněno s odstupem. Prosím o vyloučení možné patologie v oblasti tenkého střeva.</p> <p>Zároveň prosím o CT vylučovací urografii, kdy nemocná s masivní hematurií, klinicky nelze vyloučit možnou pasáž konkrementu, kdy sonograficky nemocná lživem konstituce obtížně vyšetřitelná.</p> <p>Zároveň prosím o CT vyšetření plic.</p>				

Za zhodnocení všech nálezů předem děkuji.

Na vyšetření se, prosím, dostavte 15 minut před stanoveným časem vyšetření (viz objednán na)

Datum a čas vyžádání: 9.6.2017 11:27
WinMedicalc - nemocniční informační systém ID 81088410



FIG. 2. Translation: I'm asking for CT enterography in a 61-year-old patient, heavy cardiac and asthmatic, investigated for pain in the right epi- and mesogastrum. According to EGDS, there is a slight erosive gastritis that will not explain the problem. According to previous CT, cholecystitis was excluded. The only finding was blurred structure of pancreatic head suspected of pancreatitis, which is clinically improbable. Endoscopic ultrasound will be added. I request the exclusion of the small intestinal pathology.

At the same time, I'm asking for CT urography. The patient has a massive hematuria. The passage of the stone can not be clinically excluded. Sonographically is patient difficult to investigate.

I'm also asking for chest CT scan.

Comment: The referral for combined CT enterography, CT urography and chest CT contains good clinical justification for first two examinations, but there is not relevant justification for chest CT. Information about asthma in the first sentence is insufficient indication for CT. This is a medical issue that can be assessed only by a radiologist, radiation protection inspector alone may consider request as relevant.

But the second case happens very often: The referrers write all the necessary clinical information in one column of the referral. Clinically the referral is complete, but three of the clinical columns may be empty, because all the necessary information is in a fluent text in the medical language in one column. The non-radiologist evaluates such a referral as incomplete, but the radiologist immediately truly identifies that it is complete. In The Czech Republic it often happens that the referrals even do not have columns that have names like "sufficient clinical information / medical history available, information about previous examinations, clinical question asked, type of examination given in referral", they have only a big space for filling all this information in. The practitioner is able to recognize them in the text, but nobody else isn't (see Fig. 2).

5. CONCLUSIONS

The HERCA inspection Campaign on justification in radiodiagnostics was very successful in The Czech Republic and it raised the awareness towards the right justification in radiology. It was also very well accepted

by the controlled / audited hospitals and the practitioners. The Czech Radiological Society appreciated the Campaign and the questions from the European template and the Campaign helped to create a very good relationship between the Czech radiologists and the radiation protection competent authority. During the Campaign a number of specific professional questions and issues, that should be solved in cooperation of the Radiological Society, the Radiation protection competent authority, Ministry of Health and professional bodies, was identified. The experience from the Campaign is already being used widely during the ongoing upgrade of the Czech National Radiological Standards, Czech Referral Guidelines and the rules for the clinical audits.

The experience from the Campaign showed that evaluation or audit of justification in radiodiagnostics essentially needs following:

- The radiologist must be the main person in the team of the auditors of the justification;
- No-one else than the radiologist is able to evaluate the completeness of therefferral;
- In some cases there is no relevant clinical history that could be present at the referral – the auditor-radiologist is able to recognize thesecases;
- If the referral isn't complete, the evaluation must continue by asking the practitioners what they did with this case (therefore only referrals from few days back should be evaluated, so they remember them), because the completeness or incompleteness of the referral doesn't indicate anything about the justification or non-justification of the performed examination;
- After evaluating of the content of the referral and after the oral information from the practitioners about the case, the auditor-radiologist should judge if the examination was or wasn't justified (concerning all the information at the referral and all the other information about the examination that the practitioners received from the referrer and patient);
- In the 10 Czech hospitals controlled / audited during the Campaign only few percent of the examination were identified as possibly unjustified.

ACKNOWLEDGEMENTS

We would like to thank HERCA Working Group on Medical Applications for the initiative of the inspection Campaign and for organizing it and for preparing the European template for it – the Campaign helped a lot in creating a good relationship between the Czech radiologists and radiation protection competent authority and helped to identify many of the issues that need to be solved in the radio diagnostics (not only in context of justification).

We would like to thank the Czech Radiological Society for very positive reaction on the request for their participation at the Campaign. And we would like to thank Daniel Bartušek, Aleš Bílek, Miroslav Heřman, Marek Mechl, Hynek Mírka and Jiří Weichert the participating radiologists for their essential role in the inspections and for all the knowledge that they kindly shared during it.

We would like to thank also the radiation protection inspectors that agreed to contribute on the Campaign and didn't mind the complications of their standard inspections. Especially we would like to thank Jitka Nožičková who was the main organizer of the Campaign in the Czech Republic and who participated at 60 % of the inspections of the Campaign.

THE IMPACT OF REAL-TIME ELECTRONIC JUSTIFICATION OF DIGITAL IMAGING REQUESTS

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Abstract

Introduction: Although real-time, electronic justification of digital imaging requests can be seamlessly incorporated into modern radiological workflow, there have been few reports of its implementation and impact. **Aim:** To assess the impact of real-time justification on imaging equipment utilization in a resource-limited setting. **Method:** The justification decisions on non-emergency special radiological requests at a tertiary-level South African teaching hospital for the period 1 December 2012 through 31 December 2013 were reviewed. Cancelled requests were analysed by modality and the reason for cancellation. The impact of cancelled examinations on departmental workload was computed. **Results:** Of 55589 requests, 2704(4.9%) were cancelled. Duplication accounted for more than two-thirds of cancellations (1831/2704; 67.7%), inappropriate requests for almost one-third (846/2704; 31.2%) and medical contra-indications for less than one percent (37/2704; 0.06%), with similar proportions across modalities. Computed tomography (CT) requests accounted for more than half the cancellations (1361/2704; 50.3%). Real-time justification contributed to saving 111 routine modality work-days (CT 30, fluoroscopy 30, sonography 18, MR 17, intervention 16). **Conclusion:** Real-time electronic justification of imaging requests is feasible and has the potential to effect substantial resource savings, limit unnecessary radiation exposure and decrease patient waiting times for elective imaging investigations.

1. INTRODUCTION

Spectacular technological advances in radiology in the past forty years have stimulated the burgeoning global demand for diagnostic imaging.[1] From 1988 to 2008, the number of imaging studies performed worldwide increased from 1.38 to 3.14 billion annually, while the global per capita effective medical radiation dose increased from 0.4mSv to 0.62mSv between 1991-1996 and 1997-2007.[2] However, increases in imaging utilization are not necessarily associated with incremental patient benefit.[3,4] There are thus concerns that current global imaging practices are unsustainable, being costly and potentially hazardous.[5]

There is evidence that unnecessary radiological investigations exacerbate worldwide imaging service pressures.[6] Physician referral patterns, unrealistic patient expectations, defensive medicine, self-referral and duplication contribute to unnecessary examinations.[5] Efforts to minimize inappropriate imaging include the drafting of evidence-based imaging appropriateness criteria, physician and patient education initiatives, imaging facility accreditation and revised imaging funding models.[7-12] Although there have been attempts to quantify the monetary cost of inappropriate imaging [13], there have been only limited analyses of the impact of unnecessary imaging on equipment utilization and patient waiting times.

Developments in information technology have paralleled advances in diagnostic imaging over the past four decades. Digital radiology departments utilizing electronic workflow are now commonplace in well-resourced environments and are increasingly being introduced into resource-limited settings, where the capacity for remote teleradiology reporting represents a particular benefit.[14,15] The digital imaging workflow is driven by the radiology information system (RIS), which has a number of efficiency-enhancing features. These include electronic clinician requests and the capacity for requests to be informed by real-time, embedded, evidence-based imaging algorithms. Such clinical decision-support (CDS) systems for special radiological investigations, are increasingly being implemented [14,16], but to date have shown only modest clinical impact.[10,17,18] The low impact has been attributed to the radiologist not being integral to the workflow.[19]

Justification is an optional step in the modern RIS workflow, allowing radiologist-driven, real-time evaluation of the appropriateness of electronic imaging requests. Digital justification allows radiologists to evaluate new imaging requests while reviewing the patient's complete imaging history, and to approve, modify or cancel studies. Cancellation is accompanied by an electronic explanation to the referring clinician. Data and

timelines relating to cancelled requests are archived on the RIS, facilitating analysis of institutional referral and imaging patterns.

In September 2012, the radiology department of Tygerberg Hospital (TBH), a 1386-bed tertiary-level public-sector teaching hospital in Cape Town, South Africa (SA), converted to a fully digital workflow and introduced radiologist-driven real-time electronic justification of all non-emergency requests for computed tomography (CT), magnetic resonance (MR), fluoroscopy (RF), ultrasound (US) and interventional procedures (IR). The commissioning was the culmination of more than two years of meticulous electronic workflow planning and an extensive institutional change-management program. Justification is performed on any RIS workstation invoking existing departmental protocols and published international guidelines to assess the appropriateness of imaging requests.[7,8] The TBH Radiology Department operates under the prevailing resource constraints of SA's public health sector [20], performing approximately 190,000 examinations annually. It has a single 1.5 Tesla MRI unit, three CT scanners, five sonar machines, and dedicated single suites for mammography, fluoroscopy machine and vascular-interventional procedures. There are eight Consultant Radiologists, twenty-five Radiology Residents and three Sonographers. The institutional brief was to introduce real-time justification without any change to the radiology staff complement or working hours, and to complete the justification process within an hour of receipt of requests for non-emergency imaging.

To the best of our knowledge there has been only one study of the impact of electronic justification on imaging utilization.[21] Ingraham and co-workers recently reported that electronic justification of outpatient CT and MRI requests by a large US-based healthcare provider resulted in modification of 9% and rejection of 4% of requests. They concluded that justification, through inclusion of the radiologist in patient care, contributed to safer and more cost-effective imaging methods.

The aim of this study was to assess the impact of real-time cancellation of unnecessary imaging procedures through electronic justification of non-emergency requests for special radiological investigations on imaging equipment utilization in a large tertiary hospital in a resource-constrained environment.

2. METHODS

This was a retrospective analysis of electronic radiological justifications at TBH from 1 December 2012 through 31 December 2013. A customised search of the institutional RIS was conducted for all non-emergency requests for CT, MRI, US, RF and IR procedures in the review period. Included data were sorted by modality and stratified by justification outcome, into "approved/modified" or "cancelled". Cancelled requests served as the primary measure of the impact of justification on imaging equipment utilization and were further analysed by the reason for cancellation. Data were summarized in overall and modality-specific descriptive statistics. The average clinical output in each of the modalities for a normal, 8-hour week-day was calculated for the review period and used to compute the impact of request cancellation on equipment utilization. This study was approved by the Health Research Ethics Committee of Stellenbosch University.

3. RESULTS

Of 55589 requests, 2704 (4.9%) were cancelled. Duplication accounted for more than two-thirds of cancellations (1831/2704; 67.7%), inappropriate requests for almost one-third (846/2704; 31.2%) and medical contra-indications for less than 1% (37/2704; 0.06%), with similar proportions across modalities. (Table 1) CT requests represented more than half the cancellations (1361/2704; 50.3%). Fluoroscopic requests had the highest proportion of cancelled examinations (244/2779; 8.8%) and MR the lowest (192/5543; 3.5%). Typical reasons for requests being deemed inappropriate were inability of further imaging to augment existing radiological findings or influence clinical management, and other examinations outside the radiology department, such as endoscopy, scintigraphy or echocardiography being considered more appropriate. Real-time justification contributed to a total saving of 111 modality work-days. (Table 2)

TABLE 1. CANCELLED SPECIAL RADIOLOGICAL EXAMINATIONS

Modality	Overall	CT	US	MR	RF	IR
Total (n)	55589	29647	15507	5543	2779	2113
Cancelled (n,%)	2704 (4.9)	1361 (4.6)	761 (5.0)	192 (3.5)	244 (8.8)	146 (6.9)
- duplicated (n,%)	1821 (3.3)	1008 (3.4)	459 (3.0)	112 (2.0)	141 (5.0)	101 (4.8)
- inappropriate (n,%)	846 (1.5)	339 (1.1)	302 (1.9)	73 (1.3)	97 (3.5)	35 (1.7)
- contra-indicated (n,%)	37 (0.06)	14 (0.05)	0	7 (0.04)	6 (0.02)	10 (0.07)

TABLE 2. WORK-DAY SAVINGS BY MODALITY

Modality	CT	US	MR	RF	IR
Average examinations per normal weekday (n)	45	43	11	8	9
Cancellations (n)	1361	761	192	244	146
Work-day savings (n)	30	18	17	16	30

4. DISCUSSION

This is the first report of the integration of real-time, radiologist-driven, RIS-based justification of non-emergency special radiological investigations in a large tertiary hospital. It provides important new insights into this component of modern radiological workflow, demonstrating the feasibility of incorporating electronic justification into the radiologist's normal working day. It also shows the substantial benefits of such incorporation. The study allows appreciation of the significant impact of even a relatively small proportion of unnecessary examinations on the overall efficiency, safety and cost-effectiveness of a busy radiology department. For example, cancellation of just 5% of CT requests avoided in excess of a thousand unnecessary examinations over the 13-month study period, freeing up one month of routine CT scanning time.

The findings highlight the prevalence of two patterns of radiological referral contributing to unnecessary imaging in large tertiary hospitals. The first is the potential for request duplication across disciplines when patients have co-morbidities managed by different subspecialist teams. The second is a tendency to request a series of specialised examinations prior to completion of the most basic investigation, or without consideration of the findings of more basic investigations.

The findings are of particular relevance in the light of current challenges confronting diagnostic imaging. There is mounting global pressure for more effective use of radiological resources and a growing awareness of the need for diagnostic imaging to transition from a volume-based to a value-based service.[21,22-24] There are also increasing calls for radiologists to re-establish overall control of the imaging environment.[25]

Despite this being a retrospective study, it was underpinned by the known robustness of the raw data of the modern RIS. The study represents work in progress, since it did not evaluate the complete benefits of justification for the radiology enterprise. For example, the role of cancelled examinations in conserving scanning time for radiographic technicians, reporting time for radiologists, radiographic consumables and equipment wear-and-tear has not been quantified. Similarly, patient benefits have not been computed, since protection from unnecessary ionizing radiation and intravascular contrast media have not been reported, and no estimate has been made of patient cost-savings for transport, absence from work, or the radiological examination itself. Additionally, the role of real-time justification in modifying imaging requests has not been evaluated, since the TBH RIS does not support comprehensive tracking of such modifications. A prospective study will thus be required to evaluate this component. The latter limitation is likely to have contributed to an additional under-estimation of the benefits of real-time justification. Due to TBH resource constraints, modifications to imaging requests largely result in more efficient use of the same imaging modality, or use of a less sophisticated modality such as ultrasound or fluoroscopy, rather than CT or MRI. Although this study did not assess the impact of justification on the radiologist's work pressure, this report highlights the successful implementation of real-time justification into a busy hospital department without increasing staff or extending working hours.

5. CONCLUSION

Real-time electronic justification of imaging requests is feasible and has the potential to effect substantial resource savings, limit unnecessary radiation exposure and decrease patient waiting times for elective imaging investigations.

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CLINICAL IMAGING REFERRAL GUIDELINES: WHERE ARE WE NOW?

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Abstract

In order to enhance the implementation of the principle of justification the Bonn Call-for-Action recommended that clinical imaging referral guidelines (CIRGs) should be implemented globally. The purpose of this study was to assess the current state of CIRGs. Methods: This report is based on searches of PubMed and of relevant websites on the internet and on information gained from attendance at professional meetings and discussions with many colleagues, national and international. Results: Several organizations continue to update and produce new CIRGs. There is increasing activity worldwide in the development, standardization and implementation of medical guidelines which is relevant to the development of CIRGs. Radiology is leading the way in the development of computerized decision support (CDS) by integrating CIRGs into computerized order entry systems (CPOEs). The development of CDS has raised new issues, including the number of CIRGs which are needed and the potential effect of other clinical practice guidelines on CIRGs. Conclusions: CIRGs continue to be upgraded and developed but this must be done in the wider context of all medical guidelines. CDS is an important advance for medical guidelines but it also raises new issues.

1. INTRODUCTION

In order to enhance the implementation of the principle of justification, the Bonn Call-for-Action in 2013 recommended that clinical imaging referral guidelines (CIRGs) should be implemented globally. During the following four years CIRGs continue to be revised and produced. There have also been a number of developments in health care guidelines generally, and computerized decision support (CDS) has become a reality. The paper will review these developments and assess the current state of CIRGs.

2. METHODS

The material for the paper is based on searches of PubMed and of relevant websites on the internet and on information gained from attendance at professional meetings and discussions with many colleagues both national and international.

3. RESULTS

A number of organizations were producing CIRGs at the time of the Bonn Call-for-Action, including the Royal College of Radiologists (RCR), the American College of Radiology (ACR), la Société Française de Radiologie (SFR), Diagnostic Imaging Pathways (DIP), and the Canadian Association of Radiologists (CAR). The RCR has recently released the 8th edition of its CIRGs, iRefer [1]. The ACR also continues to revise its Appropriateness Criteria and to add new CIRGs [2], as does DIP [3]. The CAR recently completed a revision of all its CIRGs and made the revised version available on its web site in 2014 [4]. It has recently set up a working group to advise the Board on how it should maintain and enhance the effectiveness of its CIRGs.

Since the Bonn Call-for-Action there have also been a number of developments in health care guidelines at large. Guidelines International Network (GIN) [5] is an organization which represents and promotes consultation and cooperation among many organizations and individuals internationally who are involved in the development of

health care guidelines. Among other activities GIN endorses and supports other organizations which have developed standards for various aspects of guideline development. These include AGREE II and GRADE. AGREE II has developed standards for assessing the quality of medical guidelines. These can also be used to assist guideline developers in producing high quality guidelines. AGREE II defines six domains of quality: scope and purpose, stakeholder involvement including users and patients, rigour of development, clarity and presentation, applicability and editorial independence [6]. The AGREE II instrument was assessed at two technical meetings hosted by the International Atomic Energy Agency and was evaluated for its relevance to CIRGs. The consensus was that the majority of items in AGREE II should apply uniformly to CIRGs But some should allow for regional differences [7]. The Grading of Recommendations Assessment, Development and Evaluation working group (GRADE) has developed standards for evaluating the quality of evidence and the strength of recommendations in guidelines [8]. GRADE states, among other criteria, that recommendations in guidelines should be categorized as strong or weak, and that a strong recommendation should be based on high quality evidence.

The most important advance in the last few years for improving the effectiveness of CIRGs is the development of robust software which allows CIRGs to be integrated into computerized order entry systems thus providing computerized decision support (CDS) to physicians as part of their daily workflow. Diagnostic imaging CDS has been shown to be effective in decreasing inappropriate requests for diagnostic imaging [9]. However, the development of CDS has raised important new issues in the area of CIRGs. One of these issues is the question of how many CIRGs should be integrated into CDS systems and in turn how many CIRGs do we actually need. Another important issue is the challenge of clinical care pathways (CCPs).

4. DISCUSSION

The interest in CIRGs extends well beyond the countries discussed above which are producing their own CIRGs. The RCR's iRefer has been adopted by a number of countries which do not have the resources to develop their own CIRGs, and the iRefer app is used widely throughout Europe and in many other countries worldwide [10]. The International Society of Radiology Quality and Safety Alliance [ISRQSA] is also interested in developing an international set of CIRGs [11].

The methodologies of RCR's iRefer and of DIP have been accredited by the National institute for Health and Care excellence (NICE) [1, 12], and the methodology of the ACR Appropriateness Criteria has been endorsed by the Agency for Healthcare Research and Quality (AHRQ) [13]. However, some of the international standards for guideline development may not always be appropriate for CIRGs. For instance, GRADE emphasizes evidence of accuracy as being very important in determining the strength of recommendations for diagnostic tests [14]. However, accuracy may not always be the most important evidence to consider in developing recommendations for diagnostic imaging [15, 16].

There is growing interest in CDS internationally. ACR has developed a CDS system which incorporates the Appropriateness Criteria, and it is now available commercially [17]. The European Society of radiology is collaborating with the ACR to develop a European version of CDS [18]. The RCR has also incorporated iRefer into a CDS system which it is now testing in pilot projects [19].

These CDS systems incorporate all the organizations CIRGS, but this may in fact not be the best approach to the development of CDS systems. The experience with drug alerts has identified a phenomenon called alert fatigue which happens when users get too many alerts and start to ignore all the alerts [20]. It is possible that this phenomenon may also be true for diagnostic imaging CDS systems which incorporate a large number of guidelines. The Centers for Medicare and Medicaid Services (CMS) in the United States considered the options of requiring CDS systems which they would approve to have a large number of CIRGs or only a core group of CIRGs. They analyzed their own data and determined that 40% of the requests for advanced imaging were covered by eight

clinical conditions. Therefore, they have decided that they will require only CIRGs for those eight clinical priority areas in any CDS systems which they approve [].

CCPs are algorithms designed to map out the most appropriate care for patients in a given clinical conditions. Diagnostic imaging is frequently part of CCPs. Software is now becoming available that allows the integration of CCPs into electronic medical records. As CCPs become more widely integrated into electronic medical records there will probably be less need for dedicated diagnostic imaging CDS and radiologists will have to start working more closely with other clinicians to ensure that the recommendations in the CCPs are appropriate.

5. CONCLUSIONS

There is growing international interest in CIRGs. However, groups who develop CIRGs need to be aware of the international standards for medical guidelines. CDS is widely considered to be the most effective way of getting CIRGs used and there is growing international interest that the in this technology. However CDS is raising new issues of its own.

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